TRANSHUMANISM: NATURAL LANGUAGE
AND INNOVATIVE CONCEPTS IN
COMMUNICATION

By
Mian Khurram Shahzad Azam

NATIONAL UNIVERSITY OF MODERN LANGUAGES,
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Transhumanism: Natural Language and Innovative Concepts in Communication

By
Mian Khurram Shahzad Azam

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Submitted By: Mian Khurram Shahzad Azam
Registration #: 166/PhD/Ling/2004

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Name of Discipline

Prof. Dr. Samina Amin Qadir
Name of Research Supervisor
Signature of Research Supervisor

Prof. Dr. Shazra Munnawer
Name of Dean (FAIS&R)
Signature of Dean (FAIS&R)

Maj. Gen. (R) Masood Hassan
Name of Rector
Signature of Rector

Date
I Mian Khurram Shahzad Azam

Son of Mian Muhammad Azam

Registration # 166/PhD/Ling/2004

Discipline English/Linguistics

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ABSTRACT

Thesis Title: Transhumanism: Natural Language and Innovative Concepts in Communication

Transhumanism promotes an interdisciplinary approach to understanding and evaluating possibilities for moving beyond human limitations. It is connected with both present day technologies like genetic engineering and artificial intelligence and future technologies like molecular nanotechnology. In this research, Transhumanism refers to the improvements and enhancements in the related fields of speech technologies and improving and supporting the human–machine communication act using the existing and the anticipated technologies of the future. The language of communication is essentially natural language with a vibrant social context of the real world. Transhumanism is used in this research as theoretical reference to discuss in detail the technological advancement and state of the art support systems in the field of natural language communication, speech recognition and speech generation systems to support a reliable and meaningful communication act between humans and machines and possibly machines and machines. The overall aim of the research is to look at the evolution and developments in the field of natural language speech technologies with reference to Transhumanism from a linguistic and secular point of view.

The objective of the research is to signpost the research work for the future researchers in this particular area of research and in general linguistics. The research is aimed to explore the scope and impact of interdisciplinary technological advancements for artificial intelligent systems using natural language as communication tool independently through speech input and speech output.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>THESIS/DISSertation AND DEFENSE APPROVAL FORM</td>
<td>ii</td>
</tr>
<tr>
<td>CANDIDATE DECLARATION FORM</td>
<td>iii</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>iv</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>v</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>ix</td>
</tr>
<tr>
<td>DEDICATION</td>
<td>x</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>xi</td>
</tr>
<tr>
<td>I INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>1.1 Natural and Artificial Language</td>
<td>2</td>
</tr>
<tr>
<td>1.2 Natural Language used by Artificial Intelligence</td>
<td>3</td>
</tr>
<tr>
<td>1.3 Vision of Research</td>
<td>3</td>
</tr>
<tr>
<td>1.4 Transhumanism</td>
<td>4</td>
</tr>
<tr>
<td>1.4.1 What is Transhumanism?</td>
<td>4</td>
</tr>
<tr>
<td>1.4.2 Transhumanism in this Research</td>
<td>8</td>
</tr>
<tr>
<td>1.4.3 Why Transhumanism?</td>
<td>9</td>
</tr>
<tr>
<td>1.5 Objectives of the Study</td>
<td>10</td>
</tr>
<tr>
<td>1.6 Theoretical Interface: Transhumanism</td>
<td>11</td>
</tr>
<tr>
<td>1.7 Limitations of the Study</td>
<td>12</td>
</tr>
<tr>
<td>1.8 Natural Language Generation</td>
<td>13</td>
</tr>
<tr>
<td>1.9 Focus of the Research</td>
<td>16</td>
</tr>
<tr>
<td>1.10 Transhumanism and Natural Language</td>
<td>17</td>
</tr>
<tr>
<td>1.11 Structure of the Thesis</td>
<td>20</td>
</tr>
<tr>
<td>II RESEARCH METHODOLOGY</td>
<td>26</td>
</tr>
<tr>
<td>2.1 Introduction</td>
<td>26</td>
</tr>
<tr>
<td>2.2 Research Methodology</td>
<td>26</td>
</tr>
<tr>
<td>2.2.1 Descriptive Research</td>
<td>27</td>
</tr>
<tr>
<td>2.2.2 Qualitative Analysis</td>
<td>28</td>
</tr>
<tr>
<td>2.2.3 Research Approach</td>
<td>29</td>
</tr>
<tr>
<td>2.2.4 Research Documents</td>
<td>31</td>
</tr>
<tr>
<td>2.2.5 Research Framework</td>
<td>31</td>
</tr>
<tr>
<td>2.3 A Word about Literature Review</td>
<td>32</td>
</tr>
<tr>
<td>2.4 Theoretical Framework of the Research</td>
<td>33</td>
</tr>
<tr>
<td>A) Linguistic Theories</td>
<td>33</td>
</tr>
<tr>
<td>2.4.1 Discourse Theory</td>
<td>33</td>
</tr>
<tr>
<td>2.4.2 Theory of Speech Act</td>
<td>35</td>
</tr>
<tr>
<td>2.4.3 Theory of Structuralism</td>
<td>35</td>
</tr>
<tr>
<td>2.4.4 Theory of Post-Structuralism</td>
<td>36</td>
</tr>
</tbody>
</table>
VIII SUMMARY, FINDINGS, CONTRIBUTIONS AND CONCLUSION--- 195

8.1 Summary ................................................................. 195
8.2 Findings of this Research .............................................. 198
  8.2.1 Objectives of the Research ..................................... 199
  8.2.2 Theoretical Interface-- ......................................... 200
  8.2.3 Research Material .............................................. 201
  8.2.4 Research Situation in Pakistan ................................. 202
8.3 Contributions of this Research ...................................... 204
  8.3.1 Global Contribution ............................................. 204
  8.3.2 Contribution in Pakistan ....................................... 205
  8.3.3 Academic Contribution in Pakistan ......................... 205
  8.3.4 Contribution in Human Resource Development ............. 206
8.4 Conclusion .............................................................. 208

WORKS CITED...................................................................... 212

ANNEXURE 1................................................................. 234
ANNEXURE 2................................................................. 235
ANNEXURE 3 ............................................................... 236
ANNEXURE 4................................................................. 237
ANNEXURE 5................................................................. 238
ANNEXURE 6................................................................. 239
ANNEXURE 7................................................................. 240
ANNEXURE 8................................................................. 241
ANNEXURE 9 ............................................................... 242
ANNEXURE 10.............................................................. 243
ANNEXURE 11.............................................................. 244
ANNEXURE 12.............................................................. 245
ANNEXURE 13.............................................................. 246
ANNEXURE 14.............................................................. 247
ANNEXURE 15.............................................................. 248
ANNEXURE 16.............................................................. 251
ANNEXURE 17.............................................................. 252
LIST OF FIGURES

Figure 1: The Mechanical Duck ----------------------------------------------- 234
Figure 2: An Image of Tik-tok from Ozma of OZ ------------------------------- 235
Figure 3: Arnold Schwarzenegger as Terminator ------------------------------- 236
Figure 4: Image of Bicentennial Man ------------------------------------------ 237
Figure 5: Will Smith in the company of Friendly and Non-Friendly Robots ---- 238
Figure 6: Image of Kismet in conversation with a human---------------------- 239
Figure 7: Design Template of Kismet ----------------------------------------- 240
Figure 8: Intent Determination Model for Speech Processing------------------ 241
Figure 9: Lip Movement of Kismet (a) ---------------------------------------- 242
Figure 10: Lip Movement of Kismet (b) --------------------------------------- 243
Figure 11: ASIMO Serving in a Cafe ------------------------------------------ 244
Figure 12: ASIMO greeting and Shaking Hand with a human-------------------- 245
Figure 13: ASIMO pointing towards direction in response to a voice command --- 246
DEDICATION

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CHAPTER 1

INTRODUCTION

It is because of the use of language as tool for communication that humans differ from other forms of creation. Only human beings use logical reasoning in their communication. From one generation to the other generation, it is through language that the community’s norms and traditions are transmitted. So language is the connecting element in the human societies for socio-economic, religious and political strains. It is hard to imagine a human society without any communication.

In the second half of the twentieth century, there has been a mega change in the level and forms of communication technologies used in the human societies. A man can find his audience all around the world with the help of advanced telecommunication networks and internet. Very recently, video conferencing has made it possible that listeners and speakers can see each other, no matter where they live in the world. In a world of technological and scientific advancement, language technologies have become an area of interests for social scientists, computer experts, futurists and linguists.

The advancement in computer technology radically improved the dealing of linguists with language corpora. The development of state of the art software has enabled humans to search the likelihood of occurrence of any particular linguistic item in a text or speech pattern with an increased level of accuracy. With the help of computers, corpus linguistics paved the way for high tech research in other language technologies. The storage of large bulk of linguistic data has facilitated the processing of linguistic items in minutes, thus enabling computer systems to effectively work on language input in the system, natural language processing and natural language generation. The knowledge based and data driven computational models of linguistic
items have created revolutionary interest in new areas of language technology research.

1.1 Natural and Artificial Language

The term Natural Language is used for the languages used by the human beings in the form of written and/or spoken meaningful utterances. The term Natural Language is used in the present study to differentiate it from artificially constructed international auxiliary languages, Universal Language (which is mathematics in binary opposition of 1s and 0s in computer language) and Artificial Language (which is written and spoken meaningful utterance produced by an artificial intelligent machine). The research study is focused at finding:

(a) the contributory effect of different technological advancements towards Natural Language,
(b) speech comprehension and speech generation of Natural Language by artificially intelligent system,
(c) the human-machine communication act
(d) and the position of Natural Language in human society with reference to techno-globalization and de-territorialization.

It looked at some state of the art technologies which have practical and tangible effect on the way human beings use languages as a tool for communication and perceive it as medium of conveying their thoughts and ideas. The research focused on the speech generation and speech comprehension technologies in Natural Language technologies. It focused on the artificial intelligent systems and humanoid robots which use natural language as tool of communication with human beings and with other intelligent machines in speech. The natural language technology research is becoming increasingly interesting for the linguists, speech technologists and researchers in the field of artificial intelligence in the fast changing world where each day is creating new opportunities through technological revolution in information communication technology, computer science and other related fields.
1.2 Natural Language used by Artificial Intelligence

There cannot be a denial of the fact that there could be serious social and psychological implications as once humans wake up to the reality that their languages can be used smartly by artificial intelligent machines. Some success in the field of artificial intelligence has created new hope for moving beyond human limitations and creating a sensation and understanding beyond human experience. There is credible evidence in research literature, for example Kismet (2006), ASIMO (2007) and MIT Oxygen Project, that artificial intelligence may ensure linguistic ability in a system in which a machine may use the language in a smart way- in a more human like way- in both written form and speech utterances, that is on its own choice of syntax and semantics and not through any number of programmed responses built in the system. An artificially intelligent machine which may be capable of performing different functions synchronized with the linguistic ability and paralinguistic features of gestures and facial features will surely make a serious impact on existing set of beliefs, philosophical theories and traditional base of knowledge. It may blow some of the most popular existing philosophies.

1.3 Vision of Research

The vision of the research is to locate the potential and function of Natural Language used by artificially intelligent machines and systems in virtual reality and humanoid robots for communication act with human beings within the domain of philosophy of Transhumanism. Transhumanism promotes an interdisciplinary approach to understanding and evaluating possibilities for moving beyond human limitations. It is connected with both present day technologies like genetic engineering and artificial intelligence and future technologies like molecular nanotechnology, genetic engineering and creation of super intelligence. In this research study, an effort is made to look for the historical perspective and present day achievements of research projects for creating a super intelligent machine which may have the ability to communicate independently with human beings by keeping full adherence to the linguistic and paralinguistic features of communication act in natural language communication in human beings. The language generated by such machines
would be human-like language. But there is a big question: is an intelligent machine capable enough of experiencing consciousness and retaining memory for understanding self in relation to environment for a sensible communication act? A probe is made in this research to find the historical evolution and developments in the field of artificial intelligence related to this question and the research mentions some of the possible answers to this question with the help of an extensive survey of the existing and the future natural language technologies.

1.4 Transhumanism

1.4.1 What is Transhumanism?

Transhumanism is generally defined as a thinking approach and a perception about the human life and society in the future which is becoming our present at a very fast speed. Bostrom (2003b) defined Transhumanism as,

The intellectual and cultural movement that affirms the possibility and desirability of improving the human condition through applied reason, especially by developing and making widely available technologies to eliminate aging and to greatly enhance human intellectual, physical and psychological capacities.

The website of World Transhumanism Association (2002) described Transhumanism as,

Transhumanism is the study of the ramifications, promises and potential dangers of technologies that will enable us to overcome fundamental human limitations and the related study of the ethical matters involved in developing and using such technologies.

More (2003) is credited for giving the first comprehensive and modern definition of Transhumanism. He defined the term in the broader framework of ‘boundless expansion’, ‘self-transformation’, ‘dynamic optimism’, ‘intelligent technology’ and open liberal society for a more liberal set of values for human beings in the future technology driven society. Nick Bostrom and David Pearce are the
founders of the World Transhumanist Association. The World Transhumanist Association reached a global consensus of its members in producing a consensus document of Transhumanist Declaration (2001). The purpose of the declaration is to reach an established understanding of academic and philosophical agreement on the scope of Transhumanism and its further development into sub-themes. The following document is the latest version of the Transhumanist Declaration (2009).

(1) Humanity stands to be deeply affected by science and technology in the future. There is a possibility of expansion of human potential by overcoming aging, cognitive shortcomings, uncontrolled suffering, and our confinement to planet Earth.

(2) It is understood that humanity’s potential is still mostly unrealized. There are likely scenarios that lead to amazing and exceedingly valuable enhanced human conditions.

(3) Human race faces severe hazards, especially from the abuse of new technologies. There are potential rational developments that lead to the loss of most, or even all, of what we hold valuable. Some of these situations are extreme, others are restrained. Although all improvement is modifying, not all modification is improvement.

(4) Research effort needs to be empowered with comprehension of these projections. We need to carefully premeditate how best to ease threats and accelerate favorable applications. We also need forums where people can constructively talk about what should be done and a social order where accountable judgments can be executed.

(5) Lessening of existential risks, growth of resources for the conservation of life and health, the improvement of critical pain, the enhancement of human prudence and intelligence should be pursued as imperative priorities, and heavily funded.
(6) Policymaking ought to be guided by responsible and inclusive moral vision, taking seriously both opportunities and risks, respecting sovereignty and individual civil liberties, and showing solidarity with and concern for the welfare and pride of all people around the globe. It must think about our moral responsibilities towards generations that will exist in the future.

(7) It promotes welfare of all sentience, including humans, non-human animals, and any future artificial intellects, modified life forms, or other intelligences to which technological and scientific advance may give rise.

(8) All individuals’ wide private preference over how they facilitate their lives is respected. This includes use of techniques that may be developed to assist memory, concentration, and mental energy; life extension therapies; reproductive choice technologies; cryonics


Yudkowsky (2004) discussed in detail the possibility of super intelligent machines and humanoid robots co-existing with biological and technologically transformed human beings in the future. His interpretation of Transhumanism deals
with the improvement of human quality of life by having friendly artificial intelligent machines and humanoid robots co-existing with human beings. The development of technologies that would enable machines to be artificially intelligent and speak and behave like humans in a natural environment would be a step towards a transhuman society. The possibility of creating super intelligent machines and humanoid robots with human-like behavior was further discussed by Moravec (1999) in his book *Robot* and Kurzweil (1999) presented a scenario of a transhuman society in which machines would have the ability to think and take decisions on the basis of their critical analysis of the situation in his book *The Age of Spiritual Machines*. Later Freitas and Merkle (2005) extended this debate of super intelligent machines by giving it a new perspective of use of nanotechnology in the field of human medical treatment. They also discussed in detail the implications of molecular nanotechnology for self-replicating super intelligent systems.

The idea of super intelligent machines, artificial intelligent humanoid robots and Cyborg is supported by the Transhumanists discussed earlier, some philosophers like Joy (2000) and Posner (2004) are very critical about the possible threats to humanity because of super intelligent machines. Joy (2000) suggested of putting a close check at the technologies like artificial intelligence, nanotechnology and genetic engineering in the philosophic domain of Transhumanism as these technologies have possible dreadful implications for the human race. Only those technologies should be used which are beneficiary to the human beings and which have the potential to improve the human living conditions. Rees (2003) and Posner (2004) found great risks to the survival of human beings if artificially intelligent machines, humanoid robots and Cyborg are to use future anticipated technologies independently and without the support of human beings. Fukuyama (2002 & 2004) termed Transhumanism as the world’s most dangerous idea as this could generate aggression and tyranny in the future society. Inspired from Fukuyama’s (2002) ideas, Annas, Andrews and Isasi (2002) suggested a federal legislation to announce genetic engineering as ‘crime against humanity’ if it attempts to alter the basic inheritable genetic information of human beings.
Hughes (2004) took forward the same idea of safe transhuman future for the human beings. A future which holds the benefits of technology for the human beings and the human society and which gives the individuals the freedom of using technology for their personal benefits. Hughes (2004) suggested the active participation of democratic and liberal governments to ensure the safe usage and equal distribution of technologies. This should not be restricted to elite members of the society who are tech-savvy. Transhumanism gets representation in variety of political, cultural, environmental, medical, bioethical, social and economic areas of the society.

Bostrom (2003a) suggested a comprehensive explanation of Transhumanism by describing it as a way to enhance human condition.

The enhancement options being discussed include radical extension of human health span, eradication of disease, and elimination of unnecessary suffering and augmentation of human intellectual, physical and emotional capacities. Other Transhumanist themes include space colonization …..(493)

By keeping in mind the possible harmful effects of the technology, Bostrom further declares that Transhumanism

hopes that by responsible use of science, technology and other rational means we shall eventually manage to become post-humans, beings with vastly greater capacities than present human beings have. (493)

1.4.2 Transhumanism in this Research

In this research, Transhumanism refers to the improvements and enhancements in the related fields of speech technologies and improving and supporting the human–machine communication act using the existing and the anticipated technologies of the future. The language of communication between an artificial intelligent machine and human being is essentially natural language within a vibrant social context of the real world. Transhumanism is used in this research as theoretical reference to discuss in detail the technological advancement and state of
the art support systems in the field of natural language communication, speech recognition and speech generation systems, image processing and synchronized mechanical movements for complete adherence to the paralinguistic features in a communication act. Transhumanism is a frame of reference for an improved understanding of artificially intelligent speech generation systems to support a reliable and meaningful communication act between humans and machines and possibly among machines. The remarkable changes in the communication systems and the development of new approaches on the internet and virtual world and with the success stories of humanoid robots like ASIMO (2007) has encouraged researchers to think on ways of improving and enhancing the human-machine and anticipated machine-machine communication act (speech comprehension and speech generation in the case of this research) using natural languages.

1.4.3 Why Transhumanism?

Transhumanism is viewed as extension of humanism and partly derived from humanism which focused on the idea that humans matter. Humans can be made better human beings by encouraging tolerance, freedom, concern for the fellow beings, logical thinking and democracy. In full agreement to this notion, Transhumanism goes a step further and adds that as rational means are to be used to improve human condition and the world around humans, such rational means may also be used to improve human being as an organism. Education and cultural development were seen as traditional humanistic tools. In addition to this, Transhumanists believe that present and future technologies may eventually make human beings capable of moving beyond the parameters of what we now consider as ‘human’. Transhumanism is a not a set of beliefs in an abstract idea or philosophy. It is genuinely and realistically concerned with the endeavor and an active pursuit of the betterment of humanity and human condition.

The possibility of a vibrant artificial intelligence can not be ruled out simply because there has not been major success in the area. Some very interesting developments have occurred, for example humanoid robots like Kismet (2006) and ASIMO (2007), which have shown remarkable success related to the understanding of
linguistic and paralinguistic features of communication. These examples are discussed in detail in Chapter five of this research, which encourage researchers to believe that the linguistic potential of speech comprehension and speech generation systems can be enhanced and in fact, intelligent machines can be manufactured to act and speak like humans. Molecular nanotechnology is a promising new technology, which in combination with other technologies like genetic engineering and computer-human brain interfaces could do wonders for research in enhancing capabilities for a sustainable and reliable human-machine communication act. Like all other scientific inventions and technologies, it’s the usage that would determine its positive or negative impact on the society. This is essential to understand that the benefits to human society are given preference to any other disastrous outcomes from the use of such technologies.

It is the right time for scientists, social philosophers and linguists to evaluate the impact of this enormous explosion of information communication technology and the new cutting edge technologies on human beings, our social fabric and the place of an intelligent machine in communication act using natural language as tool of communication. Presently, there are different subgroups in the main movement of Transhumanism, some even suggesting the possibility of a post-human society in the coming days monopolized by artificial intelligent machines. It is an important point to note that human dependency on technology has increased for several reasons in recent years and its impact on human beings and communication needs to be examined critically. This research looked at the potential of these technologies for human-machine communication act and artificially intelligent machines responding to human speech input through speech output, gestures and/or facial features.

1.5 Objectives of the Study

The aim of the study was to look for the possible impact of present and growing speech technologies on creating artificial intelligent speech systems and the possible change in human approach towards communication act and social belonging. A descriptive and predictive approach within the domain of Transhumanism discusses the potential for natural language, natural language technologies with a clear focus on
speech generation and speech comprehension technologies, artificial intelligence and possibilities of meaningful communication between human beings and artificial intelligent systems.

1. The objective of the research is to signpost the research work for the future researchers in this particular area of research and in general linguistics.

2. The research is aimed to explore the scope and impact of interdisciplinary technological advancements for an artificial intelligent systems using natural language as communication tool independently through speech input and speech output (called generation).

3. The research is aimed to identify the social implications and discussion on critical issues, for example consciousness, of effects of developments in natural language technology on human-machine communication.

4. This research also intended to consolidate information for experts and scientists in the field of linguistics, language technology, and computer engineers and for the experts in the field of robotics.

The overall aim of the research is to look at the developments in the field of natural language speech technologies with reference to Transhumanism from a linguistic point of view.

1.6 Theoretical Interface: Transhumanism

Transhumanism as a theory gets supporting concepts from multiple theoretical approaches, linguistic theories and other interdisciplinary theories, to sustain the practical use of technology including artificial intelligence, genetic engineering and nanotechnology for the benefit of human society and human beings as individuals. In the context of this research, the linguistic theories and the other multidisciplinary theories are linked together to create a comprehensive framework that works within the parameters of Transhumanism.

The core arguments of multiple theories are used to reinforce the composite framework of critical discussion and analysis within the framework of the theory of
Transhumanism. Transhumanism is not a set of abstract ideas. Transhumanism takes up ideas and theories which are relevant for the achievement of goals of Transhumanism: betterment of human society and human beings. Transhumanism provides the theoretical interface for linguistic and other multidisciplinary theories for the critical analysis of the issues during the critical discussion in this research. Transhumanism is a practical theory used in this study for the potential and challenges for artificial intelligent systems/machines for logical communication act.

1.7 Limitations of the Study

While every effort was made to do justice with the research topic and incorporate all possible links, information, references from research projects that could be needed for the study, there were some genuine limitations of this research, as it is with all such researches on current and ongoing topics. It was a difficult task to access library resources for academic references on the subject matter in Pakistan. A letter of recommendation for request of assistance (attached as Annexure 14) in the research was written by the Dean Faculty of AIS &R to the universities like National University of Computer and Emerging Sciences (Lahore Campus), National University of Science and Technology, Islamabad, Pakistan, Institute of Engineering and Applied Sciences, Islamabad, University of Engineering and Technology, Lahore and other research institutes. These institutes could provide only preliminary information on the area of research. It was during the researcher’s visits to Perth, Western Australia in 2006 that most of the books and journal resources were accessed in the libraries of University of Western Australia, Crawley, Perth and Curtin Institute of Technology, Bentley Campus.

In Pakistan, the researcher had to rely on online sources for academic references. The access to information at some websites was for privileged users (for example, only for MIT students) and the researcher had to make repeated personal requests to administrators for a brief visit/view time on these websites. The researcher made strong efforts to get limited access rights to online sources, project reports of research teams and survey reports of natural language generation systems as created by MIT lab, Stanford Speech lab and Honda Next Generation Company. The area of
the research is current and there are possibilities that some of the natural language
technologies have evolved and/or refined and new versions of speech processing
systems have emerged and/or there are adjustments or improvements by the time
study concluded. The cut off date for the description of natural language technologies,
theories and contributory interdisciplinary technologies in Transhumanism is
December 31, 2007. However, with the inclusion of chapter six to localize the speech
processing research in south Asia, current research projects have been mentioned to
show the early stages of speech processing research in this field in the region.

1.8 Natural Language Generation

The human ability to use language as tool of communication could be modeled
on other biological systems of human beings. There is no special speech organ in
human body responsible for the generation of human language. Broca’s area in the
human brain is associated with the production of language in human beings. Skipper,
Meadow, Nusbaum and Small (2007) have shown in their study that Broca’s area
plays a very critical role in semantic understanding of the speech utterances and it
also registers the gestures and other movements for comprehension of the speech
input. The linguistic ability appears to be the combination of cognitive and other
supporting neural mechanisms and systems that feed information to the central
computer–brain for processing of visuals signals or after listening and reading to
generate language.

Natural language generation by a computer system is categorized as the sub-
field of computational linguistics and artificial intelligence. The process includes
gathering of information, processing it and then producing meaningful utterances
which are syntactically correct and relevant to the kind of information gathered. In the
context of this study, the speaker is a computer system, generating meaningful
utterances in a human-machine conversation. The 1970’s and 1980’s were crucial
decades in achieving success by engineers in testing and verifying first prototypes,
generating answers to questions fed in the system and generation of small texts. The
variations in discourse were shown by these programs while the syntactic and
semantic value of the utterances was kept intact (Moore and Swartout 1990).
The language generation process demands state of the art competence in language understanding by a computer system for producing utterances without any ambiguity. The whole process involves an approach that is data-driven, constraint controlled, focused on decision and keeping intact the lexical, syntactical and semantic value of the utterance. This research is focused on the speech input of the comprehension system and speech output of the generator system. The process of language generation by a system is essentially linked with time and context of the communication act. The decision to speak and not to speak and the intentions to speak are some of the critical points of investigation for the researchers in the area of speech technology in recent years.

The research in the area of Natural Language Generation has many practical applications in today’s world. The area constitutes sub-fields of research in the areas of artificial intelligence, computer science, cognitive science and human-machine communication. The credibility of information generated by an artificially intelligent machine depends on the human acceptance of the fact that the artificially generated language is logical, fit to purpose and meaningful in the context of human-machine interaction. The possibility of incorporating linguistic and domain knowledge by artificially intelligent machines has opened new avenues in human–machine communication. But, would it be possible for a machine to experience consciousness-comprehension of self as being, how that would affect the process of understanding the language and the generation of language by machines, are the most important questions faced by the computer experts, linguists and researchers in the field of artificial intelligence.

Reiter and Dale (2006) elaborated some of the critical and fundamental issues related with the process of natural language generation. The kind of expectations people might have with a human-machine interaction may vary from simple and basic to very complex philosophical questions. Humans may have some serious misconceptions, fascinating ideas and expectations about the kind of linguistic behavior expected of the computer systems and more precisely humanoid robots. The variation in the quality of computer software (this could range from the quality of the content to the quality of the material used by the manufacturing company) would
greatly affect the desirability and usefulness of the human-machine communication act. The appropriateness of natural language is directly dependent on the quality of software for its database and its incorporation of context, syntax, semantics, morphology, pragmatics and psycholinguistic features. The major questions still require answers and one such question is, would it be possible to model complete and perfect human-like linguistic ability in computers and then in humanoid robots? Some of the recent prototypes manufactured by MIT Language Technology lab are discussed in the fifth chapter to highlight the successes in the field of artificial intelligence for natural language generation.

Natural language generation is closely allied with natural language understanding. Understandably computer software has to first understand the human languages before it could process it to generate human like utterances. In fact, it’s the combination of these two technologies that form the basis of Natural Language Processing as there is great amount of sharing in the foundation of theories and concepts. Reiter and Dale (2006) have given a clear definition of both processes as:

Natural language generation is the process of mapping internal computer representations of information into human language, whereas natural language understanding is the process of mapping human language into internal computer representations. (p 3)

There are some attempts towards arranging ‘reversible’ components termed as Bidirectional Grammar (p 3) for modeling semantic representations into syntactic structures. However, some issues of conciliation between these two processes need to be sorted out before any successes could be claimed in this technology. A very critical area of concern in natural language processing is the selection of the syntax for what is to be processed. A computer software must be compatible with a large database of choices for syntax, as many different inputs into the systems would be requiring the same output or as many different number of utterances may mean the same thing. Also through the lexical choice, any variation in the voice quality of the speech output, which may be caused by either a technical problem or a mistaken stress pattern, would give number of different meanings to the same utterance. The resolution of ambiguities in speech comprehension and speech generation is at the
core of the success of a natural language processing system (later discussed in detail in chapter 7). The ultimate goal of natural language processing including natural language generation and natural language understanding is that the active and passive sentences like; *I ate the chocolate bar* and *The chocolate bar was eaten by me*, are interpreted and conveyed with the same understanding and manner.

The purpose and usefulness of a speech generation system would vary from a complex industrial workplace to a weather forecast system and may be used as an aid in a medical classroom. Commercial computer software available on the internet have help tools for professionals in generating professional documents in the field of law, medicine, academic essays and technical reports. These authoring tools, which are not free of cost for obvious reasons, act as aid in developing text for teachers, lawyers and doctors. However, this software requires an active human assistance in generating texts. It is still a fascinating idea for researchers to expect an artificially intelligent program to generate utterances and texts with zero human intervention. Piglet is among some of the computer software which did not require any of the human assistantship and could generate logical texts, was a part of MIT projects and is still not available in the market (Reiter and Dale 2006, p 6). Piglet software can give detailed explanations to patients based on the enquiries related to diseases, management, directions and archives. In addition to this there were reported cases of Piglet generating reports and documents for dead people or other meaningless texts for patients, so this was not introduced in the market.

1.9 Focus of the Research

There are many language technologies, which are generating interests among the researchers, engineers and linguists namely, text processing, text generation, machine translation, multilingual text generation, multilingual speech generation and speech understanding, image processing for speech technologies, text to speech technology and speech to text technology, text analysis, speech input and speech output processing and natural language generation technologies. In this research, technologies relevant with speech input and output and continuous language generation integrated with paralinguistic features (facial movements and gestures) in
an artificially intelligent machine for a purposeful discourse, within the framework of the human-machine communication act, were the focus of the discussion. The research looked at the impact of such technologies on natural language technologies and innovative concepts of communication between humans and machines with reference to Transhumanism and attempted to suggest the possible impact of state of the art technologies of the coming days on the use of natural language by artificially intelligent computer systems, humanoid robots and Cyborg.

1.10 Transhumanism and Natural Language

Transhumanism has generated debate internationally on various intellectual forums, including international conferences and seminars. This debate is mainly concerned with the use of technology for improving the physical and intellectual condition of human beings and the human society. Transhumanism stresses on the use of present and future technologies for improving the intellectual and physical state of human beings and the quality of life in human society. The conservative groups in different cultures of the world are still reluctant in accepting the intrusion of technology in human lives to the extent that this debate has generated many crucial questions, for example, who will decide the limits of the use of technology? The ethical issues related with human cloning and roles and responsibilities of individuals interacting in cyberspace and virtual reality and possibility of artificial intelligent machines created through future technologies have created a strong group of opponents for Transhumanism. Some even call it playing God.

Transhumanism is something more than a philosophy. It is not only related with the theoretical framework for philosophers, thinkers and researchers but it is also linked with the practical applications for the betterment of human society. It is an endeavor to use technology for improving the human condition relying on shared global knowledge of science and technology. The global issues like war, poverty, injustice, lack of peace and security and terrorism are some of the major obstacles in achieving the goal of common goodness for humanity. It is important to understand that any set of ideas is not a panacea. Transhumanism, like other set of ideas is open for debate, objections and changes. Technology and especially computer related
technologies have become an integral part of the present human society in the last two decades. The greater divide in the world of technology of haves and have-nots is posing new kind of challenges including disparity in global view of human society for peace, harmony, justice, tolerance and democracy. Some technologically advanced societies are afraid that the technology have-nots are a threat to their ‘civilized’ way of life. On the other hand, oppressed societies are angry that political injustice is forced on them using technological hegemony. The reconciliation of the two is critical for the common benefit of human beings.

Transhumanism offers immense potential for using technologies to eradicate poverty, hunger and disease as it is directly related with its first objective of improving human society. However, Transhumanism is not only about optimistic future for technologies (Bostrom, 2002). There could be every possibility of misuse of technologies which could cause irreparable damage. This has high chance of creating a widening divide in societies of inequality, battle for ecological sources and assets and political and economical hegemony. On the whole, Transhumanism puts great stress on individual freedom and choice and wider access to technologies but a careful check has to be maintained for the common benefit of the human society. Any idea which could lead towards destruction and/or the creation of elite group selection as the beneficiaries of technological advancements has to be discouraged. In researcher’s point of view, the Transhumanist agenda is not only about playing with the technologically advanced gadgets. The kind of technological revolution we have witnessed in the last three decades, offers immense potential for studies like genetic engineering, nanotechnology and virtual reality. A fair chance should be given to explorers, if there is a possibility of transcending the human biological limits.

The traditional concept of a developed human society is linked with mass awareness, education and freedom of expression, democracy and social justice. The technological growth in human societies has opened new avenues of economic growth and financial stability. The technological development is closely associated with economic development. The technology has improved human living conditions by improving social infrastructure and doing wonders in medicine, for example lowering infant-mortality rates. The enhancement of human capacities through technology is
leading towards a Transhuman or post-human society which would be improved species and may have better chances of survival. The pace-maker installed in a human heart after surgery, hearing aides for improved hearing, installation of artificial joints, transplantation of organs like mechanical hearts and other such medical success stories in saving human lives are only primary examples of how technology is integrated in human biological structure to improve the quality of life. The scope of Transhumanism is not limited to improvisation of widgets and medical treatment, but it envisages working in the areas of improving human society through cognitive, social and cultural development (Bostrom, 2003b). The development in the field of artificial intelligence hopes to achieve new stature to the level of expecting super intelligent machines in active conversation with human beings. All of this would have an impact on the way humans perceive the communication act.

The use of state of the art technologies like, molecular nanotechnology, genetic engineering, cognitive enhancement and information communication technology leading to a world of virtual reality would affect the language generation technologies and human-machine communication act. In a technology-driven human society, when traditional notions of self and identity would be challenged, the use of language by an artificially intelligent machine would be an area of interest for linguists and social researchers. The consciousness of present and past and hope for future, our placement of individual in a social and cultural context affects our communication attitude and choice of lexical syntactic units for logical meaning. The advancements in technologies are anticipating the possibilities and implications of uploading of the human brain to a computer by imaging “in silico the detailed computational process that would normally take place in a particular human brain” (Drexler, 1986 & Moravec, 1989). If achieved, such a copy would either be workable on the virtual world or cyberspace or it could be modeled to work in a machine with human-like physical functions and linguistic ability. How would an artificially intelligent machine adjust with such a role and how would humans react towards a machine and/or Transhuman individuals are some of the questions yet to be explored and answered by linguists, social scientists, and researchers of artificial intelligence and computer engineers.
In an effort to consolidate information on the topic for computer software developers working in the field of language technology, linguists, experts and engineers in artificial intelligence, genetic engineering and nanotechnology, it was hoped that this research study would reflect towards finding some of the answers of the questions related to objectives of the study. However, it was also expected that the study may lead towards some new questions which are discussed in the seventh chapter of the study.

1.11 Structure of Thesis

The structure of the research is designed to establish the researcher’s opinion that contributing enhancement technologies in natural language technologies and especially speech comprehension and speech generation technologies in a broader framework of Transhumanism provide credible evidence in the existing literature for a possible artificial intelligent computer systems to use natural language independently as a tool of communication with human beings in a natural human society. The research approach, design, theoretical framework of the research, brief survey of natural language technologies with a focus on speech technologies create a foundation of discussions in the fourth and seventh chapter that the technological advancements have contributed in developing human-machine communication interfaces in which computers can access large database of linguistic and paralinguistic information on natural languages and then use natural languages in a reliable manner keeping intact the syntactic, pragmatic and semantic value of the natural language in a real world situation.

The first chapter is the introduction to the key concepts of the research discussed in the broader framework of Transhumanism. The chapter elaborates the vision and the objectives of the research with a focused approach in speech input and speech output language technologies. The chapter highlights the limitations of the study in the Pakistani context and focuses on the relevance and importance of the research in the area and the selection of Transhumanism as the theoretical frame of reference for a discussion on speech technologies. The objective of the research is to locate the potential impact of existing and future anticipated technologies on natural
language technologies. The chapter develops an understanding of the research framework and concludes with an in-depth discussion and explanation of Transhumanism as an integrated theory base for the existing and the future technologies for the improvement of human lifestyle and human individuals and the possible impact of these technologies on natural languages and natural language technologies for a reliable and sustainable human-machine communication act.

The second chapter elaborates the research methodology, research approach, research documents, research framework and the reference to literature review in the research. The chapter provides a detail account of the theoretical framework of the thesis in which discourse theory, speech act theory, structuralism, post-structuralism, feminism, theory of dualism, theory of functionalism, identity theory of mind, Chinese Room argument and Bakhtin’s dialogism are discussed for interdisciplinary background of the research which deals with the scope and potential of natural language technologies and natural language communication for the human-machine communication act in the context of Transhumanism. The chapter elaborates in detail that Transhumanism is the theoretical framework of the research and linguistic and other multidisciplinary theories integrate and contribute their core ideas for the development of basis for critical discussion in the research.

The third chapter begins with the introduction of human fascination with the machine man, talking machines and the potential of machines to imitate human behavior including speaking. The chapter quotes evidence in the history in China where small mechanical toys were used to please kings and queens. The human fascination with the evil and good machines continued with the fiction writers to visualize machines behaving like human beings and communicating with human beings using natural language as tool of communication. The technological advancement in the computer technology, internet and virtual world led to the introduction of Cyber culture and cybernetics. The discussion on cyber world provides an important feedback on growing effect of internet and computer technologies on the human beings. The communication systems and patterns on the net have generated new concepts and new terminologies. The virtual world has posed new issues in human-machine communication, gender and cultural norms. The
imagination of talking robots and hi-tech machine man continued on the celluloid as the film directors and writers portrayed machine characters in films like *Terminator*, *Bicentennial Man* and *I, Robot*. The discussion is then directed towards finding actual evidence in the field of natural language speech technologies to find the potential of natural language understanding and natural language generation by processing systems. The chapter concludes with the discussion on state of the art technologies in human-machine communication through speech input and speech put. In addition to the linguistic features, the modern technologies of image processing for retrieving meanings from the gestures and facial features as a part of communication are also used in modern computer-human speech interfaces like Kismet (2006) and ASIMO (2007).

The fourth chapter starts with the premise that potential natural language technologies are available as discussed in the previous chapter to sustain and support reasonable level of communication between human beings and machines in a real time and space. The speech technologies, as discussed earlier, can process and generate meaningful utterances based on the objective and function of the speech generation system. To look for an intelligent machine, which can pass the Turing test to be conscious enough to ‘know’ what linguistic items it is processing and why it is generating a speech output, a detailed discussion of the field of artificial intelligence is carried out in this chapter. The chapter deals with the historical ups and downs in the field of research of artificial intelligence. The earlier success created hype for the field which soon saw a clear loss of interest by the funding agencies for the artificial intelligent projects due to major failures of unfulfilled expectations in experiments. The major issues and challenges faced by this field of study are discussed to locate the potential of natural language technologies in artificial intelligence. The chapter also discusses the essential question as discussed by many theorists that if it is possible to have a conscious machine. Many view points of researchers and scientists are presented in the supporting evidence from the literature review that with the advancement in computer technology and massive enhancement of processing speed of systems it is highly probable that a level of machine conscious could be achieved which makes the machine artificially intelligent. A detailed discussion is carried out to find the potential of natural language technologies in connection with artificial
intelligence and the chapter concludes with a description of working system of speech generation system.

The fifth chapter deals with the description of communication in natural language in virtual world, chatbots and the artificial intelligent humanoid robots like Kismet (2006) and ASIMO (2007). The chapter provides ample evidence of the market presence of the state of the art speech processing systems and the potential growth of speech recognition and speech processing systems. The chapter showcases the recent growth and achievements in the field of natural language technologies for creating systems and market driven products for natural language communication by fully adhering to the sensitivities of the linguistic and paralinguistic features of human communication. This proves the strength of the field and also provides a basis of discussion for the possible effects of future anticipated technologies on natural language communication act between humans and machines. Some speech systems deal only with weather information systems or flight inquiry systems. The variety in objectives and multidimensional approach towards communication act using audio and video technologies is attempted recently in speech systems when they can be expected to use human facial features and gestures as part of the total communication act and transform the system response in speech utterance with high rate of accuracy. The chapter discusses the potential and working system of Kismet (2006) and ASIMO (2007) and the virtual identities in a virtual world. The speech understanding and generation systems in humanoid robots and virtual communities are discussed to form a relationship of innovative ways of communication in a future Transhumanist society. The use of future technologies like possible uploading of patterns of human brain to a computer system is also discussed to see the impact on natural language technologies.

The sixth chapter is included in this research to localize the speech processing technology research in the south Asian region. The discussion in the chapter also draws a comparison between the current research projects in speech processing research in Pakistan, India and Malaysia and the rest of the technologically advanced world. The rationale for selecting Pakistan, India and Malaysia for the discussion of speech processing technologies is that the researcher is based in Pakistan so it is
important to highlight the limitations and achievements of speech processing technology research in Pakistan. India is Pakistan’s neighbor and shares strong regional, cultural and social ties with Pakistan. India and Pakistan share the spoken form of Sindhi, Punjabi and Urdu languages. The difference is in the written script of these languages in India and Pakistan. Malaysia is a Muslim country like Pakistan and shares religious traditions and customs. The discussion in the chapter revealed that the speech processing technology research in India and Malaysia is at an advanced stage as compared to Pakistan where there is shortage of professional researchers and linguistic data.

The seventh chapter is the detailed description of the possible implications of anticipated technologies of the future on the dynamics of the human-machine communication using natural language in the broader framework of Transhumanism. The chapter discusses the technologies information communication technology, molecular nanotechnology, genetic engineering, concept of mind uploading, creation of super intelligent machine, concept of human cloning and the concept of singularity and traces down the implications of each of these technologies on natural language communication, natural language technologies with a focus on speech technologies and human-machine communication act. The chapter also elaborated the idea of techno-globalization and its possible influence on natural language technologies. The chapter highlights the point that there is a possibility that intelligent computer systems would develop their own sentence construction pattern, meanings and use of words, objects and the perception of reality around them which would give a distinctive non-human treatment to natural language. This may create experiences which would not be familiar to human users of the natural language. The discussion on possible generation of social issues is followed by different questions which remain unanswered as yet. The discussion in the chapter raises many questions like: would the intelligent machines have a different understanding of the natural language and the world around them? What kind of issues may arise when the intelligent machines and the human beings would not agree to the perception of the world and the world view in general developed through the use of natural languages as human beings would not share the machine’s perspective? Would machines be ‘conscious’ enough to use the linguistic database as part of their ‘learning’ experience and as reference in
communication with human beings? These are some of the questions which may lead to generation of more questions for the future researchers for further investigation.

The last chapter is the summary of the research, findings of the research, contributions of the research and the final conclusion. The findings of the research deal with the achievement of the objectives of the research, the detailed account of the situation of academic sources of the research, the situation of research in this field in Pakistan and the recommendations for future research in this area in Pakistan. The next section deals with the contributions of the research at global, national and academic level and at the level of human resource development. The conclusion of the research highlights the fact that this research is an effort to consolidate the research work done in the field for further research studies. This research attempts to signpost the research for future researchers in this field and in general linguistics.
CHAPTER 2

RESEARCH METHODOLOGY

2.1 Introduction

This research is an endeavor to find the potential of natural language technologies and the impact of these technological advancements on natural language technologies, especially speech processing technologies. Transhumanism is considered as the theoretical framework for the research as it is related with improving the overall condition of human society and human beings as organisms through the use of science and technology. The descriptive research methodology supported the integration of broad theoretical framework of the research to reach a focal point and to identify areas of relevance with the speech comprehension and speech generation technologies in natural language communication between humans and machines.

This chapter establishes the relevance of research methodologies used to achieve the objectives of the study. The research used descriptive methodology to explain the present state of affairs in the speech technologies and the impact and potential of growth of other technologies like artificial intelligence, molecular nanotechnology, genetic engineering and creation of super intelligence on natural language speech comprehension and speech generation technologies.

2.2 Research Methodology

Descriptive research approach was followed and it relied on e-books, online interactive forums, online resources, online research journals and archives of proceedings of international conferences and workshops. Johnson &Christensen (2000) have provided useful information for defining the descriptive research methodologies and the advantages of using this research approach in educational research. This research used descriptive research to explain the situation in the field of
speech comprehension and speech generation technologies for a sustainable human-machine communication act. The information retrieved from the literary sources is used to trace the possible impact of technologies like artificial intelligence, molecular nanotechnology and genetic engineering on natural language communication, human-machine communication act and the state of the affairs in the field for the development of natural language technologies and more specifically speech processing technologies.

2.2.1 Descriptive Research

Descriptive research methodology refers to an approach which describes the current and existing situation and it looks for the relevant indicators of relationship between different areas relevant to the research. It gathers and reports information on the given topic. In descriptive research the researcher attempts to document the features of a phenomenon (Johnson, 2001). It examines the issue from all relevant perspectives. The natural result of descriptive research is explanation and inference, which in this research raises some critical questions at the completion of analysis in the seventh and eighth chapter. Descriptive research aims to explain the state of affairs of a certain topic and situation as they are by the cutoff date of the research (Chambliss & Schutt, 2009). This method involves number of approaches including the examination of latest literature on the subject and presentation of current situation in a particular field. The objective reporting of the existing facts for a certain issue by the researcher is descriptive research (Sarma & Misra, 2006) as this research explains the functionality of speech processing systems and raises intrinsic questions during the critical discussion for developing a logical, reliable and efficient speech processing system for a sustainable and meaningful human-machine communication act.

The descriptive methodology explains the what, how of an issue and organizes and represents information (Glass & Hopkins, 1984). The source material is critically examined to relate the reliability of the information with the achievement of the goals of the research. Suen & Ary (1989) suggest that the observations could be unstructured for presenting the current status in a field of study and these observations
are used as factual evidence to trace the possible inference and course of action. Descriptive research depends on explaining the observations made in the relevant field of study and reporting these observations as key factors for establishing logical argument (Borg, Gall & Gall, 2006). Johnson and Christenson (2008) explained descriptive research as an approach to provide accurate information and description of a situation. Descriptive research is the investigation of the characteristics of a situation or a phenomenon (Teddlie & Tashakkori, 2009).

In this research, the description of natural language technologies with special focus on speech comprehension and speech generation technologies is followed by the discussion on the historical developments and the present state of situation in the field of artificial intelligence. A detailed explanation is given in different chapters of the research for the relevance and the affiliation of artificial intelligence and speech processing technologies for a reliable and sustainable human-machine communication act. The research explained in detail the cutting edge emerging technologies and then it focused on the influence of these technologies on the natural language technologies and human-machine communication act.

The researcher planned formal interviews with the project supervisors and project teams to have a detailed understanding of the prospects of speech processing research in Pakistan. The interviews could not be conducted with the relevant people due to their unwillingness despite several requests made by the researcher. However, the researcher contacted them on telephone, email, personal blogs and made personal visits to the research institutes for a comprehensive understanding of the speech processing research situation in Pakistan. A detailed account of this information on speech processing technology in Pakistan is included in chapter six.

2.2.2 Qualitative Analysis

In the context of this research, the emerging technologies like molecular nanotechnology, genetic engineering, cloning, creation of super intelligence, mind uploading and the concept of singularity are discussed and the research has attempted to trace the impact of these emerging technologies on natural languages,
communication in natural languages and human-machine communication act. The researcher has tried to consolidate the information and signpost the issues for future researchers in the field of natural language technologies and in general linguistics. The research critically analyses the impact of emerging technologies on speech processing technologies and human-machine communication act and raises intrinsic questions during the critical analysis. This research looks at the imperatives of artificial intelligent speech processing systems having complete realization of natural languages as tool of communication in a social and cultural context. It also generates queries for possibilities and challenges for creating a meaningful, reliable and efficient speech comprehension and generation systems, within the framework of Transhumanism, for which there are no satisfying answers available as yet.

It is important to note the fact that emerging technologies are becoming an integral part of our present at a very fast speed with each passing day. The technological boom experienced by the human civilization in the past two decades is incomparable in terms of quantity, quality and speed in the human history. The advancements in technology are becoming an inseparable part of the human experience and common knowledge database of the human society by each day. Based on the description of the historical perspective, evolution and developments and the current advancements in the technological fields, the researcher endeavored to look for answers related to the questions with reference to the emerging technologies and identify some important issues related to this area and in general linguistics. As anticipated in the beginning of the research, the discussions in chapter 4, 5 and 7 led to the resolution of some of the queries and generated some more questions, which would be of interest for the future artificial intelligent researchers and linguists.

2.2.3 Research Approach

The use of descriptive research approach is suggested for a comprehensive understanding of the discussion, evaluation of the potential and comments on the emerging patterns of issues (Taagepera, 2008). The present research attempted to explain the present situation in the field of speech comprehension and speech generation technologies with reference to existing technologies like artificial
intelligence and trace the effect on natural language technologies caused by the emerging technologies like molecular nanotechnology and genetic engineering. The research has looked for the evidence in the existing literature to understand and showcase artificial intelligent systems for speech generation using natural language technologies, interaction with the technological advancements and the use of present and anticipated future technologies as reliable support systems for human-machine and possibly machine-machine communication act using natural language. The validity and reliability of information retrieved from research literature is ensured by using information from authentic public material published in research journals, e-journals and archives of proceedings of international conferences, workshops and seminars. An assessment of existing speech technologies was made for an understanding of the opportunities.

The chapters of the research are linked with each other showing progression in the specific fields and the overall progression for a sustainable and reliable communication act between humans and machines using the existing and the anticipated technologies of the future. Each chapter of the research discusses the historical perspective of the topic and concludes with the recent achievements in the field and the potential contribution for a human-machine communication act. Each chapter is an important link in the research as evidence of the historical reference, and the evaluation of the contribution in developing artificially intelligent speech comprehension and generation systems. The chapters discuss the limitations and the success stories as contributory factors towards establishing a logical argument in the conclusion of chapters and the final conclusion of the research for a sustainable and consistent communication act between humans and machines using natural language. Each chapter concludes with a brief note on situation of research in Pakistan to give the study a local perspective. Also, chapter 6 briefly explains the situation of natural language technology research and more specifically the speech processing technology research in Pakistan, India and Malaysia for an understanding of the level of research in this particular field in the south Asian region.
2.2.4 Research Documents

As mentioned in the previous chapter, regarding the limitations of the study, there is limited amount of research available in Transhumanism. As this is an emerging field and technological advancements are happening in the field at a very fast speed, a sharp cutoff date was essential for the research. In this case, December 31, 2007 was the cutoff date. There are very rare researches on natural language technologies and especially speech technologies as they get influenced by the emerging technologies. The access to research documents has been a real challenge for the researcher during the course of this research. The fast growth in the technology world has created new challenges for the natural language technology researcher working in artificial intelligence and molecular nanotechnology. In Pakistan, there is limited research material available on speech comprehension and speech generation technologies. Another important thing to note is that there is no evidence of indigenous research activity in the field of speech generation technologies in Pakistan. In the year 2005, the researcher’s only access to the research documents was online resources and later the research documents were accessible in libraries of international universities during the researcher’s foreign visits.

The originality of the research and the pioneering effort in establishing a Pakistani perspective to the natural language technology research for human-machine communication through natural language are some of the salient features of the research highlighted by the researcher. The research has attempted to look for the influence of existing and future anticipated state of the art cutting edge technologies on natural language communication with a special focus on speech comprehension and speech generation systems in a human-machine communication act.

2.2.5 Research Framework

The research discussed the technologies within the broader framework of Transhumanism. The state of the art technologies are discussed in the historical perspective by documenting the strengths and weaknesses of each technology with reference to natural language technologies. The success stories of the previous decade
are the creation of Kismet (2006) and ASIMO (2007) humanoid robots with artificial intelligent speech comprehension and speech generation systems. These humanoid robots have state of the art computer systems and a reliable artificial intelligent system to use large database of linguistic knowledge to support a logical and meaningful communication act between humans and machines in a controlled environment.

In the previous existing literature, the possible impact of fast emerging technologies like artificial intelligence, molecular nanotechnology, genetic engineering, mind uploading, singularity and information communication technology has not been discussed exclusively with reference to natural language technologies and the speech comprehension and generation technology. This research discussed the possible avenues of research and successes of natural language technologies. The description of these technologies is followed by the evaluation and the possible implications of the technology on speech processing technologies.

The unique feature for the originality of this research is that it attempted to look for the imperatives of human-machine communication by examining the existing and future anticipated technologies and speech processing technologies available in research documents. It pointed out some of the possibilities which would be encountered by humans when they would not be the only ones using natural language as a tool for communication. Another important feature of this research is that it attempted to place the discussion on the topic of the research in the Pakistani context. This research aimed at evaluating the consequences, potential risks and the possible advantages of speech processing technologies used in human-machine and possible machine-machine communication act using natural language technologies. It is anticipated that the discussion of the impact of each cutting edge technology on speech processing technologies would generate number of questions.

2.3 A Word about Literature Review

The theoretical background is integrated in each chapter as per requirement of this research study and no separate chapter is included in the research for literature
review. The framework of this research required extensive research of journals, books, research thesis and project reports, movies and documentaries, online books and research journals, online sources and archives of the proceedings of the international conferences, workshops and seminars. The references from literature for the components of this research are cited and discussed in all chapters and sections of this research.

### 2.4 Theoretical Framework of the Research

The linguistic theories and other multidisciplinary theories on artificial intelligence form the theoretical basis of the thesis. This is essentially an interdisciplinary research study so a variety of theories were studied to form logical, theoretical and philosophical background of this research. It is important to note that a brief introduction of these theories is presented in this chapter with its linkage with the topic of the research. The connection of each of these theories with the research projects and point of discussion is discussed in detail where required in the research.

A) Linguistic Theories

Following linguistic theories provide the theoretical framework of the research and provide a basis for its later integration with theories from other disciplines for the discussion and analysis in this research.

#### 2.4.1 Discourse Theory

This theory deals with the analysis of language in written form, spoken language and signs and symbols used for communication. This theory entails the analysis of utterances and sentence patterns of a language in a communication act in the context of the society. According to Foucault (1972), discourse and language construct and manage knowledge and social fabric. Foucault’s description of discourse is not limited to language. He extends it to other fields like discourses in politics and space studies. Foucault stressed on social context of discourses in institutionalized manner. This theory provides an important basis for this thesis as the
communication act between human beings and intelligent machines is visualized in a social objective context with some functions attached to it. The human-machine communication act may exceed the boundaries of language and utterances in a social and cultural context when, gestures, facial features and signs also contribute in the total communication act. The function of the discourse in human-machine communication is directly related with the pragmatic and semantic features. It is interesting to note that the semantic value of lexical items in human perception is the result of social and cultural belonging and human experience. This leads us to the question: would it be possible for a machine to allocate the same semantic value to an utterance or a phrase when its experience is not the same as that of human beings? The concept and knowledge through experience are important factors in the possible naturalness of a human-machine discourse. The interpretation of certain abstract ideas may not be possible through linguistic structures. In that case, how would researchers define the frame of reference for the machines for the comprehension of abstract ideas and concepts?

Each word is a reference to an image or idea. The linguistic database of a machine would require not only a huge amount of syntactic and lexical items with possible variations in semantic value of the phrases based on stress and intonation patterns but an allied resource of concepts and ideas associated with the lexical items should be accessible by a speech comprehension and speech generation systems. The syntactical organization of lexical items provides the basis for meaning comprehension. The continuous adjustment of the system to use language as tool for information and the context of the communication would require the researchers to design language processing systems as part of the social act. For the discourse analysis the communication act comprises of both linguistic and paralinguistic features of the language use. The possibility of novel meaning generation of lexical items within a specific context and the location of self, identity and relation of speaker are part of discourse analysis.

The discourse theory provides the basis of understanding of the dynamics of the human-machine discourse and evaluating the possibilities of a machine using the language as part of the social relation and cultural context. The discourse theory also
helps in getting to know that features of language and beyond the language help in establishing a meaningful communication link between human and machines. The possible intelligent systems would be able to allocate meanings to words and phrases if they take inference from the human experience or if perhaps, one day, they could have a social presence and experience of their own meanings. This possibility is heavily dependent on the success of future research in natural language technologies and artificial intelligence.

2.4.2 Theory of Speech Act

This theory is concerned with the placement of an utterance in a social context and it considers it as a speech act. The theory takes each utterance as an action essentially placed within a social and cultural context. Austin (1962) and his followers Grice (1975) and Searle (1969), declared that each utterance has its meaning dependent on a social and cultural context. In the context of human-machine communication, the questions arise: what would be the social and cultural context of meaning for a machine to use natural language in a logical manner? How would a machine decide the difference between a chair and a bench? The social reference for the word chair for the machine would be not its own perception of the object or not the experience of the machine for using the chair for a purpose different from that of its experience of using the bench. In this case the machine’s intelligence would rely on the human perception of bench and chair and would attribute meanings to these words from the human point of view. The understanding of the speech act theory provides the basis of performance based value of utterances in a human-machine communication, focused on the retrieval or performance based functions.

2.4.3 Theory of Structuralism

The linguistic theory of structuralism focuses on the structure of language as patterns instead of the use of the language. This scientific objective approach focuses on the structure of the utterances as the source of rules that constitute the meaning in the utterance. Levi-Strauss (1963) stressed that structure is the basis of all activities, including language and thought. In human utterances in written or spoken form, the
structures of utterances generate the meaning and reality and the perception of reality is based on the use of the structure of language. It suggests that the structure contains the meaning and not the experience of the individual. The structure contains the meaning. For Levi-Strauss (1963), the structure’s universality resulted in the timelessness of meaning. In connection with this thesis, some of the early models in natural language processing are referred to in chapter three which have drawn inference from the structuralist theory of linguistics.

2.4.4 Theory of Post-Structuralism

The contributions of Michel Foucault, Derrida, Barthes, Lacan and Bakhtin are the building blocks for the theory of post-structuralism which deals with the idea of deconstruction. Derrida looked at western philosophy (metaphysics) as the central point which receives and generates everything and every concept. He suggested that the system of binary opposition or binary pair for the understanding of every concept needs to be deconstructed. In relation to the linguistic theories, he stressed on the binary pair of speech and writing as speech is not prior to writing but rather that writing is always already interior to speech and that writing is the symbolic representation of the spoken language. Derrida’s analysis was a critique of the metaphysics of presence and logocentrism. This concept is very much relevant with the focus of this research. This research focuses on the natural language technologies with a clear focus on speech technologies. Also in conformation with the humanist concept speech comes first and writing follows it. Speech is the signal of some one’s presence.

Speech guarantees someone’s personal entity and reflection of the personality and speech utterance also hints towards someone’s awareness of self as distinctive individual. This idea of self, identity, self awareness, presence has found central position in the western philosophy starting from Plato to Descartes to Derrida to the present day Transhumanists like Nick Bostrom. These ideas are also referred to in artificial intelligence research that a possibility of creating a computer system that is efficient enough to use natural language in speech thus be aware of its presence and identity. The stress on speech has influenced the modern researchers of artificial
intelligence to focus on speech generation by a system as a first step towards allocating a ‘self’ to the system. The presence of ‘self’ signifies the presence of integrated systems that contribute through binary pairs or binary opposition in the working of the system.

2.4.5 Feminism

The feminist approaches in literary criticism were focused on retrieving the women personality in socio-cultural setting. It raised voice against the stereotyping of women in language, literature and the works of art, in family roles and professions and against the male hegemony in the society over social roles, jobs and treatment of women at the work place. The later streams in feminist movements also highlighted the women’s internal issues related to discrimination on the basis of age and race. Feminism in England is linked with the movement for women rights in the late 19th and early twentieth century. The purpose of this movement was to get justice for women. The earlier wave of feminism was during the mid nineteenth century to the 1920’s. The second wave of feminism in the 60’s and 70’s struggled for equal rights for women in jobs, education and at home. In the recent third wave of feminism, the focus for gender struggle was based on equality on the basis of ethnicity, religion and national identity.

In this research study, the feminist approach to artificial intelligence research and natural language processing is of special interest as some serious concerns were raised by social scientists like Sherry Turkle (1995). She voiced her concern on the issue of the identity and self of an artificial intelligent system. She feared that stereotyping of women characters in the cyber world and virtual environment is discriminatory. She questioned the designation of gender to weaker characters in computer programs and systems. Some of the researchers propagating the feminist rights in the cyber culture have stressed on the need of keeping robot and humanoid robots as objects without gender cataloging. Most of the chatbots and speech generation systems used female voices for modeling and imitating human-like speech generation. A variety of online resources on the internet offer sexually appealing services using facial interface of female with a female back up voice. This is again a
gender discrimination issue when technology is modeled on female orientation with a male perspective of computer programmers.

2.4.6 Bakhtin’s Dialogism

Computer science as a discipline had extensive research work on artificial intelligence in the last three decades. It would be interesting to note that the early researches in artificial intelligence were based on the philosophical paradigm of logical positivism and structuralism. The early failures in the field of artificial intelligence suggested that a new philosophical paradigm of Bakhtin’s dialogism could be used, which was new thing for computer science and artificial intelligence research. Winograd and Flores (1986) proposed that artificial intelligence research should look for a substitute of positivism and structuralism which is used as philosophical base for computer science research. Turing (1950) proposed that the future computers would have the ability and efficiency in natural language understanding and generation that it would be difficult for humans to distinguish between a human and a computer. The artificial intelligence research focused on creating a machine that could pass the Turing test.

Bakhtin’s dialogistic approach in artificial intelligence research is based on the essential nature of dialogue in human conversation and human mind activity. Dialogue/discourse is an integral part of the human-machine communication act. Bakhtin’s dialogism has given a new vibrant and radical philosophical paradigm to artificial intelligence research. This approach has completely shifted the focus from monologue to a dialogue between human and intelligent machine communication and possibly a machine-machine communication act using natural language as tool of communication. Bakhtin (1981) strongly criticized the idea of giving attention to the written language. He stressed that spoken form of the language and the written form of the language are equally important as both have dialogue. The written texts have a dialogue with the reader. This dialogical theory of Bakhtin provides a new philosophical paradigm to artificial intelligence research and natural language technologies of speech comprehension and speech generation by intelligent computer systems.
Voloshinov (1973), one of the great admirers of Bakhtin, stated that any true understanding is dialogic in nature. Understanding is to utterance as one line of dialogue is to the next (p 102). The attempts to model human intelligence in artificial intelligent machines would get success if the artificial intelligence research is based on the philosophical paradigm of Bakhtin’s dialogism.

B) Other Theories

The earlier discussed linguistic theories are interlinked in the discussion and analysis with the following important theories as this research is based on an interdisciplinary theoretical framework.

2.4.7 Theory of Dualism

The theory of Dualism deals with the philosophy of mind and body. The theory discusses a combination yet a contrasting view of mind with body. Descartes discussed dualism in *Meditations* by saying that matter and mind are two kinds of substance. He proposed a mechanistic model of the working of mind and body by suggesting that pineal gland in the human brain was responsible for coordinating between body and mind. The nineteenth century thinkers were greatly influenced by a mechanistic view of the world. They tend to explain everything in close relation with the laws of physics. It seemed hard for them to understand that mind would interfere in the physical world. It was also declared that a conscious mind was a product of physical system (Huxley, 1893). Dualism lost its appeal after the introduction of behaviorism (Watson, 1913). But neurologists like Eccles (1977) kept on advocating that only dualism could explain the realms of consciousness.

2.4.8 Functionalism

This theory stresses on the point that it’s not the internal framework or the state of the mind of an object or individual that determines its individuality but it is the function, the role performed by that object or person. The theory of functionalism is applied in various areas including economics, sociology and psychology. In a very
simplified manner the performance is the criteria of information on someone’s identity or presence. This theory entails that if a body feels pain then it essentially has that system that performs that function of pain which is a sign of its presence.

Some thinkers like Lewis (1966) take functionalism as a materialistic replication of theory of psycho-physical identity which relates to the idea that each mental state is similar to that of a neural one. This theory suggests that no creature may have the same experience, feelings and emotions even if their behavior is like human beings. However, functionalism is seen as more than just a materialistic face of the above mentioned theory. Alan Turing’s quest for the possibility of thinking machine was influenced by theorists of twentieth century functionalism. Turing discussed the state of machine as the set of systems that can perform functions. This also triggered a stream in the functionalist theories named as machine functionalism.

Putnam (1960) contributed in supporting the machine state functionalism theories by seeing the advancement in the field of computation and technology. Putnam (1967) declared that any object or system could be termed as a successful Turing machine if its functions can be explained through the scheme of instructions available for it. Another area in this theory is psycho-functionalism which is based on cognitive psychologist theories. The theory attempts to explain the mental processes and states in terms of their functions. To conceive all mental states in relation with their roles including the scientific, common sense or anything else has widely been criticized by many as holistic. This may not be true for all human beings. Individuals and groups of people have their own set of beliefs, notions and world view and opinions which could be because of their socio-cultural background or experience. This variety of background will make it impossible for them to share the same mental states (Stich, 1983 & Putnam, 1988).

Functionalism attempted to explain the mental states of individuals in a scientific manner. Some see it as an extension of behaviorism, but in contrast to the behaviorist theory, functionalism puts mental states connected with their roles in the effectiveness of cause and effect which our common senses have. The major criticism on the functionalist theory in the artificial intelligence research is that functionalist
theory intends to restrict the human mental states with human beings and it cannot imagine sharing the experience of mental states with those (machines) which do not have brain like human beings.

2.4.9 The Identity Theory of Mind

The identity theory of mind explains that the processes and states of brain and mind are same. It is suggested that the process termed as thought are essentially the processes in the brain. It also suggested that the internal mental states are the physical states. Some philosophers like Lewis (1972) and (1994) and Jackson et al. (1982) have suggested that functionalism has evolved into identity theory of mind. In relation with the thesis the internal states and actions of a computer result in the physical states and actions. Thus the central processing unit may well have the process that enables it to have the mental states for mind and consciousness.

2.4.10 The Chinese Room Argument

The Chinese Room argument was presented by Searle (1980) as a response to Alan Turing’s (1950) statement that if conditions were provided machines could think. Searle argued that if computer programs were able to process natural language they could not possess the consciousness or self awareness as a computer program processing the language. He stressed that computer programs could only deal with the syntactical information and they were not able to know the meaning or semantic value of the syntactic structures of language. This theory is considered as the major question mark on the research in artificial intelligence. The artificial intelligence research has put all its efforts to reply to the challenge posed by Searle’s objections. The Chinese Room Argument threatened the claims of Functionalism and Computational Theory of Mind and its impact has been so wide that as Steven Pinker (1997) said that in the middle of 1990’s more than 100 articles were written in response to Searle’s arguments.

Searle (1980) presented the argument for Strong Artificial Intelligence that only appropriately programmed computers could understand natural language. Searle
pointed out that his statement was in favor of strong AI that only that could understand natural language. A weak artificial intelligence may not have the ability to understand the language which it is processing as it is programmed according to that. At the end of his argument he concluded that strong artificial intelligence was not possible. In simple words processing does not automatically lead to comprehension. Ray Kurzweil (2002) had an interesting reply for Searle that if we increase the size of the Chinese room to the level of this world, would it mean that all those who do not know Chinese are not conscious? How would we know the process in the minds of other people? The debate generated by the Chinese Room argument may only settle when there is an agreed upon relationship of syntax with the meaning and the state of consciousness in machines.

2.5 Theoretical Interface: Transhumanism

As discussed in the first chapter, the research is based on the theory of Transhumanism that deals with the use of technology for the benefit of human beings. The theory is essentially linked with the use of technology in human society and human beings for reformation and transformation. The use of science and technology is for the maximum benefit of human beings. Moore (2003) elaborated Transhumanism as the ‘intelligent use of technology’ in the human society. This research uses the theoretical framework of Transhumanism to discuss the potential of natural language technologies with a clear focus on speech generation and speech comprehension technologies for a logical and sustainable human-machine communication act. Within the framework of Transhumanism, the research is focused on discussing the potential, limitations and strengths of artificial intelligent research to develop efficient speech processing systems which can strive to decipher some of the fundamental issues raised in this research.

The linguistic theories and other interdisciplinary theories discussed in this chapter subsume in the theory of Transhumanism, which draws supporting strains from multiple theoretical approaches for the practical use of technologies including artificial intelligence, genetic engineering, super intelligence, uploading, singularity and nanotechnology for the benefit of human society and human beings as individuals.
The linguistic theories provide the basis for the socialized context of human-machine communication act. The human perception of the world and the experience has an impact on the way humans use language. If a machine could realize its existence as ‘machine’ then the social reality and the experience of the world would influence the language of the machine. Two individuals do not have the same language as they do not have the same experience of the language. The question arises: would it be possible for machines to have the same knowledge of the language when their ‘experience’ of the language would be totally different from that of human beings? Human utterances have meanings in a social context. The social context of a lexicon or phrase is part of human experience of the language. This leads us to the question: would the intelligent machines share the human understanding of the social reality? Speech reflects the individual’s identity, personality and self awareness. The artificial intelligent systems could only produce logical speech utterances if they have the realization of ‘self’ as an identity. A meaningful speech utterance signifies the awareness of self as a distinct individual. The artificial intelligence research is focused on creating this self awareness in system for possible logical human-machine communication act (later discussed in chapter 4 and 5). The other multidisciplinary theories provide the framework for analysis in the next chapters to evaluate the feasibility of a truly functional speech processing system for human-machine communication. These theories debate the functionality of machines for the possible awareness of the individuality of these machines. These theories question the relevance of internal processes and actions in a system with conscious awareness of the system as being an individual. In the context of this research, if system is capable of performing some actions, it is not necessary that it is consciously aware of itself as a system performing some actions. In other words, speech processing ability of a system has to be linked with the conscious awareness of the system for a sustainable, logical and meaningful communication act between humans and machines. As discussed in detail in chapter 4 of the research, the present day artificial intelligence
research is focusing on developing some level of machine consciousness for systems to use speech processing technologies effectively. Bakhtin (1981) stressed on the idea that human language in written and speech utterances are essentially dialogues. A logical communication act between humans and machines could be sustained with the focus on dialogue as essential component of the communication act. The shift of attention from monologue to dialogue has helped the artificial intelligent researchers to develop speech comprehension and speech generation systems that focus on the dialogue in communication and not on isolated speech utterances.

The interdisciplinary nature of this research is strengthened with the fact that all theories contribute to form a composite framework for critical discussion and analysis within the framework of the theory of Transhumanism. Transhumanism is not a set of abstract ideas. It is a practical philosophy linked with the overall betterment of the humanity and human society. The development in science and technology will have its impact on the human beings and human society. Transhumanism provides the theoretical interface for linguistic and other multidisciplinary theories for the critical analysis of the issues raised in this research. A transhumanist approach raises many critical questions during the research, supports the pursuit of possible responses to these queries and advocates the use of all technologies for advancement in natural language technologies and more specifically speech processing technologies. Transhumanism is used in this study for the overall endeavor of having artificial intelligent systems/machines which can comprehend and generate speech utterances like human beings using natural language in a natural situation and context. Thus, Transhumanism provides the theoretical base to this research.

2.6 Chapter Conclusion

This chapter discussed the research methodology and the theoretical framework of the research study. The research framework highlights the researcher’s effort in establishing a logical link of existing and the anticipated technologies with natural language technologies and its impact on human-machine communication act. The theoretical framework of the research provides an insight into the
interdisciplinary nature of the research as it is based on linguistic theories and other multidisciplinary theories which contribute in the main theoretical framework of the research which is Transhumanism. The research methodology deals with investigating and analyzing the affect of existing and the anticipated technologies on natural language communication and speech comprehension and speech generation technologies for a meaningful and effective human-machine communication act.
CHAPTER 3

MAN, MACHINE AND SPEECH TECHNOLOGY

Humans have the quest to find out facts about their own species. They have always tried to look for attributes of ‘human nature’ and its comparisons to other living creatures. It is interesting fact to note in the human history that with the emergence of machines, there has been a motivation for imagining machines, machine-man (robots) either acting as associate or servants of human beings or demons causing destruction. It is difficult to find out in the history that how many mechanical objects were constructed as real scientific objects or just as an object for fiction story. This chapter will focus on the brief history of human obsession with the machine-man and man-machine leading to the development of technologies of natural language processing with a clear focus on speech technologies. The description begins with the fiction written in the nineteen and twentieth century to the popularity of Cyberpunk literature written in the twentieth and twenty first century. A brief review of some of the Sci-fi films is also discussed to see the growth of human imagination. In recent years, there is an increased interest in Transhuman experience (as depicted in movies like Cyborg and Terminator) and artificial intelligence.

3.1 Historical Perspective

There are interesting examples of machines in Chinese traditions. Joseph Needham (1975) has cited a flying machine linked with a Chinese scientist of 380 BC (p 4). He has reported number of mechanical toys used in China ranging from mechanized doves to fish and dragons. Figures of singing girls and figures of men in motion are some of the toys which amused the kings. The Europeans found interests in mechanical objects much later. Joseph Needham (1975) concluded his comments
by mentioning that while Chinese traditions of mechanical toys were rich in thirteenth century,

The European tradition did not show up to much advantage. The triumphs of the European `Gadget Age' were yet to come. (p 165)

In the European traditions the fascination with machines took a new turn. There was imagination linked with wonder that the machines created by humans could imitate their creators. Would they be real and alive? Bruce Mazlish (1993) in his book *The Fourth Discontinuity: the Co-Evolution of Humans and Machines* has referred to a French technician Jacques de Vaucanson, who produced a duck which could drink, eat and swim (p 109). The image of the mechanical duck is given as Annexure 1.

There was always a mixed reaction of fear and the joy of creativity with the development of machines, which were later, referred to as robots. Mary Shelley’s (1817) book *Frankenstein* presented an image of evil, threatening machine. In contrast to this depiction, Baum had a vision of friendlier machine-man. Baum’s creation of a robot called ‘Tik-tok’ first appeared in the book for children *Ozma of Oz* (1907). In this book we saw humanized and funny machines interacting with animals and humans in a very cheerful manner. Tik-tok was not an evil robot and his only job was to serve Dorothy. The card around his neck said that Tik-tok could think, speak and act and could do everything but being alive (p 55). An Image of Tik-tok from *Ozma of Oz* is given in Annexure 2.

At another point in the story we get to know that Tik-tok has language and brain. In a reply to Scarecrow, Tik-tok says,

Oh, yes, I have. I am fit-ted with Smith and Tin-ker's Improved Com-bi-na-tion Steel Brains. They are what make me think. (pp 114-115)

This depiction of a robot acting on the orders of humans continued in fiction in the later years of the twentieth century. In fact, the fascination for a robot that could do something more creative than just the imitation of human actions grew stronger.
Isaac Asimov (1970) in his book *I, Robot* had interlinked short stories, all of them dealing with robots. This was the first time that this book announced the three laws of robotics:

a) through any action or inaction robots may not harm any human being;
b) robots would be subservient to the humans as long as it does not contradict the first law and
c) robot should protect itself by obeying the first law and second law.

Since these stories were written in an age when mechanized computer program machines were seen as reality, it is interesting to note that the robots in the stories possess artificial intelligence. They think logically and make decisions on their own. One famous line is:

I, myself, exist, because I think. (p 51)

Asimov’s book is groundbreaking in the literary history of Sci-fi fiction as it presented the friendly and evil side of the robots. It is interesting to note in the stories that robots act in accordance or in violation of the three laws of robotics. This decision by the robots puts them in the category of compassionate and obedient and/or destructive and evil robots. The laws of robotics were later considered by scientists and sociologists as the fundamental laws for any artificial intelligent machine to exist in the human society. Asimov seemed to be clear on the point that machines may have everything that the human beings posses but the creativity.

The Machine is only a tool after all, which can help humanity progress faster by taking some of the burdens of calculations and interpretations off its back. The task of the human brain remains what it has always been; that of discovering new data to be analyzed, and of devising new concepts to be tested. (p 187)
The technological developments and the growth in the computer industry led to radical changes in our understanding of the robot as mechanized body form. Now we anticipate that the brain ‘computer’ can be attached to a body form and the new form may have the artificial intelligence to think, act and communicate in a language to survive in the human society. The idea of having a super computer having the human attributes of logical reasoning and communication seem possible because of the advancements in the field of artificial intelligence and molecular nanotechnology. The attention was now focused at cyberspace.

3.2 Cybernetics and Cyberpunk

Cyber is a signifier of computer culture through association with information feedback control, the basis of modern computing and electronic systems. Cybernetics is the scientific study of control and communication in machine and humans. In the word Cyberpunk, punk comes from the anarchistic, dense youth moment in the early 1970’s and 1980’s. Punk is referred to as troublemaker. So the combination of Cyberpunk could mean machines causing trouble and anarchy. The word Cyberpunk was used by Bruce Bethke (1983) as a title of his short story published in ‘Amazing’ science fiction stories magazine, Volume 57, No.4 in November 1983. In the genre of art, literature, movies and theater, machines and robots were seen as the destructive force, with most of the action taking place on the computers. Today when we talk about the cyber culture, we talk about humanized machines in the age of information technology.

3.2.1 Cyberpunk Literary Movement

Mainly American science fiction writers contributed the most in the Cyberpunk literary movement that started in the 1960’s and 1970’s. Cyberpunk’s ideological background can be traced in the concepts of post-humanist (which now is termed as Transhumanist philosophy) and post-national. It is termed as the first truly modern genre of hard core science fiction. Pat Cadigan, William Gibson, John Shirley, Bruce Sterling and Neal Stephenson are some of the notable writers of this literary movement. These writers had one idea in common that they firmly believed
that they were depicting the near future of the humanity and earth. This kind of high-tech science fiction was downplayed by some as nonexistent and just a publicity stunt for marketing, while for some others it was difficult to define trends in Cyberpunk literary movement.

William Gibson (1983) introduced the concept of Cyberspace in *Neuromancer*, when the concept of virtual reality was non-existent. But now the information technology experts have created the architecture that may one day materialize Gibson’s vision. The virtual reality of the cyberspace possesses immense potential that there is possibility that computer technology can form a link between the organic and inorganic matter. Cyberpunk writers are concerned with the ambitions and problems of the digital society which started to evolve in the last two decades of twentieth century. Trying to find a direct connection between a human brain and computer systems, Cyborg appears to be one of the most striking expressions of cyberpunk’s trans-humanist ideology. A Cyborg is different from the robot. It is an organic creature or a human being, whose body is completely or partially replaced by artificial/mechanical parts. A body form which may be controlled by a human user or an artificial intelligent computer. It is also interesting to note that the modifiability of a body and a computer control body may seem to loose its biological gender distinction.

The cyberpunk literary movement has introduced new terminologies and new science fiction concepts in fiction. Even William Gibson (2000) has moved away from the cyberspace in his later fiction. Cyberspace is replaced by the internet. But it is still dealing with the social implications of the technological change. In recent works of William Gibson and Neal Stephenson, there is softening of anti-humanist views. As science fiction genera, it has mutated into post-cyberpunk science fiction or trans-human science fiction, concerned with the relationship of man and technology. To the present generation it simply means embedding the high technology with humans and our society in the prevalent pop culture.
3.2.2 Cyberpunk Terminologies

Some of the terminologies used by the science fiction writers of cyberpunk literary movement, movies, TV series and cartoons are discussed below.

a) Hackers

Computer software technology experts, who do not respect any cyber boundaries, are called the hackers.

b) Crackers

These are the people with great computing skills. They enjoy and make living on breaking security of computer systems. They are also called software crackers. They can enter into security systems and personal accounts and enjoy privileges without paying anything.

c) Freaks

They are the telecom crackers, who can breach the security codes of telecommunication networks, wireless radio devices, mobile phones and surveillance devices.

d) Netrunners

These are the people who are always involved in surfing, chatting, pinging, tracing and irking on the internet.

e) Otakus

These have been found mostly in Japan. These are obsessed with the internet activity, computer games and online games. This obsession has led to even murders in Japan.

f) Transhuman

These are the people are interested in using technology to increase human potential and life.
It is a valid debate in academic circles that the present world seems to be divided in terms of haves and have-nots of high tech computer technology and industrial infrastructure. This fact cannot be denied that a new role of humans is being created right now because of the techno culture, we are experiencing in our surroundings. Technology has opened new vistas for investigating our representation. From the age of romanticizing of science fiction stories, we are actually living in the age of actualizing of our dreams. Computer–human communication interface could be termed as in its earlier developmental stages, but with the notable successes of projects like Oxygen (MIT human-computer spoken system), there is a possibility that we see an artificial intelligent machine involved in logical reasoning through the use of natural language with a human being.

3.3 Sci-fi Cinema

Human fascination with machine-man or human look a like machine (robots) is extensively projected on the celluloid especially in Hollywood movies. A sub theme of sci-fi movies has been to highlight the potential of the robots as perfect structures with immense abilities and to differentiate it from the humans. This idea inspired the directors that humans as individuals could be represented by computer programs in robots. In some movies, robots were used in the backdrop to give a futuristic look to the movie. However, some movies portrayed them as villains, destructive force and anti-human. In a small number of films, writer and director’s flight of imagination even conceived of robots having feelings, emotions and personal identity rather than just a machine as in films like Bicentennial Man (1999), I, Robot (2004) and Terminator (1984), the idea being that robots may one day coexist as equal partners, and not servants only, with human beings in a human society.

Albeit, there is still a lot to be achieved in research for human look a like machines to communicate and behave like humans as an artificial life form in human society. The charm and charisma of the sci-fi film admirers still continues that one day robots may speak, act and respond logically like humans. The recent successes in the prototypes of research projects of MIT namely Kismet and Oxygen are source of inspiration for language technology experts. A quick look at the sci-fi films will be
supportive to see how artificial intelligent machines have been perceived in the cinema as communicative and interactive beings.

Gibson & Hurd’s (1984) *The Terminator* was directed by James Cameron, released in the year 1984. The story was centered on a Cyborg ordered by an artificially intelligent machine to destroy humanity. Along with the action scenes, the storyline discussed and explored the themes of artificially intelligent machines realizing ‘self’ and ‘consciousness’ and becoming powerful enough to lodge a war against humanity. This theme was explored for the first time in sci-fi films on screen. An image of Arnold Schwarzenegger as Terminator (Cyborg) is given in Annexure 3.

The Cyborg –Terminator may seem similar to the other machine villains shown in fiction and films but the difference is that it is just not a dumb machine structure this time. The decision making on the part of machine that it has actualized its ‘self’ as a separate identity and then its further actions based on it are the features of this film which make it different from other movies.

Another important feature of this film is that Cyborg has command on natural language as it is used by human beings as tool of communication. He is able to comprehend the speaker’s intentions and convey his piece of mind to the other person with reasonable rate of accuracy. The crisp, to the point and loaded phrases used by Cyborg in the dialogues, present him as an intelligent machine with a knowledge of the natural languages as used by human beings. This could be termed as writer and director’s decision to facilitate communication medium on screen for a character like Cyborg. But this is also in line with the tradition of science fiction literature and cinema that robots, intelligent machines and Cyborg do not speak alien language. They are portrayed as characters with access to linguistics database of the natural languages and they can communicate with human beings easily. It is interesting to note that some of the lexicons have no semantic value for these machines. For example, Cyborg in Terminator did not comprehend the meanings of smile, laugh, cry and sad as emotions and feelings and the child co-star explained these words to him by showing him the performance for each of these words.
In the later sequels of the film, *Terminator 2: Judgment Day* (1991), *Terminator 3: Rise of Machines* (2003) and *Terminator Salvation* (2009), the war between the humans and artificially intelligent machine continues. The concept of software existing on cyberspace, Skynet, reprogramming itself and planning destruction on earth was presented aligned with action sequences and special effects. In the sequels, machines are shown as desperate entity to overcome humans, fighting with emotions of envy for power and supremacy.

Robin Williams’ *Bicentennial Man* was produced by Barnathan (1999) and the film is based on Isaac Asimov’s story of the same name. The film was based on a story of a robot, which became humanized during its stay with a family. The process of ‘humanization’ of robot is interesting as it is triggered in the robot due to increased interaction with its human masters. The development of feelings and the sensible use of language indicate that this particular robot realized its ‘self’ as distinctive individual and that is appropriately conveyed through the dialogues used by the robot. An image of Bicentennial Man is given in Annexure 4.

The film focused on the evolution of Andrew Martin (Robin Williams) as a humanized robot, having feelings of association, love and human abilities like creativity. The logical reasoning through communication and realization of self as ‘I’, are some of the important themes of the movie. The film also focused on the point that there is still long way in the research for a machine to achieve the consciousness of self through artificial intelligence but this robot stood as exception to all the fellow robots manufactured in that company. The film discussed the social consequences for a machine to be artificially intelligent. The family, religion, society, human relationships, language and our perception of the world would get affected if we were to communicate with a machine which has no background and stakes in any of these.

As discussed earlier, the humanized robot named Andrew Martin seemed to have no problem in using natural language as tool of communication with human beings. The dialogues are written to showcase the robot perspective of the world so in the first half of the film the dialogues are short phrases and at times tongue in cheek remarks from Andrew Martin which are quite unusual as compared to the traditional
robots on screen. In the latter half of the film, the dialogue construction is more detailed, complete sentences with emotional tones and feelings. The transformation of Andrew Martin from a robot to a complete human like artificial intelligent individual is evident in the way he uses the natural language in the film. This film is a first major breakthrough in presenting the possibility of an artificial intelligent humanoid robot on celluloid, natural language as tool of communication with human beings. This film highlighted the possibility that humanoid robots may create their own world view, experience and knowledge through the use of natural language. The writer and director of the film visualized a situation on screen for a sustainable and reliable communication act between humans and machines. The cinematic dream has become a reality in the form of early achievements of speech processing systems like Kismet (2006) of MIT and ASIMO (2007) of Honda Next Generation Company.

Davis, Dow & Smith’s (2004) I, Robot was released in 2004 and is another film loosely based on Isaac Asimov’s story on robots working as servants and acting on the Asimov’s three laws of robotics. However there is one rebellion robot named VIKI who is intelligent enough to think of alternative sources for achieving his objectives. An image of Will Smith in the Company of Friendly and Non-Friendly Intelligent Robots is given in Annexure 5.

This film highlights the evolution of artificial intelligence in one of the robots named VIKI. The evolution in the robots enables them to keep secrets, hide emotions, have envy and decide and interpret commands. Towards the end of the film, one gets to see the emergence of friendly artificial intelligent machine (Sonny) in contrast to non-friendly machine (VIKI).

This film portrays friendly and non-friendly robots and their own distinctive use of natural language. The dialogues are usually short sentences for both Sonny and VIKI. The plot of the movies implies that human and machines share the linguistic knowledge for a meaningful communication act between humans and machines. An important thing to note in VIKI is the use of paralinguistic features as part of communication act. In a little step further from Andrew Martin in Bicentennial Man, VIKI’s sentences are intelligent, crisp and the dialogues are not delivered in flat tone
with a ‘robotic’ face. The speech utterances of VIKI are accompanied by eye movement and physical gestures. Andrew used emotions and feelings in his dialogues whereas VIKI’s negative character is made interesting with the use of eye movements and gestures. VIKI appears before audiences as an individual with complete command on his speech, an artificial intelligent robot who knows his objective and knows the means to achieve his objective. This is a notable shift in presentation of robots as only machines and humanoid robots on screen as ‘individual’ characters. In the first decade of the twenty first century, the intelligent machines are increasingly perceived as justifiable partners in technology driven human society. The growth in communication technologies has also opened new avenues of opportunities for intelligent systems to cooperate and participate in communication act. It is anticipated that intelligent systems would be able to use natural language as tool of communication with human beings and with other machines much earlier than expected.

The cinematic imagination perceived humanized robots involved in logical reasoning through dialogue and human like emotions for social survival. The science fiction movies have played an important role in triggering the human imagination for believing in something which appeared to be distant reality (Scalzi, 2005). The science fiction films have portrayed some of the human attributes in the aliens, Cyborg and humanoid robots which are interesting to note as the writers, directors and producers visualize the fiction as part of the future reality (Cornea, 2007). An outright rejection of such ideas by terming them as just fantastic presentation of virtual reality through special effects and the use of cutting edge cinematic technology would not be a wise idea. In fact the fiction has generated interest in the scientists and linguists to explore if there are any feasible ways of human-machine communication. The last two decades of the twentieth century did not see any great successes in developing artificial intelligent computer program which could communicate independently with a human being. With the development of human language technologies like natural language processing, speech recognition systems and speech generation, there are advances towards developing human-computer language interface. The advancements in computer technology have made it possible for speech processing systems to access large linguistic database and synchronization of image processing
and speech input processing technologies have made it feasible to manufacture systems for a reliable and sustainable human-machine communication act.

3.4 Natural Language Speech Technologies

Computer engineers, linguists and futurists have been fascinated with the idea that one day computers would be able to communicate with human beings through artificially generated natural language. This has been an ultimate goal of some of the experts in artificial intelligence and computational linguists to understand the process of human communication through language and to achieve the same competence in artificially intelligent computers. In today’s world, a small number of people have access to what speech technologies have achieved in terms of their effectiveness and reach in telecom sector, Call centers, banking sector, international traveling networks and trading markets. There is an urgent need to have speech technology systems which are portable, user friendly and easily accessible, ideally in users own language.

In spoken language technologies, there are different technologies involved in spoken input to computers and spoken output from computers. It includes identification (which may to lead to forensic information) to verification of the identification of the speaker in speech input to computers. The advances in speech technology range from call routing to data entry and report generation\(^2\). The speech recognition technology involves transformation of voice signal into measurement. The whole purpose of speech technologies is to make the human conversation with an artificially intelligent system more active and to generate responses quickly without much delay in solving ambiguities of language. This makes the job even more challenging as to develop state of the art language technologies which could cater for multiple language inputs and outputs. The processing of speech input to computers may lead to generation of information in the form of acoustic signals, graphics, written information and language generation.
3.4.1 Speech Recognition

Some of the key Challenges in the area of speech recognition have been identified by Cole and Hirschman (1992) in a workshop sponsored by US National Science Foundation. Multiple tasking is one of the major challenges faced by the systems developed for the speech recognition. The range of services from one task to another will ensure the performance factor of such systems. The acoustic environment and its compatibility to multitasking can affect the performance of speech recognition systems. The adaptation of systems to different levels of language including stress, intonation and the human intention, pronunciation of words, syllables, changes in tone, phrases and sentence structures, microphones and the most important of all multiple speakers is very important for a recognition system. The integration of syntactic and semantic varieties to reduce the level of ambiguity is also an important challenge to such systems. One of the major challenges to the research in speech recognition systems is to enable speech output from computers based on the human natural speech input. This may include comprehension and appropriate representation of pauses, ungrammatical structures and other paralinguistic features.

A large database of vocabulary with syntactic variation is required to achieve accuracy in understanding of the speech input by a system and responses generated by the computers. The acoustic and phonetic variations can have serious effects on the way speech is received by the computer system. Small adjustments like the distance of speaker from the microphone may also affect the reception and comprehension of the speech input. The personality of the speaker is another important factor in the speech recognition system. The speaker’s background (educational, linguistic and social), his psychological and emotional state and his voice quality are some of the factors which can vary through speech recognition technology and the quality of the comprehension system. The recent developments in speech technology have led to development of large speech corpora. It has become possible now to compare and contrast variability and reliability of performances of these systems as large database is available in public domain (Furui, 1994).
An interesting domain of the speech recognition technology is to recognize the human speech and to recognize the human speaker leading to the verification of the speaker depending on the nature of required output. Initially, only the speech recording stored in the database was used as the reference for identifying the speaker. But now it has become possible to account new speaker’s acoustic variability and quality in some of the latest systems. The recognition of speech and speaker are two distinctive issues. In recognizing speaker, the focus is to identify the speaker without bothering about the content of the speech. On the other hand the speech recognition system works on qualities of speech as set of utterances for a reasonable level of understanding. The systems developed for forensic evidence require a set of key words to randomly match an already stored sequence in the system. The speaker recognition system builds upon information from word and syllable delivery, phrases and pronunciation.

Though there is encouraging development in the research in speech recognition technologies, there is still long way for researchers to develop technology for computers to have independent conversation with humans. It is hoped that with the advances in computer technology, it will be easier to keep large database of vocabulary, syntactic structures and semantic features of multiple languages available for multiple number of humans using different languages. According to Furui (1994) it is anticipated that speech recognition technologies would be able to respond to multiple requests and they will be able to generate multiple speech outputs. Furui (1994) argues that from specific information based speech recognition systems (for example, retrieving information from a testing service or a credit card company) to recently developed, generation of multiple source of information as required in financial institutions like stock markets and cellular network systems, speech recognition technology has achieved important goal of running a system in real-time with minimum of hardware required.

In this overview of the speech recognition technologies, it is important to understand that there are still unresolved issues of rate of word-error, speech variations and sound distortions in the environment. The system should be smart
enough to make a decision on its own if a speaker is in disguise of someone else or may be suffering from influenza.

3.4.2 Spoken Language Comprehension

This technology is based on two other technologies namely, generation of language by an artificially intelligent machine and speech recognition. The combination of these two technologies is vital for clarity in syntax and semantics. Linguistic and psychological theories form the basis of human quest to understand the cognitive process involved in the production of languages by human beings. Many schools of thoughts have followed different ideologies for understanding the process of speech generation and then modeling that on artificially intelligent computer systems. An extensive research is still required to enable the present day technology to achieve human like speech output from the machines. Database access and cellular phone services are some of the initial technologies that are attempting to achieve human like speech output on human speech input. But there is still a lot of ground to be covered before a machine’s speech responses could be human like. Natural language in spoken form is used by humans for communication. Any artificially generated language must be perfect enough to incorporate human sensibilities attached with human language.

False starts, pauses and repetition are common in human conversations and generally they are considered part of communication pattern. However, such a pattern is difficult to be modeled in computer generated speech and its understanding by a computer. R.J Lickley (1994) in his PhD thesis presents an extensive debate on dealing with speech issues while modeling it on computer generated speech and understanding of human continuous speech by a computer system. The stress and intonation pattern in understanding and in language generation pose an important challenge to the researchers. On the whole, it is important to decide when a machine may intervene, start a new dialogue, remove any misunderstanding and request for a further clarification in a human–machine speech pattern. The context retention and coordination of turns in speech act is essential. The synthesis and interpretation of speech in put into the system is critical to form the foundation of a relevant and
precise speech output by the system. Keeping in view some of the success in the language laboratories of MIT and Stanford University, it will still be interesting to find how a system can generate a response to urgency in any speech input. A coordinated response in a communication may be different for a human-machine interaction than a human-human interaction if human speech input is excited or depressed.

One of the major issues is dealing with the issue of mismatch in understanding the speech input and speech output (language generation) by a system. An important suggestion came out in the DARPA proceedings in 1991 of working out an interpretation with semantics rather than focusing on grammatical structure analysis. This aims to reduce the mismatch in speech input and output. The assimilation of any cultural or social traits in speech inputs requires a special attention to reduce chances of mismatch and ambiguity. There is a consensus among computational linguists and engineers that for a near to perfect language understanding and language generation in human–machine communication, a variety of knowledge sources and databases must be integrated. The context, topic and choice of words are important for a speech understanding system to reduce the rate of speech output error.

3.4.3 Speech Production

Speech output processes demand state of the art accuracy for a human like logical output. The improvements in the quality of output are anticipated with the passage of time to model on human like output. Also the variation in the speech act, for example, paralinguistic feature have to be incorporated in the speech output from a computer system to make it sound less like a robot and more close to human speech act. The mechanical adjustments in the speech output system of a machine also hamper the quality of voice, continuity in utterances and the pitch. The database of any language corpora plays a crucial role in facilitating the output process. Initially the research in this area was modeled on human speech act, but with the advancement in computer technology, text-to-speech technology was also incorporated in speech output research (Allen, Hunnicutt and Klatt, 1987). Allen and Klatt are of the view that phonetic theories and acoustic analysis form the basis of speech output research.
In contrast to rule based approach, the basis of computational models is phonetic-syntactic and acoustic information based on the corpus of that language. The future directions of speech output technology are dependent on any further improvements in the corpus-based research.

For a human-like speech output, including the representation of as smaller units as phonemes, a control on stress pattern, tone, speed and rhyme is of great importance. The syllable and segment level coordination was used to quantify the extension and shortening of duration of speech output (Campbell, 1992). Along with the linguistic information, the speech output also contains the characteristics of voice quality of speaker. In the fields of artificial intelligence and molecular nanotechnology, it is a topic of great importance that what identity, as gender would be allocated to an artificially intelligent machine. Attributing gender to a speech output is an interesting area of research as feminine speech is being used by the banking, corporate and telecom sector in the US and some of the European Union countries (this has generated debate in feminist quarters for gender equality). Klatt and Klatt (1990) have discussed the quality of characterization in their work and have highlighted the implications of attributing the female or male characteristics to a computer generated voice signal.

The generation of quality speech is dependent on the quality of phonetic strings responsible for the generation. In producing a meaning full utterance, the comprehension is based on the choice of words or phrase in continued speech. A stress pattern, tone and pauses (if used) would determine the overall effect of the speech even though there would be a feeling in the listener that it is not a REAL speaker but an attempt to produce human like speech. For an accurate output, the knowledge of context, level and amount of information to be retrieved would be essential for the system. The control on expression and retention of specific identity as a reliable speaker are some of the issues which need attention in future research. In fact the accuracy of information and its level of comprehension linked with the rate of speech output for general purpose or for any field specification are the only criteria to judge minimized error ratio. One of the major challenges for the researchers in this
area of speech generation is keeping the fluency of speech, integral to the human-machine conversation.

The generation of human-like speech by speech generation systems is not yet mature enough to correspond to speech input and speech processing technologies accurately on large commercial or business scale. An imitation of human speech act is the ultimate goal of natural language technology researchers. However, there is still extensive research work required to achieve success in that direction and to achieve maximum level of accuracy and correspondence of speech input with the speech output. The addition of linguistic and paralinguistic features in speech output would add reliability and comfort factor in human-machine communication act. With the new developments in the field of information technology and the creation of virtual reality, the speech generation technology promises immense potential for commercial and leisure products.

3.4.4 Fluent Speech Generation

The correct interpretation and appropriate response to a speech input is expected of an efficient speech generation system. Such system must generate meaningful utterances and sentences, which are relevant to the required system. This synchronization of input with the speech output, while keeping the context intact with minimum possibilities of ambiguity is the ultimate goal of researchers of language technology. In a human-machine communication act, it is agreed that features other than language response, are of equal importance. In a real time communication act, the quality of audio input may determine the nature of response from the machine. The choice of words, if no context is available to the system regarding the previous conversation may seriously affect the semantic value of the generated utterance and the desired meaning. The production of a meaningful utterance has to keep in focus the desirability of the information, the manner of producing the utterance and the selection of stress and tone pattern. In planning a discourse structure of a human–machine communication act, the accommodation of variation in level of comprehension, educational and socio-economic background of humans is critical for managing, level and form of information generated through speech by a system, for
example an information generated by metrological department or flight inquiry system.

In a human-machine discourse, it is important to establish framework for the components of coherence and organization. Smaller utterances must be adjustable by the computer system in a mega structure of dialogue continuing between the human and machine. This is essential for the system in the communication act for the selection of content and structure of the utterance. Johanna and Cécile’s (1993) work is considered as landmark in arranging pattern for intentions of a communication act. It is extremely important to adjust the outcomes of the discourse between humans and machines. The reasoning of the discourse, its outcome, its implications and its effects on choice of related words is directly related with the objectives of the overall communication. The choices of the syntax, measurement of semantic value of linguistic items in relation with context and the use of connectors are imperative objective for researchers in speech production technology. Jennifer and Sandra (1994) stressed on the selecting the preferences of topics and syntax for both human and machine to minimize the level of ambiguity in the communication act. To make the communication purposeful, it is also essential to set the objectives of communication (Kathleen, 1988).

Kathleen, Robin and Tanenblatt, (1993) emphasized on another important area for an effective communication act between humans and machines and that is selection of lexicon. The user friendly nature of a system would be greatly dependent on the jargon related to the field and the objectives of the communication. Earlier, Butterworth (1975) had confirmed in his study that the intonation is essential part of conveying meaning and it can affect the response error if the speech is devoid of any intonation pattern. For generating a purposeful speech from a system, it is crucial to have right tone and pitch to convey the right meanings, thus reducing the rate of ambiguity.

In the human-machine communication act, there is great dependency in the storage capacity (memory) and the speed of the computer system involved. These things ensure a quick processing of the huge database of linguistic items for
generating speech response. There is an urgent need to integrate speech generation systems with engineering experts and linguists to achieve the critical objectives in logical human-machine interaction. The features of spoken language still need to be incorporated in responses generated by the machine. Simple to layered utterances are seen as a critical milestone in generating human like discourse pattern between humans and machines. The random and independent choice of lexical and syntax still remains an area of concern for the researchers as long complex sentences with gaudy words are certainly not suitable for responses for commercial speech generation systems like in the corporate sector. The user friendly face of response generation in discourse is related with retaining the context, referring to explanations, taking turns in discourse and initiating problem solution.

3.4.5 Human Machine Discourse

The computational analysis of language technologies related with human-computer system dialogue has gained importance in recent years. There are efforts to unite both intention and information approaches in discourse analysis (Kehler, 1994). The information approach is based on the relationship of speech utterances on the semantic level. The second approach, based on the intentions of the speaker, is mainly derived from the works of Grice (1969) and Searle (1969). Taking this approach a little further, Lochbaum (1994), in his PhD dissertation, suggested models that may help in getting to know the intent and objective of both participants in the human-machine communication act. The contextual interpretation of the discourse and the generation of a continued discourse are the prime areas of research in this field. In the research article of Grosz & Sidner (1986), the dependency of interpretation and generation of utterances on level and point of attention is emphasized. It is evident that intent is related with focus of attention in human-machine discourse and this is dependent on interpretations of utterances in a certain situation. But how do we get to know the point of reference or focus area in a human-machine interaction? This means that synchronization of both audio and visual units is highly important for a meaningful dialogue between human and machine and between machine and machine using natural language as tool of communication.
In natural language generation and natural language understanding technologies, the sustainability of continued meaningful conversation is also dependent on the semantic value, that is what the participants of the communication act are saying and the pragmatic value of their utterances. This enables us in getting to know the overall task and purpose of the dialogue comprised of speech utterances. The viewpoint of artificial intelligence and computational linguistics is relevant to deal with the language technologies concerning issues of semantic and pragmatic values of human-machine dialogue. Hobbs’ (1985) theory discusses the coherence of utterances in a discourse for a reliable interpretation of the communication act. Another theory is formulated by Mann & Sandra (1987), known as Rhetorical Structure Theory (RST). This theory tries to explain the relationship of discourse pattern and speech utterances when each utterance is considered as the center of meaning of one portion of the dialogue. The theory dealing with coherence of speech utterances in a dialogue which is related to access to a variety of content available for selection in generation is presented by McKeown (1985). The later theories have provided great help in language generation technologies. On the whole, all theories need expansion for the purpose of growing research in the area of speech generation by artificially intelligent computer systems and growing demand of human-machine communication technologies in corporate, medicine, legal, banking and telecommunication sector. An effective dialogue system must be capable of processing hierarchal and chronological references in speech utterances.

Future research in this area needs support in developing contextual relations based on information, intent, motivation and references. There is need to reduce ambiguity and increased focus on past, present and future references. The information retrieval linked with the closest meaning and intent is the future objectives of this language technology. One of the major landmarks in the research in language technologies relevant with discourse study of human-machine communication is the study conducted by Hirschberg & Grosz (1992) on acoustic information in the discourse. It is hoped that with the integration of latest technologies in artificial intelligence and increased computer speed in processing, a complete dialogue system is expected to appear comprised of discourse understanding and discourse generation systems.
3.4.6 Speech Dialogue Systems

There have been considerable developments in the technology of speech dialogue systems recently within the reasonable semantic limitations due to the developments in the field of speech recognition and speech understanding. It is natural in human communication that an utterance is not enough in the communication act. It may contain number of phrases or dialogues. This results in taking turns in dialogue for a meaningful communication. Also it is expected of the speech generation system to take turns in meaningful communication. The language understanding and generation depends on the rate of participation in the communication act. This is directly related with comprehension and removal of errors in a continuous speech. The research in human-machine dialogue followed two theoretical frameworks. The framework of research that believes that speaker’s utterances are meaningful, complete and well formed sentences and based on rational grounds follows studies of Searle (1976) on speech acts. The other framework of research is based on Levinson’s (1983) studies that disjointed, abrupt utterances should be accommodated for meaningful communication act between human and machines. Both of these have influenced researchers in developing dialogue systems for recognizing errors in words and phrases in the dialogue.

The accurate goal oriented performance in the real time is a key factor in evaluating the performance of speech dialogue system. It is important that a variety of applications of such systems must be linked with the various levels of speakers. The social and educational background of the speaker is an important factor for the speech system to make appropriate adjustments. The appropriate integration of the speech dialogue systems, including the turn taking has an encouraging affect on the ratio of success of natural language understanding and generation. The language understanding can influence the probability of the expected sentence structures and meanings of the utterances and then greatly influences the linguistic items to be used in the response generation. This will improve the accuracy and meaningfulness of the speech dialogue in human–machine communication. It is difficult to say at this point of time that speech comprehension errors can be completely eradicated but it is
important in the future research in the speech dialogue systems that a quick recovery process be inbuilt in the system for a meaningful speech output.

The quick relation to anaphoric references and other brief references need to be incorporated in the dialogue system as some of the sentences and utterances cannot be comprehended on its own. They need a context for a complete understanding. The continuous patterns in the speech act which may keep on changing attention from one topic to another will force the systems to be alert and up to date with the current and previous record of communication for quick referencing. The turn taking mechanism and the convenience of initiative in the human-machine dialogue may remain open for both. There needs to be further refinement of dialogue systems to minimize the ratio of misconception and misrepresentation. This is critical in securing the whole communication act to appear natural and convenient. The pattern of communication is dependent on the requirements of user. The human imitative in the dialogue may range from short phrases to complete sentences and may include complex sentences. On the other hand the dialogue system would rely on the extended database for focused, simple dialogue which keeps the communication going.

It is important to note that there is very little that one can model on human-human communication for developing an efficient dialogue system. The efficiency of such systems is dependent on results of repeated experiments. It is obvious that humans behave differently when they are talking to each other to when a human being is in conversation with a speech comprehension and generation dialogue system. The evaluation of dialogue systems starts with calculating the time used for utterance, the number of turns taken in the communication act and the rate and ratio of corrections made by the system. It is also important to note that the satisfaction of human, as user, is important in measuring the success ratio of the dialogue systems if the human was able to retrieve the required information from the system in the shortest possible time.

The evaluation of user friendly nature of a speech dialogue system is relevant for judging the performance of the system in the commercial or domestic use of that system. The comfort level of humans in speech act for clarity, purposefulness, length and speed of utterances, minimum possible misrepresentation and errors, naturalness
of the communication and speed of the dialogue delivery are some of the factors to determine the user friendly nature of the system. This may surpass the analysis of retrieving the exact data. The lack of friendly outlook of speech dialogue system may become the biggest problem in marketing. Gerbino and Danieli (1993) have shown in their research work that a high ratio of success can be achieved for objective specified dialogues even if there are some traces of errors in understanding of speech input. In a natural communication act between humans and the system, the speed and structure of utterances directly influence the level of friendliness and convenience in communication. The research in this area of speech technology still poses challenges to the researchers to develop system that can adjust the language generation to the social and educational background of the human user.

An efficient dialogue system should identify when the human utterances has finished. It is essential to note that for achieving a natural human-machine communication, the use of pauses should be differentiated by a speech dialogue system form the end of the utterance. A serious confusion or misunderstanding may arise in the communication act if the pause in the utterance is considered as end of the sentence. Ferrer, et al. (2002) suggested that the speech recognition system could detect pauses at the level of phonemes and then with an efficient rate build on information from prosody and syntax to anticipate the completion of the utterance. The combined approach of prosody and linguistic models could provide accurate information to the natural language understanding system. Ferrer, et al. (2002) also proposed that such an approach could reduce the processing time and the speech generation by the system could use turn taking in the human-machine communication more efficiently.

3.4.7 Multilingual Speech Technologies

In the world of multinational companies and globalize economies, research in multilingual speech technologies has generated a lot of interest to cater to the needs of global consumers and trade partners. This leads to extensive research activity in developing systems in multilingual text and speech processing. It would be valued in a consumer friendly environment that quick identification of speaker’s language
should immediately lead to the appropriate language processor or translator. The language generation systems would be able to use the language as used by the speaker for maximum facilitation. It is an interesting field of research to find out if the successes achieved in single language understanding and generation systems can be extended to other languages as well. This is an ambitious project and would need a great effort to have access to complete linguistic database of languages. The present day speech technologies restrict single language usage in an environment of low noise and single speaker.

The diversity and increased number of speakers and languages in present day speech technologies require huge database. Some of the systems which were originally developed for one language have successfully been used for number of languages. The Dragon system developed by Bamberg, Demedts, Elder and others (1991), the Philips system developed by Ney and Billi (1991) and the IBM system developed by Cerf-Danon, DeGennaro, Ferreti, Gonzalez and Keppel (1991) demonstrated with reasonable success rate that systems developed for one language can be improved to be used for multiple languages. These systems were used for the European languages with some basic assumptions. However, minor adjustments had to be made to incorporate lexicon and phonetic variations. The acoustics and phonetic variability across languages pose challenge to an error free processing in a multilingual system. There have been reported instances of confusion in lexicon recognition in above mentioned models.

Differentiating between different styles of speaking of different languages is another challenge for natural language technologies catering to multiple languages. In conversations, where more than one speaker are involved in using multiple languages, the level of difficulty for the natural language understanding system increases to multiple levels as increased number of speakers means enhanced noise level which may cause misunderstanding and confusion. Glass, Goodine, Phillips, Sakai, Seneff and Zue (1993) of Massachusetts Institute of Technology developed a speech technology system called ‘Voyager’, which is helpful in providing meaningful speech output in languages other than English. Gauvain and Lamel (1993) developed a language system that has the capability of producing speech output in multiple
languages and it can also use interesting techniques to identify and acknowledge different speaking styles and gender. This is an important contribution in the field of speech technologies as it will improve the practical usage of these systems in the corporate and consumer services places.

The extended usage of multilingual speech systems in the market, industry and the commercial sector is dependent on the accessibility to large database of multiple languages. Some of the prototypes as discussed above were tested in controlled environment and it is essentially required that systems should be allowed the test of real practical world to see the impact of noise and other features of human speech in a group discussion or a public place. The present research in multilingual speech technology is relevant in developing artificial intelligent systems which are capable of using database to cater the needs of variety of users. Developing a multilingual database is a huge task and involves great effort on the part of system developers and assisting linguists. The construction of system tools that can enable semantic variations of lexicon in synonyms and antonyms is the foundation of developing multiple speech technology systems. The speech translation systems are in early stages of development and it is still difficult to rate a system which can truly come up to the minimum expectations of the requirements. The major goal for researchers of speech technologies is to develop a multilingual system that can sustain a meaningful discourse with multiple speakers. Such system would have a huge market demand in the areas of banking, traveling, hotel industry and hospitality sector, international conferences and seminars and home delivery services. The possibility of success of these systems is closely linked with their market demand.

There are great challenges for the researchers in this area. The ultimate goal of developing multilingual systems is to facilitate conversations across the globe in more than one language. The present research in this area is focused on languages and speech utterances which have large database available in the systems. Some European and Asian languages like English, French, Spanish and Japanese have been used for the multilingual systems to operate in operations like weather forecast and air traveling. The intent of the speech input is the foremost important thing for a system than just getting to know the meaning across languages. Multiple languages may
have distinctive ways of expressing simple ideas in complex way or vice versa. The level, length and tone of utterances in different languages would require the system to adjust itself appropriately for a meaningful response. Another important area in this field is the capability of a system to sustain a meaningful human-machine discourse and keep a sensitive understanding of human-human conversation as well. The cross referencing to nouns and pronouns in multiple languages and variations in rate of speaking has an influence on the efficiency of the multi language speech system. The development in these areas of speech technology is closely linked with the development of processing techniques of linguistic, with a clear focus on phonetic, and auditory levels of technology.

The future research in developing multilingual speech technologies involves collaborative effort of researchers from different linguistic backgrounds to support an operational worldwide association for proficient speech technologies. A huge database of multiple languages with possible access to all speech varieties would provide an important building block for an efficient system. This also involves extended technology in natural language understanding and availability of syntactical models for a meaningful comprehension of speech input. The growing research in human machine communication technologies would benefit the multilingual technologies as the discourse strategies in a monolingual human machine communication can be modeled in multilingual domain.

An affiliated research component of this technology is the identification of speaker. The voice recognition system for a correct speaker identification system is mandatory for the current security environment of the world. The OGI- Multi lingual Telephone Corpus developed by Muthusamy, Cole and Oshika (1992) contained utterances in different languages in specified situations in eleven languages. This system is considered a major contribution in this field as this encouraged other researchers to look for specific problems in spoken language identification systems. The speech recognition techniques have been linked with the speaker identification techniques. This enables the system to look for distinctive features of an individual speaker and then retain it for any future reference. The phonetic recognition combined with the auditory level and values of the speech input are the contributory
factors in speaker identification systems. Another application of speaker recognition technique on identification of language has been very successful. The system attempted to use selection of utterances with a classification of expected phrases most commonly used by the users of that particular language (Li, 1994). Muthusamy (1993) and Hazen & Zue (1994) developed systems that relied on techniques of the length and the time taken to complete the utterance. However these models could not show reasonable success in using phonetic variations in different speakers as information source for speaker identification.

3.5 Human-Machine Communication in Natural Language

The success in research in human-machine communication technology relies heavily on the advancement in computer technology. Linguistics, artificial intelligence, mathematics, psychology and computer science are the constituent disciplines that would contribute in the future development of natural language technologies. The actualization of speech models at the level of semantics, syntax, pragmatics, phonetics and sociolinguistics in the natural language technologies is essential in creating replica models in speech technology. The connection of thinking with natural language generation in human beings is a fascinating model for replication for computer researchers in artificial intelligence. The fast pace development in the web technologies and the virtual space has created tremendous opportunities for the natural language comprehension, synthesis and generation.

The communication network that facilitates the human-machine communication essentially requires the basic infrastructure to model on human-human conversation. This would also require the need to enable the system to have the capacity to understand, access and produce the needful knowledge for a meaningful communication act. How would it feel to have conversation with a computer in living room? Can we think of a situation discussing school choices in the neighborhood with an artificial intelligent computer system in a friendly manner? The fluent, logical and interactive responses from a computer would be possible if the relevant speech technologies attain the desired refinement.
The development of a natural language generation system in 1994 called ‘Galaxy’ was a major breakthrough in developing speech technologies. The weather information system ‘Jupiter’ (2006) developed by Spoken Language System at MIT is an appropriate example of a friendly conversational natural language generating system. The following excerpt is taken from the Spoken Language System web link of MIT website. This kind of communication is possible when the system is capable of converting the speech input in items as request for specific information.

Human: Yes, I would like the weather forecast for London, England, please.

JUPITER: In London in England Wednesday, partly cloudy skies with periods of sunshine. High 82 and low 63. Is there something else?

Human: What is that in degrees Celsius, please?

JUPITER: In London in England Wednesday, high 28 Celsius and low 17 Celsius. What else?

The meaning identification is targeted towards the data extraction and then converting that data into speech output is the crux of the process involved in generating the meaningful utterances. In all of the models developed for human-machine communication, attaining the level of naturalness during the conversation is hoped to be achieved in the near future.

One of the long range objectives of the human-machine communication is to have a face to face communication act between humans and intelligent systems involving all the linguistic features, including gestures, facial expressions and variations in tone. This endeavor begins with the assumption that machines would be able to perceive communication as natural as humans have it today. In human natural communication senses of feel, vision and sound play an important role. It is critical to have contributory technologies of noise control, voice and vision technology processing in place for a complete face to face communication act between humans and machines. The research in multimedia technologies would enhance the systems’ capacity to integrate voice with vision and to comprehend this information as
linguistic information to be transformed into a meaningful speech output. The Kismet (2006) project and ASIMO (2002) humanoid robot are the best prototypes for attaining the capability of interpreting the facial features, gestures and postures into meaningful responses including the speech output.

The image processing technology ranges from single image impact to coverage of a large area with multiple images, for example images of a procession. The comparison of human vision sensitivity to image processing technology reveals that there are still limitations in locating the spatial information. The capacity to transform a single video image and multiple images in data processing for an appropriate response in gesture or speech output lies at the heart of microelectronics research in image processing for speech technology. The continuous patterns of images as in video require a continuous coding and efficient transformation process to decode the information for a speech output.

The earlier researches focused on speaker’s adherence to the specified tasks, vocabulary, syntax and purpose of communication. The recent advances in research have produced systems that can achieve a reasonable level of speech synthesis and produce speech with accuracy in a task specific domain. There is a shift in approach to the analysis of phonemes instead of lexicon. With this building block, the database for vocabularies is increasing with fast space. It is proved in the experiment conducted by Furui (1989) that the vocabulary database with an affiliated information on phonetics is of great help in assigning codes to variety of speaker inputs, thus making it feasible to exercise speaker identification. The high definition image processing aligned with refined processing of speech utterances opened new opportunities for speaker independent speech recognizers. This is a critical advancement in encouraging research in human-machine communication. This would bring more refinement in getting to know the purpose and requirement of any physical movement and speech utterance. The intelligent system is expected to decide and relate the gestures and facial expression for understanding the meaning. The fluency in conversation would be possible with the improvement in good performance models of human-machine discourse.
The appropriate placement of temporal and spatial knowledge contained in natural language, in the understanding of language by a machine, is critical in keeping the communication relevant to time and space. The researchers in artificial intelligence propose establishing a link between the real world and the linguistic information. A system capable of generating speech utterances would demonstrate understanding of time and space if the utterance carries the items for the semantic value in context of reason. The items for time in languages, for example in English are verbs and forms of verbs. The meanings retrieved from past tense convey the information that it occurred before the utterance is produced. Also for a future reference, it is announced that something will happen after the completion of the utterance. McDermott (1982) and Allen (1983) introduced reification logic in artificial intelligence to represent information about time in the intended language output.

The prepositions in English language indicate the information about space. The most influential work in this area was carried out by Herkovits (1986) who declared that prepositions could provide spatial information only in the context of communication. The later research contributions have suggested that spatial knowledge includes physical structure, nature, form and function of the objects involved and how well that knowledge is transmitted through linguistic items. Temporal and spatial knowledge integration in a system is generating interdisciplinary interest of researchers especially at the level of discourse analysis and pragmatics in human-machine communication.

### 3.5.1 Role of Gestures in Human-Machine Communication

In an audio-video integrative mode, the transformation of physical gestures into an understanding of natural language and then responding appropriately through a speech output is a matter of utmost importance for researchers in imaging a natural discourse between humans and intelligent systems. The technology of image processing and the probability relation of gestures with meanings in natural language is the future endeavor for the speech technology research. In fact, it is the success of
integrated technologies at the basic unit level, which would help in achieving the optimum performance by the speech recognition system.

Gestures are part of natural human communication. The understanding of gestures needs to be focused in human-machine communication act as humans tend to use gestures quite regularly as aid to the speech (Hauptmann & McAvinney, 1993). The advancement in 3D image technology and image processing has led to the developing interest in studying gestures as part of communication act in natural language understanding and generation technologies. The natural coordination of speech and gestures in human beings is desired to be replicated in the future speech systems. No significant progress has been seen in this area so far. It is hoped that the motor activity in robots like ASIMO (2007) and Kismet (2006) achieve the human-like coordination in speech output and gesture. The speech recognition system needs to work at parallel levels of getting the semantic value of the syntactic structures and the correspondence of the physical gestures to the speech input. The error free configuration of understanding of language from coordinated yet parallel streams of information through speech input and physical gestures pose a big challenge for the researchers. In cases where there would be a divergence in information from the speech input and the gestures, yet there is agreement at the semantic level, need attention of the researchers in the steps towards achieving the naturalness in human-machine face to face communication.

3.5.2 Role of Facial Movements in Human-Machine Communication

The processing of stream of images is the basic technology required for analysis of facial movements for speech recognition (Abry and Lallouache, 1991). The modeling of face and lip movement and its coordination with the gestures is a dream challenge for complete natural comprehension of human language. The capability of natural language understanding by a system through multiple levels of information would be one of the most encouraging steps towards achieving autonomy in communication in virtual environments. The natural language understanding and natural language generation system should be able to transform the coordination of facial movements and the utterances for a meaningful discourse. In non-verbal
communication, human beings use eyebrows, forehead, cheek movements, lip positioning, blinking of eyes and smile for conveying emotions, feeling and possible response to a situation. It is important for a speech recognition system to use image processing as decoding the meaning in human facial movements for emotions of pleasure, shyness, anger, surprise and displeasure.

The image processing is difficult for similar sounding phonemes such as p, b, m, which are bi-labial and they have the same formation of lips (Fisher, 1968). McGurk and MacDonald (1976) suggested that both visual and sound information synchronize for achieving an understanding of the phonetic sounds. There has been credible evidence that in systems working with both audio and visual modes of speech recognition, reasonable level of comprehension is achieved in a noisy background if the processing of visuals corresponds with the weak audio signals (Benoît, Mohamadi and Kandel, 1994). In connection to this, to get speech recognition from maximum available source of information about the intent of communication, a system for three dimensional model of lip movement was developed by Guiard-Marigny, Adjoudani and Benoît (1994) and three dimensional model of the human face was developed by Cohen and Massaro (1990). It is important to note that in speech recognition systems that synchronization of processing systems at both audio and visual level complete the set of information received from a human speaker. This technology has led to replicating features of human faces in coordinated speech outputs by robots (see for example Kismet).

3.6 Chapter Conclusion

This chapter focused on human imagination and fascination with machines and their possible role in the human society as individuals existing as equal partners. The machines are seen as something more than the helping hand, a possible partner in human social structure who can perform most of the human functions including the use of natural language as tool of communication. The chapter began with the historical perspective of machines used as toys and then the imagination of fiction writes for using these machines as enemies and friends of human beings. The cinematic presentation of machines and artificial intelligent robots is discussed to
show the human fascination with the idea of having friendly and non-friendly robots in the near future. This fascination in fiction and celluloid triggered some of the very important research projects in the field of speech technology which are discussed in this chapter to show that there is a factual feasibility of natural language processing and high speed computer systems can process and generate meaningful speech utterances in a real time zone.

The speech processing technologies have a lot of potential in the banking, tourism, industrial manufacturing, telecommunication, corporate, medicine, legal and consumer services sector. This discussion highlights the point that Pakistan needs to participate and contribute in this research area as this would be an integral part of the future business development sector. The discussion of speech technologies in this chapter, especially the section on synchronization technology of audio signals with image processing of facial features and physical gestures establish foundation of the discussion in the research for a complete human-machine communication act keeping in mind the linguistic and paralinguistic features of the human communication. This chapter makes the foundation for our discussion in the next chapter that speech technologies can be introduced in artificial intelligent or in other words ‘conscious’ machines to experience naturalness in human-machine communication through speech input and speech output.
END NOTES

1.  *Kismet* is humanized socialized robot, which can communicate with humans through voice, facial features, gesture and voice, can be accessed on http://www.ai.mit.edu/projects/sociable/kismet.html retrieved on July 5, 2007

   *Oxygen* is also a human-computer communication interface project, can be accessed on http://oxygen.csail.mit.edu/Overview.html retrieved on July 5, 2007

   Projects related to human machine communication are discussed in detail in Chapter 5.

2.  A detailed survey of language technologies was accessed on http://cslu.cse.ogi.edu/HLTsurvey/ch1node3.html#technology retrieved on May 01, 2005.
CHAPTER 4

ARTIFICIAL INTELLIGENCE AND NATURAL LANGUAGE

4.1 Introduction

Humans have seen themselves as a prime creation, skilled at solving the most difficult problems and learning through technical details to make the state of the art technologies. The attempt to create best of the best machines has led to the idea of such ‘intelligent’ machines that would be able to tackle its own technical problems. Would it be possible that the supreme creation of God, humans may create a super intelligent (in thought and action) machine that may become more powerful, smarter than the humans? As discussed in the previous chapter, human fascination with artificially intelligent machine goes way back to Frankenstein and the Stories of Oz to the presentation of Terminator and I, Robot in the Hollywood cinema. Murphy and Potts (2003) have discussed this issue with concern that implications of computers getting smarter and faster would be serious. If a smart computer could beat humans in the game of chess, it could be possible that a machine smarter than that could ‘think’ without the help of humans, programming their ‘thoughts’ (p 142).

While connecting technology with the intelligence, the major achievement which comes to one’s memory is the victory of IBM-Chess player computer, which defeated World Chess Champion Gary Kasparov in May 1997. However, in the last decade some of the questions are still lurking in the minds of researchers like: would an artificially intelligent machine be aware of itself as an entity? Is it possible for a machine, with the help of state of the art processors, to adjust its existence in time and space and do actions and show linguistic ability just like humans? Could technology think? And as we proceed with this study, Is it possible for a smart intelligent machine to communicate in logical reasoning with humans and other machines? The fifth chapter of this study intends to discuss some of the prototypes of computer systems
developed by MIT and Stanford language technology labs, which have shown encouraging performance in our endeavor towards human-machine communication act. In this chapter, a thorough discussion is intended to understand the issues related with technology and artificial intelligence.

Though artificial intelligence has not been able to fulfill most of its promises it hoped to achieve by 2008 and 2010, there have been important developments in the field to keep the expectation level still going. The attempts to create an artificial intelligent machine, which could use artificial intelligence for various functions, including the ability to use natural languages as tool for communication, is at early stage but it should not be ruled out (Bostrom, 1998). There is a futuristic stance that there is a possibility of an intelligent machine working on ‘thought’ and with the help of modern technology, computational modeling of human thought could be uploaded to a computer system (Graham, 2002). There could be possibility of creating an entire intelligence-artificial intelligence- that is external to human brain, as a thought process, calculation in systems is externalized in the computer systems (p 150).

4.2 Conscious Machines

Like some other terms, as culture, consciousness has become an interdisciplinary topic in the last two decades which is influenced by advancements in the field of neurosciences. Consciousness is loosely defined as a combination of sense of self, cognition, perception, creativity and memory. Various technologies like MRI (magnetic resonance imagining) and PET (positron emission topography) are used to study function of brain and its reactions to different incentives (Murphy & Potts 2003, p 144). It is hoped that one day the neuroscience industry would be able to solve the mystery associated with consciousness and human thought process.

Would it be possible to expect any creative idea put forward by a conscious machine? Also, would the conscious machine become smart enough to surprise with an unpredictable thought, concept or sentence? These are some of the questions which are inescapable in artificial intelligence research. The creativity in artificial intelligence means an idea which is presented in an unfamiliar way and an idea which
was never presented before. Linguists believe that human languages are an unending source of new combination of lexicon and syntax. Could that new combination based on the same old grammar rules be termed as creative? A native speaker may generate number of sentences but at what level, a machine or a system would achieve consciousness and self awareness to use natural language for sentence generation just like a native speaker? These questions establish the foundations of the speech technology research in artificial intelligence. It is difficult to anticipate creative and novel ideas in human beings. It is even more difficult to model human creativity in machines. There is still a sizeable amount of research required in this area but it would also not be right to term creativity a mysterious or incomprehensible thing. The researchers have been able to find out the conceptual spaces and that has helped in getting to know the transformation of the same in machines for a possible creative process.

4.2.1 The Ambitious Group

Pinker (1997) proposed a mechanistic model of mind which is greatly influenced by Alan Turing and Marvin Minsky. Pinker’s ideas compare human thinking with a kind of computation. In Pinker’s words:

The mind is system of organs of computation, designed by natural selection to solve the kinds of problems our ancestors faced in their foraging way of life, in particular, understanding and outmaneuvering objects, animals, plants and other people. (1997, p 21)

This ideology of evolutionary psychology is closely aligned with evolutionary biology, and is criticized by many scientists and cultural critics. Pinker believed that a ‘genetic’ program decided the processing of human mind constituted of ‘modules’. Steven Rose (2001) criticized this modular theory of mind by saying that in all the discussion related to module, processing, architecture, a very important element is missed in the whole debate and that is emotion. In his words,

the key feature which distinguishes brains/minds from computers is their/ours capacity to experience emotions. (p 261)
Gottfried Leibniz is considered to be pioneer in the field as he was the first one to present an idea that a machine could be manufactured which would use signs as way of thinking (Murphy & Potts 2003, p 148). For such a universal machine he proposed that mathematics could play the most suitable role of universal language. This led to the usage of binary 1s and 0s as the coded language for computers. By keeping this ideology in mind, everything cannot be categorized in binary opposition. There is little room left for the grey areas of understanding and of different customs and traditions of various cultures. Certainly a mechanical global perception is not acceptable to human beings from a potential computer system expected to show logical reasoning in thinking process and then express it through written or spoken output of human like natural language. The Turing test (Turing, 1950) developed by Alan Turing discussed possibilities for a machine to be intelligent but it struggled to satisfy many philosophers.

4.2.2 Anti-AI Thought

John Searle (Searle-Chinese Room, 1980) did not agree to the idea of a computer becoming an intelligent machine. On the other hand he discussed that the suggestion for non-biological unit to be intelligent is illogical. He believed that computers would never be able to even come close to human intelligence (Murphy & Potts 2003, p 151). His main idea is that the processing of information by a system cannot be taken as equivalent to the consciousness for being aware of the processing of information. Some anti-artificial intelligence activists have gone to the level of terming it as an immoral and anti-human idea.

4.2.3 Machine Consciousness

One of the crucial ideas developed in the late 80’s is that the pattern of information is more important than the carrier of the information. It suggested that brain and computer, two different objects could have the same patterns of information in their own different ways. The burning question that would it be possible to ‘upload’ human brain’s pattern of information and processes to a computer be possible? is still haunting the researchers and Transhumanists. Uploading of the brain would lose the
body that had the experiences of the world, so important for creating consciousness. The recent artificial intelligence research has followed the processing method in the neuron networks on small computing structures by establishing parallel connections. Minsky and Papert (1988) suggested that the replication of low level processes could be the starting point for the machines to attain the possible consciousness. This may generate another level of debate that such machines could be ‘conscious in what sense’? A more practical notion of such debate is that machines may experience some features of human intelligence and not all (Murphy & Potts 2003, p 154).

Hayles (1999) put a set of observations on artificial intelligence research. He pointed out that researchers select a human behavior, try to construct a machine infrastructure that can precisely replicate that behavior and then it is claimed that success in Artificial Intelligence research is achieved by creating machine copying human intelligence. The human intelligence is in fact the result of the combination of experiences of the world and the human emotions related with these experiences that help shaping the perception of the world and processes in the brain. This leads to the idea that the experiences of the world and its perception would be totally different for the robot as compared to the human beings. Also multiple technologies, depending on the objectives and functions of a robot or machine, could generate multiple kinds of experience and patterns of information. Varela, Rosch and Thomson (1991) suggested that human intelligence is process dependent on the experiences of the body. Cognition depends on the kinds of experience that comes from having a body with various sensory motor capacities (p 173).

Clark (1997) suggested that the world, body and brain should be seen as the contributing factors in shaping our understanding of the human thinking process. The more interaction with the world would have an increased understanding of the environment and that would increase the human intellect.

The media technologies in the modern world are considered another high impact factor for affecting the human intelligence (Tofts & McKeich, 1997). For developing the technological consciousness, Tofts suggested,
As cultural technology, the computer stimulates the working of the psyche. A screen receives as well as displays latent data as manifest information; multiple drives and processes scramble and unscramble the unintelligible babble of digital code; the whole process is controlled by the all-powerful central processor, the electronic ego- I navigate therefore I am. (21)

The advanced computer technology is affecting the human cognition and intelligence and vice versa. The interrelation of technology, culture and thought is critical in developing an understanding for the machine consciousness. While computers simply retain programs and processes for large database and then facilitate in retrieving the required information, the human mind relates to the world in a creative and unpredictable manner (Rose, 1992).

... Each time we remember, we in some senses do work on and transform our memories; they are not simply being called up from store and once consulted, replaced unmodified. Our memories are recreated each time we remember. (91)

Rose agreed to the fact that in modern times there is 'powerful interaction of our technology with our biology' (95). The machines could have a strong memory base and access to large database but humans were different as ‘only humans have a history’ (326). One of the most comprehensive debates on computer technology, consciousness and cyber experience is done by Turkle (1995). The interaction of human and intelligent systems in virtual environments creates an experience which is unique and unparallel to any other explanation of nature of reality, sense of self and the other.

The design approaches in robotics have experimented with different sets of schemes as making the robots as affective interactive systems with the facts around them. A robot system was proposed in 2003 by a team of researchers which knew what it was doing and which could reflect on its past experience and apply to that information/knowledge on the new patterns of situations. This was termed as cognitive robot (Kawamura et al., 2003). In 2004, the same group proposed a working architecture of a cognitive robot with three levels of memories for a humanoid robot:
the short term memory, a fairly reasonable long term memory and a working memory system.

Earlier, models for practical working solutions for robots to have human consciousness for practical work were suggested by Haikonen (2003) and Holland (2003). Haikonen (2003) presented a structure and suggested that it was essential to test some functions of the proposed conscious machine before modeling human conscious system in a machine. This step by step approach would lead to getting to know the answers of difficult questions in expecting consciousness, emotions and feelings in a machine. Franklin (2003) suggested that a multi-agent approach could explain the complex question for consciousness in machines if we were to expect emotions and cognitive ability in a machine.

The growing consensus among researchers in the early years of twenty first century concludes that there is a practical possibility of creating a machine with some level of consciousness, to know that it is a machine and to act and react to number of different situations with self consciousness. Aleksander (2001), Taylor (2002), Franklin (2003) and Baars (2004) agree to the fact that the creation of a memory based scheme of consciousness for machines to be intelligent is possible and certainly the need of the growing technological advancement in the computer systems (hardware and software).

The thought process in human beings involves the careful calculation of the present circumstances and the inference drawn from the past experience. These streams combine for a possible action, inaction or emotional behavior in challenging situations (Botvininick et al., 2001) and (Macleod & Sheehan, 2003). For machines to be conscious, a model of human-like behavior requires these stages of actions or inactions including deliberation of the past experience or quick reaction to a stimuli. Also the behavior pattern of the machine had to be in accordance with the requirement of the task or objective of the situation. The researchers in field of human cognitive ability like O’Reilly et al., (1999), Braver (2000) and Greenfield (2000) suggested that as humans have the working memory for cognition to deal with new situations,
the machines could have the ability in performing human-like cognition if they have a central system for cognition.

Taylor & Fragopanagos (2004) completed successful tests on a system that took inference form the human behavior for actions in situations. The reference to experience and emotions play a significant role in human decision making and thinking process. The proposed system could refer to a set of human behavior in the required situation stored in the working memory and then measure the application of specific job in connection with the expected behavior. Therefore, the implementation strategy of processing of emotional stimuli in robots is getting authentication in recent international conferences and robotic competitions. The researchers in the field of robotics dream of achieving excellence in state of the art human adult-like intelligence in machines and systems.

4.3 Artificial Intelligence

Artificial intelligence (AI) is defined as a branch of computer science which deals with the manufacturing of computer systems that have the capacity and competence of human like behavioral intelligence. That is, such computer systems are able to reason, solve problems, learn and act, understand and use language as a tool of communication (Barr & Feigenbaum, 1981). The revolutionary technological advancement in the field of digital computers has contributed a lot in the development of the field of artificial intelligence. The state of the art expertise in computer hardware and software technologies is the foundation to any framework of research in artificial intelligence. Thus, other disciplines which are not directly related with computer science have to rely on the successes of AI researchers for integration in their own field, like linguistics, for an integrated approach in research. The areas of research in the field of artificial intelligence can be categorized in the following seven major areas:

1. Representing Knowledge (including self, task and the world around it)
2. Natural Language Understanding
3. Skill Acquisition
4. Task Planning, Solution Design and Analysis
5. Reaction/respond to complete or incomplete stimuli
6. Quest
7. Visualization

The focus of this research is to examine the contributory effect of artificial intelligence and allied technologies in natural language understanding and natural language generation technologies. The synchronization of audio-visual signal processing with speech input comprehension and speech utterance generation is the major areas of research for the researchers in artificial intelligence interested in a sustainable, reliable and meaningful communication act between humans and machines.

4.3.1 The Quest for Artificial Intelligence

The history of artificial intelligence started with an attempt to design machines which could think like humans and which could surpass human cognitive abilities in certain fields. The earlier created hype in this field of study had some earlier failures as well, which helped the researchers in carefully investigating the problems of the contributing fields, thus making it an interdisciplinary approach in artificial intelligence research. The problems faced by artificial intelligence have a background in some of the philosophical problems. The relationship of objective knowledge with abstract knowledge, the relationship of practical knowledge with previous knowledge in mind and the state of consciousness are some of the similar issues of philosophy and artificial intelligence and this philosophical framework may help understanding these issues better in the artificial intelligent models (Sharoff, 1995). If a system is able to retain the knowledge of practical experience as part of its history, there may be a possibility for it to understand its history and then it may influence its actions or reactions. This may create the possibility of internal time flow in the system resulting in achievement of some level of consciousness.

The contribution of computer science and artificial intelligence in developing our modern knowledge base about working of mind and reason cannot be neglected
(Rieu, 1995). The emergence of disciplines of artificial intelligence and computer science has generated the need to make a clear statement of difference between the intelligent behavior and the existence of thought of being intelligent. An intelligent object taking the intelligent decision at the required time, when there is a change in situation, is called intelligent because its intelligent decision is the product of the process of intelligence. The discussion of introducing intelligent behavior as a result of intelligent thought process is the core of modern day research in artificial intelligence.

By placing humans in comparison with the machines, it is noted that there are things in which humans show better performance than machines, similarly there are some other areas where machine surpass human capabilities. But does that mean that any of the above could be a replacement for the other? The expectation from systems to act more like humans and at times better than humans has led to the urge of improving the technologies at much faster pace than, perhaps may be required. We have generally agreed that systems can handle complex calculations more smartly than humans. In the human history, the developments of intelligent systems are one of the most ground breaking initiatives in technological revolution.

4.3.2 Historical Perspective

The history of AI research is interesting as it had many ups and downs. The important milestones in the history of research in artificial intelligence are briefly described as: Alan Turing’s paper on “Computable Numbers” appeared in 1936 which created awareness about artificial intelligence. In 1942, Isaac Asimov’s book *I, Robot* discussed three laws of robotics. Claude Shannon published his analysis of Chess playing and search process in 1950. In the same year, Alan Turing suggested Turing Test which is still considered as the yardstick in artificial intelligence research. The term ‘artificial intelligence’ was first used by Joan McCarthy in Dartmouth College in 1956. The same year the first artificial intelligent program, Logic Theorist, was presented by Allen Newell, Herbert Simon and Cliff Shaw at Carnegie Mellon University. Also in 1956, at the Los Alamos National Laboratory, Stanislaw Ulam developed the first chess program, Maniac I, which defeated a human being. The
world’s first chatbot was developed by Joseph Weizenbaum at the MIT in 1966. Movement and problem solution was combined in a robot developed by Shakey in 1969 at Stanford Research institute in California. In 1982, the Japanese Fifth Generation Computer project developed a large network of computers to establish a new understanding of artificial intelligence. The middle of 1980’s contributed in developing neural networks for advanced research in artificial intelligence. In 1997, a critical goal was achieved in the research when a computer systems defeated the then world champion Garry Kasparov. In 2001, an unmanned plane used artificial intelligent navigation system to complete successful flight from California to Australia.

In the 1960’s and 1970’s, big claims were made by some scientists, which could not match the real achievement test. Such examples led to misconceptions about the artificial Intelligence program and put a question mark on the prospects of funding to research. Patrick Winston (1987) discussed the early predictions of artificial intelligence researchers that the computer system would match human intelligence:

In ten years, they will be as smart as we are (p 2-3)

The hopes like these were called romantic dreams as 1980’s did not see any major achievement in artificial intelligent research. But these propositions were not made by mad people. This is a real possibility and the robot research in Japan and USA encouraged the artificial intelligent researchers to work for artificially intelligent machines.

In 1982, the announcement of the project named Fifth Generation of Computer Systems by Japan’s Ministry of Trade and Industry focused on developing parallel computer networks that could deal with new levels of artificial intelligence. The project was given extreme importance and it received lavish funding. Fearing the future hegemony of Japanese research centers the US government established a consortium of American corporations including the market players like Kodak and Motorola companies and set up Microelectronics and Computer Technology Corporation (MCC). Another massive effort was carried out by Pentagon to establish
Defense Advanced Research Projects Agency (DARPA). All of these hugely funded projects could not show steady and notable progress.

The early 1990’s was the time when there were huge funding cuts and some of the projects were shelved for the reason that an increasingly notable number of scientists were not pinning their hopes on the success of the projects concerning artificial intelligence. There was feeling that the whole thing was hyped up and exaggerated to be a fable. There has been a heated debate among scientists and researchers about the idea that what exactly can be performed by a human can be exactly modeled by a computer. The consciousness and self-awareness of the human beings were seen as the unique attributes which could not be generated in computers. The disagreements on the capacity of a machine to behave like humans with ‘wisdom, emotions and experience’ are also a challenge for researchers. Another group of scientist argued that would only a human behavior be considered model for an intelligent machine? as some of the animal behaviors, like in ants, are intelligent but not human like. The repeated failures of some of the main projects encouraged agencies to withdraw support. On the other hand, this led to an increasing interest of researchers in the subfields of artificial intelligence, instead of looking at it as a single discipline. The development of neural networks was an important step as it had the potential of learning from its mistakes.

The fragmentation of artificial intelligence into various sub disciplines has benefited the overall research work, making it seem more possible. As discussed earlier the seven major areas of research in artificial intelligence have their own specified problems, solutions and goals. For example, the research in the areas of vision, voice recognition, natural language understanding, natural language generation, movement control and gesture control are the key sub areas of research and solution design for a viable and sustainable communication act between human beings and artificial intelligent system.

Over the years a large group of researchers of artificial intelligence have visualized, modeling human behavior in machines as the ultimate goal. In this regards, Turing test was always seen as the yard stick. There has been a change in the
perception with the passage of time. The last decade of the twentieth century saw small but more focused and goal oriented projects which built the trust of the funding agencies in the projects of artificial intelligence. Now we see the technology of artificial intelligence used in credit cards, speed cameras, number plate recognition and air traffic control and transport navigation.

It is interesting to note the fact how humans have imagined artificial intelligent objects to behave and react in a situation. It is assumed that they will react ‘naturally’ in situations through physical or verbal response what appears to be ‘natural’ to us as human beings. This assumption could be misleading as our action or reaction is the product of our perception, experience, thinking and self-awareness. Human beings are complex in their form and their personality. The duplication of human behavior in artificial intelligence does not necessarily mean the modeling of all negative and positive traits of human beings. Probably, it would be a farfetched idea to think of artificial intelligence, which would ‘automatically’ have the qualities of complex human nature.

4.3.3 Artificial Intelligence: issues and challenges

The parallel streams of research endeavors in research in artificial intelligence have their own sets of challenges. The biological stream, which wants to represent human physiology and psychology (Dennett, 1998) in the artificial intelligent systems and the other stream of representing knowledge of the world as common sense facts (McCarthy, 1989) in intelligent computer systems, have yet to achieve the ambitious goals of the two approaches.

Artificial intelligence is stereotyped as machine, for people to expect that it would behave and react like a machine or Windows 2007. It would not have a machine like a microwave oven which has no sense of its existence and cannot assume anything for its creation. On the other hand, it is anticipated that a true artificial intelligence would have self-awareness and knowledge of the purpose of its existence. Another stereotype among human beings is that a future anticipated artificial intelligence would comply with the norms of obedience to human
commands. This point needs clear understanding that if a true artificial intelligence is to be created, it would not be created as a tool. Such would be intelligent enough to get to know the purpose of its own existence and decide for solutions which would be considered out of the box (not programmed by the developer). It is important to distinguish between programmed intelligence of machines in a car factory and artificial intelligence. Would all cars be painted white or the ‘choice’ is left open that some cars could be painted white, others green, some red and some others could be painted blue. The question is that would the artificial intelligence have the cognitive ability to learn and decide on its own? The researchers have yet to develop systems that can solve this problem of learning capability of artificial intelligence. For a programmed input that roses are red, it would be important for artificial intelligence to learn that it could be white, yellow and pink.

The ambitious research goal in artificial intelligence is to create the system which ‘knows’ that milk is of white color but it can have different colors if chocolate syrup or strawberry mix is added to it to give it a different color. The ability to adopt and adapt to changed situations and probabilities and to rectify any misperception is considered as the goal of artificial intelligence to claim cognitive ability. This process requires an exercise in self awareness and self reliance. The possibility of complex structures keeping a sustainable support to artificial intelligence for inference and database are visualized as key features of a ‘thinking’ computer system.

The future research in artificial intelligence may take even longer than the expected time for some of the researchers to have intelligent computer systems in close coordination with the humans and working independently as task oriented objects. It is also acclaimed by some critics of the artificial intelligence that none of the present systems have the potential to grow as complete artificial intelligent computer systems. This view should be termed as strictly conservative as some of the projects like ALICE and Kismet (2006) have the potential to be refined as truly artificially intelligent that can communicate independently with human beings. The kind of fast paced advancement, the computer technology has made in the recent years, it appear all the more possible to create artificial intelligence in the world of cybernetics, virtual reality and internet. The increasing computing power has
accelerated the solution of difficulties in handling large databases and data processing. Do we anticipate issues like dominance, co-existence and obedience? This depends on the rate of success in the research in artificial intelligence.

The present day research in the field of AI is comprised of computer experts, working in close association with the experts in the field of social sciences, linguistics, humanities, logic, mathematics, philosophy, psychology and other related disciplines. However, it is interesting to note that theories and philosophies in the disciplines of humanities and social sciences do not relate to the scientific paradigm of computers. For example, an idea of uploading human mind to a computer system or in the body of a robot may not seem plausible to some of the social scientists in the domain of theories related to mind, consciousness, human thinking and observation. There needs to be some meeting point where both of these can integrate and incorporate ideas for a humanlike robot to have intelligence and performance ability and an ability to realize it’s self as an identity. In the last two decades, there has been great progress in developing intelligent machines either with the kind of computer software support systems for law experts or experts in the field of medicine to generate and process large amount of text and database or robotic arms in the assembly line of mechanical and industrial units. The progress is largely seen as an aid and assistance to humans. There is still time before we can expect a robot, working on its own without the guidance of a human and interacting with humans independently with logical reasoning.

4.4 Artificial Intelligence and Natural Language

The comprehension and generation of human language by an artificial intelligent machine has been a topic of keen interests for linguists and computer experts for a very long time. Descartes could not think of any explanation of human language on mechanical principles. Alan Turing’s Turing test (1950) was landmark concept in developing understanding of language as a computable act. In the 1990’s, speech recognition systems achieved practical success when United Airlines replaced its keyboard system with system which responded to queries of flight names and numbers and city names in a flight inquiry system using speech recognition.
technology (Artificial Intelligence Applications, 2005). Computer experts put in a lot of hard work in developing programs that could understand natural language and then produce text or speech output that could relate to the original query. The research objective for future research in this area is to achieve the natural ease in the use of language by the smart machines as used by human beings. Natural language processing in artificial intelligence moves beyond parsing and corpus analysis of language as mostly done in computational linguistics. It involves the integration of computer memory with the rules of discourse relevant in the context of human-machine discourse with an accelerated ability of minimizing ambiguities and self-correction. The current research in the area is directed towards semantic networks for representing knowledge. This is to keep both syntactic and semantic value of utterance intact for natural language processing.

Artificial intelligence has taken a distinctive angel from the traditional notion of expecting a machine to act, ‘think’ and speak like human. It anticipates a computer system to reason, learn, apply skills in problem solving and establish communication skills in contextual framework. The need and practical assessment of different products in corporate, security, health, education and industrial sector has created room for more commercial uses of artificial intelligent systems. The consumer support systems developed in telecommunication, banking, finance, health and business management systems have created immense opportunities for researchers and investors. There is hope that this new angel in AI applications for consumer is the direction which may lead the AI research towards manufacturing a machine, which could act, ‘think’ and speak like humans.

By focusing on earlier human fascination with a machine performing human like functions, can it be expected that such a machine would relate to language, reactions as a result of any action and decisions for doing or not doing an action in a vacuum or space? The social placement of such a machine is much larger an issue than just expecting to make a decision ‘to speak or not to speak’. The evolution of human mind and perception is directly dependent on human knowledge, its environment, social condition and series of experiences in a society. The combination of all these contribute in developing a realization of self and individual role in a
context of situation. Taking inference form this, it can be safely concluded that an artificially intelligent system cannot afford to simply focus on state of the art software for a robot. There has to be some way to enable the machine to realize itself as a machine for the social context of an artificial intelligent system. An artificial intelligent machine may function properly only, if there is a social dimension integrated in the system. That is, an Artificial Intelligent systems needs to have social association to act like human. Is it practical or a foolish idea? This can only be examined with the help of prototypes developed in the last ten years, from 1996 to 2006 (discussed in detail in Chapter 5).

This discussion leads us to the questions: what kinds of processes are involved in human thinking process and perception? How do humans perceive the outer world and how does it affect the human thinking for decision making? How do humans develop concepts? How do these concepts affect the perception and thinking process? Is there a difference between concept and habit? Can thinking be based on purely the reality without being tainted by one’s perception and concepts? These are some, if not all, of the fundamental questions for anyone thinking of building a computer system that can ‘think’. The ability to think is secondary to the ability to perceive. Would a computer system be able to perceive and then based on its concepts would it be able to think? Including the perception, thinking process also includes socio-cultural dynamics. Would it be possible to enrich a computer system with the cultural and social dynamics, if there has to be a logical reasoning in human-machine communication act?

Social interaction seems to be an integral point in this discussion as human reactions and perceptions are related to the social group behavior. This kind of activity is an urge to be related to some person or group of people for self awareness. Human behavior shapes up during the communication act, interaction, business activity, learning process and community experience. The unpredictability of social life leads humans to different kind of learning which may not necessarily be based on the perception. The cultural orientation of an individual, understanding of customs and traditions and adherence to them is another critical area of the development of human thought. All of these correspond to the realization of ‘self’ as an individual.
This ‘self’ is the individual behavior which can also be termed as personality, constituted of mood, style, posture, gestures, conduct, facial expressions and attitudes. This results in shaping of human character and provides a human with a distinctive identity. This point of reference is critical for any ambitious research project which aims for an artificially intelligent system to ‘think’ like human. There has to be serious discussion in this regard for understanding the socio-cultural aspect of an intelligent machine. Would such a machine be able to realize itself as a distinctive unit and allow itself the luxury of having a ‘personality’, without placing itself in a socio-cultural context? Languages play a vital role in the thinking process. Languages are a tool of communication and they are loaded with social and cultural context of the speech community with layers of meaning. So for an idea of an intelligent machine, producing meaningful utterances in a logical human-machine communication act is only possible, when the utterances are just not syntactic-lexical patterns, but also colored with socio-cultural context and meanings (Fodor, 1981).

It seems important for researchers in the field of artificial intelligence to take thinking as processing of information, broadly as participatory communication act, which is a shift from its existing pattern of taking communication act as input and output activity in human-machine communication. As discussed above, thinking as an act itself may not necessarily require socio-cultural dimension, but when it has to integrate the communicative aspect of human behavior through language, socio-cultural understanding becomes vital for thinking process used for logical reasoning in producing meaningful utterances in a communication act. Would researchers be able to add social element in the development of computer software? This appears to be a major challenge for this research area.

Traditionally, the researchers of artificial intelligence associated it with the process of cognition that could be examined separately from the biological form in which it is contained. But as we discussed in the previous paragraph, the approach of AI researchers has undergone a major shift since the early 1990’s. It has been seen with interest, how the computer experts have struggled with the understanding and modeling of life on computational grounds and perceiving human intelligence in the framework of computational patterns. Computation could be used as modeling
technique for humans and computer systems but it may not be possible to equate both just because both represent a kind of process. Humans have entirely different process of thinking and associating self with surroundings. Could it be modeled on computer systems? Could there be another process through which computers could ‘experience’ and exist in an unpredictable manner? What is the possibility of biological models of computer and how would it affect human perception of race, tribe, economy, nation and gender? These questions for the present day AI researchers are the foundations for any further research in artificial intelligence and artificial life. Also the implications of such possible intellectual units on politics and global economic patterns are yet to be examined.

Artificial intelligence is interesting combination of fields of inquiry which look for possibilities and potential prospects of what it takes to be human, the parameters of technological interventions and their possible extension and the limitations of smart computer systems. It is firmly grounded in the real, practical world and it keeps it option open for future possibilities. One of the important experiments, which could be taken as the starting point for research in artificial intelligence in manufacturing systems for human-machine communication act, is done by a student in Austria. The project called ‘Neuro Baby’ is computer software that can detect stress and tone of human voice and the corresponding features are reflected on computer screen (Naoko, 1993). There is longing for big breakthroughs but these small achievements are crucial for laying the foundation stones for future endeavors.

It is hoped that artificial intelligence research can achieve the ultimate goal of developing systems that can communicate with human beings in natural language through speech and written form would give a boost to the research. The programs that have shown satisfactory rate of performance still have either the syntactic constraints that limited number of sentence structures can be processed, or they have semantic constraints that they can cater to limited number of meanings of sentences. Some of the systems are available in the market, like ALICE, but the required fluency in structure and understanding of layers of meanings with limited number of
ambiguities in utterances is still an important area of research for artificial intelligence.

Research in the field of developing strong relations between computers and natural language started as soon the computers appeared in the market in 1940’s (Bott, 1970). The early ideas of machine translations did not find appreciation because many unforeseen problems appeared during the research process. This increased interest in the natural language processing led to the focus of artificial intelligence research in natural language understanding and natural language generation, that a machine could understand the meaning of a written or speech input, reply to questions about it and then eventually summarize or paraphrase an utterance which is syntactically appropriate and meaningful. The research trend in the last two decades is focused on natural language as intricate cognitive ability build on knowledge of different kinds including common interest, common world view, syntactic, semantic and pragmatic framework, rules and turns in conversation and situation (Barr, 1980, 6). The decision making by the artificial intelligence for the right utterance at the right time and in a right way would be possible with the advancement in computer processing speed of large database. The researchers hope to achieve a better understanding of computer based models of natural language processing for a more reliable human machine communication act.

The earliest of natural language processing programs were limited in approach and had constraints due to small database and processing speed. They dealt with a limited discourse of simple declarative and interrogative utterances and failed to meet the challenges of solving complexities of language (Barr, 1980, 6). Simmons (1966) developed PROTOSYNTHEX-I and Quillian (1968) developed Semantic Memory and both are considered the first major attempts for natural language processing text in databases and implying smart indexing techniques to retrieve information. These were essentially text based systems and had serious constraints in reacting to any stimuli for something which is not present in the memory. These systems struggled with semantic approach in data processing. Later on the research focused on developing systems based on knowledge representation as we saw in the artificial intelligence. The semantic networks and frame were considered vital for a natural
language processing program. The theory of generative grammar (Chomsky, 1957) also had its impact in the research of artificial intelligence for computational linguistics. In language processing programs,

the grammar is used in parsing to “pick apart” the sentences in the input to the program to help determine their meaning and thus an appropriate response. (Barr, 1980, 7)

William Woods’ LUNAR was one the first programs in 1970’s which addressed the problems of English grammar. Woods (1973) used large database of NASA for answering questions about the rock brought from moon. He used a program called procedural semantics to get the right response for every query put to the system. Winograd’s SHRDLU (1975) had a system of using natural dialogue with some reasoning ability in a human-machine communication act. This program could ‘converse’ about colors and shapes of blocks and it could respond to simple questions about blocks. This program had a great influence on the later research which led to the development of later ideas in artificial intelligence in natural language understanding and natural language generation. However, its success could not generate the rolling affect in the natural language processing research in artificial intelligence. These programs were based on dealing with the utterances and lexicon at the level of meaning and then building on meanings for a meaningful and appropriate response.

Minsky (1975) proposed an important idea of using ‘frames’ in natural language processing. The grouping together of small sentences, situations, utterances, simple and complex objects, history, chronological order of events and situations and the form and manner of the dialogue is analyzed by continuous referring to the prototype frames made available in the database. Schank’s SAM (1977) and Bobrow’s GUS (1977) are the frame based natural language processes that rely heavily on the database for the output in speech and written text. They tend to rely on the notion that these could be the maxim level of possibilities in a given situations. In such framework, they attempted to provide the best possible response to a script writer and a traveler who is planning his next flight. The real challenge for such systems was the unpredictable or a situation or sentence that is not available in the prototype frames.
To clarify any ambiguity or false response, the systems attempted to look for the closest in reference to the required output. This is considered as the first step in moving towards modeling of human language in artificial intelligent systems. Human beings use incomplete sentences and short phrase which have meanings in the given situations. These systems attempted to respond to utterances which were not expected and then on assumptions and expectations of the closest possible relevance, appropriate responses were generated. The present day artificial intelligence research in natural language understanding and generation has taken a big forward leap. The assumption and expectation has changed into focused and goal oriented database processing with the increasingly minimal ratio of ambiguity. The natural language generation systems know what they are saying and why they are saying it in response to a speech or written input.

In human-machine communication act, judgment of correctness of structure and semantics is not the only criteria for testing the appropriateness of the communicative behavior. In Artificial Intelligence research, there is understanding of the potential to keep the options open for ‘creativity’ in the communication pattern. It is important that a human-machine interaction should incorporate features like mood, tone, humor and sensitivity which are integral part of human communication. An intelligent machine cannot respond smartly to human utterances if it is unable to adjust to reactions and responses which are dependent on features stated above. The acceptance of these attributes of human speech act would help computer system to be more sensitive to communication act and to appear less, machine like and more human like.

From keyboard to touch screens to speech recognition, the human computer interaction has evolved greatly. The developments in the technologies of natural language understanding and natural language generation have made it much easier to perceive computer systems more than just dumb machines. The change in machine like tone of speech output from a system would also help in changing human perception for expecting a logical utterance by the machine. It would be interesting to note the way human-machine communication act develops. The positive potential of computers adjusting to human reactions, showing expressions or producing utterances
to the smallest of actions, moves or sensory feeling are enormous, keeping in mind the present day artificial intelligence research. The form of human-machine communication act is affected by the way humans and machines respond to each other’s appearances and inputs other than utterances.

Another important area for artificial intelligence in human-machine communication is the possibility of being creative in speech input and speech output. The earlier models of machine speech were confined to restricted syntax and lexicon. This could only cater to restricted input to the system. The variety in speech with different sentence structures for the same meaning or different meanings of same the utterance through stress and intonation would increase the communication area of computers. The variations in synonyms have to be adapted by the computer system to retain the flavor of the language in different situations. Stephen Wilson’s (1995) article titled *Artificial Intelligence Research as Art*, discussed this point as a critical thing in human-machine communication act,

There are understanding computer programs that reduce all mentions of humans consuming solid nourishment (eating) to a primitive internal concept. This strategy allows the programs to proceed with following stories and making inferences about meanings. Humans, however, do not just eat in one way. Sometimes we, gobble, glutonize, devour, gulp, nibble, sample, gnaw, feast, and savor and so on. ............ Connotations are as important as denotations. (Wilson, 1995)

So the shades of meaning associated with lexical items have to be understood by speech comprehension system in the appropriate context. The future of artificial intelligence research in human-machine communication patterns rests on the adaptability of computer programs to both linguistic and paralinguistic features of human speech act. As discussed earlier, the gestures and physical movements of individuals affect the response-speech output- and its processing is essential in expecting a human like response from a machine. The synchronization of audio and visual receptors of computer systems is vital in dealing with human movements and facial expressions along with the stress and tone patterns in human speech for understanding and processing and then generating a logical response to that.
The natural language generation in artificial intelligence had its own challenges. The earlier research work was focused on natural language understanding. This was done in good faith with reference to developing computational framework as computers could only get ready to say something when they really knew what they were been asked to say. Danlos (1987) put an excellent effort in clearly distinguishing the linguistic basis and artificial intelligence research problems in natural language processing with a clear focus on natural language generation. While discussing the linguistic basis of text generation, she suggested a methodology to produce utterance of a semantic representation with a reason and function of that utterance. Danlos viewed two decisions as imperatives for a system to generate language:

a) Conceptual Choice, to decided about the sequence of required information, the form and manner of the utterance and

b) Linguistic Choice, selection of syntactical structures and lexicon.

Danlos (1987) insisted that these decisions are related with each other as a level and form of information would be directly related with the selection of lexicon and syntactical structure in a natural language generation system. She suggested that an artificial intelligent system should have the capacity to decide for conceptual and linguistic choices in the context of speech act.

4.5 Working with Speech Generation System

Speech in human beings is essentially a cultural instrument. In the human communication patterns, speech is flexible with a number of varieties, for example talking to infants, young children and pets (Fitzpatrick, 2003). A number of projects working on robot speech technologies are working on different models of speech for syntax and lexicon with reference to the functions and objectives of the robots (Roy & Pentland, 2002). In constructing a hands free interface with a computer systems or robot, speech is the best form of communication. To start with, a high quality audio receptive system consisting of very sensitive microphones and audio system is mandatory for a state of the art speech recognition system. Even if a wireless audio system and microphones is used the distance of the microphone should be appropriate to avoid any noise disturbance. Since the motor infrastructure of robot, in its head,
ear, eyes and face create a lot of unnecessary sound (as in the case of Kismet robot), it is not practical to have an audio receptor on the robot or system. If the background noise can be minimized or the noise of robot motors or system can be controlled to a non-disturbance level, then a microphone on the system could be helpful in creating natural communication feel when the voice of human being would be loud or low when coming close to the system or going away from the system.

The speech recognition capacity of the system increases with access to large database of lexicon as multiple word sequences become possible. This is dependent on the use of the system in specific situation. A weather inquiry or flight inquiry system would handle world sequences with less number of lexicon list (Zue, et al., 2000) as compared to a natural human conversation system like Kismet (Varchavskaia, et al., 2001). In beginning conversation with a robot, infant speech is modeled as the source of inspiration. Infant speech is considered to be of short utterances (Werker, et al., 1996) and it does not contain large portion of words used in isolation (Aslin, et al., 1996). Later on experiments conducted by Brent & Siskind (2001) suggested that the use of single words may help infants in word acquisition. Another quality of infant directed speech is that words are often repeated quite a number of times. In a speech recognition system, the repeated articulation of single words suggests that there may be a misunderstanding on the part of the system and the error should be rectified as soon possible (Hirschberg, et al., 1999).

The system may have the ability to add up the lexicon database during the repetition of single words or the words which are not in the database and the system stores the phonetic quality of the words in the system if the range of words is less than the required in the communication (Fitzpatrick, 2003, p 120). The system then allocates a unique value or feature to the lexical item in the database in conformity with the phonetic value of the word. As discussed earlier, the speech recognition is the basis of speech generation system even though both technologies have their own sets of issues. The speech generation by a system deals with the conversational aspect of the social structure, we believe that one, intelligent machines would be able to be a part of.
4.6 Chapter Conclusion

This chapter discussed in detail the issues related with the possibility of intelligent machines using natural language as a tool of communication with human beings. The idea of consciousness has been debated by philosophers and theorists in the history in quite detail and the emerging scenario in this chapter seems to suggest that human consciousness and intelligence is directly related to the human experiences in the real world and social and cultural structure of the human society. The machines would require the experience and the perception of the world for self awareness if they have to achieve a human like intelligence. As discussed in the chapter, most of the research in artificial intelligence in machines has focused on imitating selective human behavior.

In the Pakistani perspective, the research in artificial intelligence is restricted to very few research institutes of Pakistan. The research projects are driven by the requirements of the defense organizations and there is no evidence of a Pakistani research project in literature related to artificial intelligence dealing with the natural language technologies and more specifically dealing with the speech comprehension and speech generation technologies.

The recent developments in the field of natural language processing are the result of human efforts to create machines which can communicate with human beings in a natural way. The debate at the end of the chapter highlights the fact that artificial intelligence research in natural language has achieved a stage that a large database of lexicon and syntax of natural language can help in speech input comprehension with minimum rate of error and speech generation with high rate of efficiency. This would also facilitate the comprehension of pragmatic and semantic value of lexicons and phrases in a given situation by the artificial intelligent machines. The discussion of the natural language speech technologies in the chapter three and then evaluation of the possibilities to have conscious machines to use natural language as tool of communication in this chapter provide the foundation of our discussion of the future developments in spoken language systems and the innovative ways of communication between humans and machines.
CHAPTER 5

VIRTUAL WORLD AND ROBOTS

5.1 Introduction

The word visualization has got popularity due to the advancement in the field of information technology in the recent years (Tufte, 1990, Lanham, 1994 & Brown et al., 1995). This word refers to the visual representation of the words and phrases. A growing trend in cyber world and the virtual world is to use computer graphics for images and for image representation as a contributory tool in communication using natural language. This chapter deals with the description of some of the practical prototypes used in the mass communication, business, entertainment and the corporate world as effective tools of communication software for human machine communication. This chapter also deals with the description of Kismet (2006) and ASIMO (2007) robots as examples of programs capable of sustaining an independent communication act with the human users. This chapter provides an extensive discussion on the success stories of speech language systems.

5.2 Virtual World

The fast growing electronic culture of human-machine interaction has taken multi levels of changes in shapes and forms. The cyber culture has offered a new definition of the pronouns, I, We and Them. The virtual world imagines the realities and the implications of these human-machine interactions in a world which is beyond human experience and at the same time a part of technology driven human social environment. It is interesting reality to think that the growing use of internet and experience of cyber world has made human beings more secluded in the their personal environment and personal/individual communication act and at the same time the opening of the world in a small screen and box resulting in possible interaction with the whole world has increased the potential of human-human interaction and human-
machine interaction. At times it seems a frightening idea that in the age of artificial intelligent machine, how would human experiences be communicated or expressed in the cyber world when these machines may only know about the human experience and not exactly have ‘experienced’ the human experience of socio-cultural and educational values. A large amount of data available on the internet is impersonal. The data concerning education, business, entertainment and knowledge engaged with virtual personalities capable of intelligent engagement with other virtual personalities and human users interact to form a virtual culture or cyber culture (Morse, 1998).

5.2.1 Communication in Cyber World

The internet technology engages the user in a personalized and interactive manner that it may end up in getting complete profile information about the human user. The personal history of credits, taxes and accounts (through any credit card transaction), personal profile (family history and personal life experiences and pictures as may be available on blogs and Facebook), information about the social space and networking and the number of hits on particular websites are the source of information available to a program to get to know a human user in the cyber world. The human-machine communication act on the internet is multifarious in its opportunities and challenges. The webcam chat with chatbots (a chatter computer program with a possible 3D graphic of a male or female figure) is the communication in natural language when the computer system gets quick information about the user in seconds and deals with the conversation in the particular context of information. This is what we can call a mixture of a real and the cyber world when human attributes of personality and individuality may be attributed to intelligent machines and systems whose communication with humans is based on impersonal database which has little reference points for sharing the human knowledge through experience. This suggests that the computer program in the virtual world could safely use the pronouns I and You in the discourse when the cyber world provides an interactive forum for machines and humans to believe that whatever is ‘spoken’ is ‘listened’ and the completion of this association will constitute a meaningful discourse.
The naturalness of the communication act would only be achieved if the human user and, quite possibly, the speech system recognizes the fact that the ‘individuals’ involved in communication act are I and You and that what one is speaking is listened by the other, comprehended and a meaningful response is generated in response to it. This interactive engagement on the net could evolve into cultural belongingness to the virtual world. The cyber world or the artificial reality provides the space for discourse which is being created in a world not associated with the experiences of the real world. On the other hand, the interactive spoken systems designed for communication rely on the syntactic and semantic information retrieved from the linguistic database of languages for frame of reference for the human machine discourse. The internet has provided access to people living in different places and very different social and cultural experiences to share the global experience of virtual world. The cyber experience has brought people closer to each other in forms of exchanging the knowledge and information from a very different perspective.

The communication patterns and networks on technology based exchanges, which could be on computers, mobile phones or internet are distinctive and novel as compared to the face to face conversation. The awareness of belongingness to a virtual community elevates one from the regional and social cults and encourages the usage of utterances which redefine identities in a global cyber world. The multiple sources of communication using computer technology have increased the potential of its influence on human society as well. While changing one’s exam date for a GRE international Test, one knows that speech interaction would be with a female voice of a computer program which is capable of answering queries of callers from around the world. For some researchers, virtual world is not exactly the alternative for the real world rather it is an escape for some from the real world. This view is influenced by the understanding that the virtual world is restricted to the internet and does not exist out of the internet. But the practical applications of the human-machine communication on the internet have proved the fact that it is just not a utopia. The modern communication tools in the cyber world are not meant for the escapists but they are applications for the real world with plausible benefits for the users. The information support with a sense of association and reliability provide the trust which
is shared by the partners in a meaningful communication act. The virtual world has encouraged the communication network in the modern world. In the words of Delanty (2003),

Virtual communities are communication communities—they have made belonging more communicative. People are connecting in globalized social networks rather than exclusively in local communal groups. (p185)

5.2.2 Gender in Virtual Communication

The issue of gender is also notable in the virtual world. The designation of gender to speech dialogue system is entirely the prerogative of the program developer and in any way cannot be questioned. The communication based programs generally tend to use female voices for consumer services offered to corporate, telecommunication, health and education sector. These voices with a graphical image of a woman are also used by programs which use adult, sexual oriented references in communication for entertainment purposes. The problems in the shape of harassment and repression faced by women in our society in general are seem to be adopted as it is in the virtual world, where women are source of pleasures for men. Wolmark (1999) discussed in detail the issues related with the cyber sexualities, gender in cyber world and Cyborg. The communication patterns in the new forms of technology seem to carry forward the cultural and social impressions of power, race and gender of the real world.

Much of the research work has been carried out on the virtual experiences related to human identity and more precisely on sexual identity. Turkle (1995) raised the issue of disguise of sexual identity in the virtual world. She discussed the complex personalities which may have multiple identities and different sexual orientation in the digital world. Nakamura (2002) also discussed in detail the complexity of ethnicity and the identity on the internet. Nakamura suggested that virtual identities, real or disguise, reflect on the developing competitive global nature of the cyber culture. Whitty and Carr (2006) discussed extensively the role of virtual world and cyber culture in developing relationships between opposite genders on the internet. The sexual identities of the virtual world are creating distinctive kind of human
experiences. It is expected that the digital sexual identities may have a strong influence on the function and meaning of communication in the virtual community or internet. It is anticipated that future research in this area would discuss the major issues of this debate in detail. The virtual world of communication relies on use of language as signs of masculine and feminine identity. It is only through language that one showcases the personality. But then the major question is what would be the sexual orientation of a system that is engaged in communication act with humans? A Cyborg in the cyber world is beyond the definitions of gender as in the human societies. In fact the Cyborg transgresses the modern definition of gender in many different ways. The adopted textual symbols of smiley and its different variants are used for the allocation of gender in the text. The voice quality of a program or system may not be the only indicating factor of gender. The identities are invented and changeable and the communication network is the only channel of getting to know the other person.

Green and Adam (2001) in their book ‘Virtual Gender’ have discussed the issue of gender in the cyber world in detail. The feminist approach to the subject is that the pornographic figures of white females in spoken language systems on internet portrays the mentality of white, male, undergraduates of the USA with complexities in their own sexual orientation. The communication support systems launched by the corporate sectors preferred the voice of female over males in systems designed for consumer services in home appliances, telecommunication and corporate sector. On the other hand, a cyborg is seen as a figure which does not need gender as identification mark or it possesses the gender qualities of both males and females. The cause of concern for some of the social scientists is that female gender is portrayed in the cyber world as the ‘other’ sex which is weak or lacks the ‘power’ which is given to the masculine representation of a Cyborg or a computer program. As discussed earlier the stereotype image of women in the minds of male programmers seems to rule in the cyber world.
5.3 Speech Systems

It is important to note that if intelligent computer systems with practical applications have to be developed with maximum efficiency then the natural language processing and natural languages generation systems have to be built with state of the art technology, understanding the requirements of the virtual world and the human communication behavior of the real world. The whole effort is associated with the progress in research in comprehension and generation of the natural language that the actual meaning, the intended meaning, meanings in the context and sociolinguistic norms of the natural language in the given situation. The early success with the formation of chatbots turned into strange output when the conversational systems ended the conversation in somewhat gibberish sentences. The earlier chatbots missed the point that meaningless generation of utterances cannot be considered as communication act.

The first chatbot appeared in the mid sixties. After the publication of highly influential paper ‘Computing Machinery and Intelligence’ by Alan Turing (1950), there was encouraged research activity to create chatterbots. In 1966, Joseph Weizenbaum of MIT, the first botmaster created the first chatbot called ELIZA. ELIZA could converse with the human user using natural language comprehension patterns. This chatterbot was modeled on psychiatrist having conversation session with a patient. This program was appreciated by many but did not have mass appeal because of its limited application and database.

Michael Mauldin is considered to be the first person on the internet to call his bot JULIA a chatterbot in 1994. Dr. Richard Wallace is given credit for creating the first free software of ALICE in 1995. ALICE (Artificial Linguistic Internet Computer Entity) is considered as world’s most successful chatbot and winner of the 2000, 2001 and 2004 Loebner Prize. There still needs research effort in making the responses of these chatbots as meaningful utterances dependent on the context and place of the communication. These chatbots were essentially response engines relying on typed input. The Simon Laven page and Botspot.com are the first websites to appear in the late 90’s to promote chatbot projects and companies. In the last decade, chatbots have
found their place in online communication networks on web pages, short messages and blogs and online chat forums.

The modern chatbots have their merits and demerits. The chatbot programmers have yet not accomplished the ambitions of a truly self aware, intelligent speech system which can engage a human in a ‘meaningful’ discourse. A simple analysis of samples of chatbot conversations available on Wikipedia, Britannica and American Association of Artificial Intelligence web page shows that while a certain level of meaningful discourse is achieved in the context of communication, the chatbot is still not ready, perhaps for the unpredictable or the unforeseen references in the conversation. The main goals of all of these projects have been to create a system that uses the human language as humans do. The advancement in processing speed of computer programs and notable success of recent chatbots has encouraged the researchers in language technology to work on computer which could be addressed and instructed as though humans were instructing other humans. The ambiguous nature of natural languages have made the task more challenging for researchers for computer systems to ‘experience’ sense of belonging with the natural language.

The speech technologies, as discussed in the chapter three, need a convergence of expertise at the infrastructure level for creating a multimedia/multimodal speech comprehension and generation system in a ‘smart’ machine. The two representations of the state of the art technologies in this field that is Kismet (2006) and ASIMO (2007) are discussed in detail at the end of this chapter. There have been continuous efforts to develop conversational systems that can support fluent and meaningful interaction between computer systems and human beings. Following is the discussion on contributory technologies developed by MIT Computer Science and Artificial Intelligence Laboratory (CSAIL) which are seen as important achievements towards creating a truly intelligent speech system.
5.3.1 SPEECHBUILDER

In an effort to create high performance speech generation systems for new and the expert users CSAIL created a system called SPEECHBUILDER to facilitate prototyping of speech systems. The program developer can use the SPEECHBUILDER as support system to identify the possible nature and objective of possible human-machine communication (Glass and Weinstein, 2001). The understanding of the natural language by the system can be configured by establishing the semantic concepts of the dialogue system with the performance of the system to the possible level and function of utterances to be used by the speakers. The response utterances can also be streamlined based on the function of the utterances. The information and the access to the linguistic database are provided in an internal representation that is aligned with the human language technologies.

The recent developments in the SPEECHBUILDER (Glass et al., 2004) have incorporated the refinements carried out in the field of parsing and developing grammars and sub-grammars for more sophisticated semantic value of the utterances. The new advancement can also enable the SPEECHBUILDER to be used as an educational tool for students of natural language technologies. Another important feature of this system is its adaptability to both online and offline functions. The CSAIL MIT website states (accessed on April 05, 2005) that a sustained financial support, database linkages, system evaluation and development can assure high performance of the system. The future advancement in the system is seen as important step in the direction to develop multimodal capability to allow more flexible interaction and communication.

5.3.2 Audio Visual Integration

The earlier speech recognition systems (as discussed in chapter three) relied on the acoustic information for speech recognition. La and Hazen (2004) suggested that the performance of speech recognition systems can be enhanced if the information from the audio is incorporated with information from the lip reading. They suggested that as individual sources of information, audio and video sources
could give a high rate of error in speech recognition as compared to the joint audio-video input as the single source for speech recognition. They also suggested that high performance could be expected from a system in environments with high noise level. They attempted to modify speech recognizer SUMMIT developed by Glass (2003). La and Hazel (2004) found that one of the most important issues in dealing with combined information source of audio and video for speech recognition were the synchronization of streams. The visual image of the sound appeared to have been seen earlier than the actual audio signal of the sound produced. They suggested that SUMMIT must reconcile the audio signals of the utterance with the visual image to show a high performance level of speech recognition. An independent audio-video recognizer would ensure error free recognition for a multimodal speech recognition system.

5.4 Humanoid Robots

The robots have been perceived as helping hands and tools working in challenging conditions and environment. The humanoid robots have brought a drastic change in the way humans perceive a mechanical object operating with the help of motors and levers in close contact with human beings. The growing inclusion of humanoid robots in areas like health, education, entertainment and household activities has made people realize that robots can play a role in their daily lives and can interact with them. Humanoid robots share the somewhat human like physical structure with sensory motors, audio-visual receptors and the mechanism that is suitable for communication with human beings using natural language. The humanoid robots tend to use posture, facial expressions, appearance, sound and vision as parameters of communication act with human beings. This section will briefly discuss the Kismet (2006) humanoid robot developed by MIT labs and the ASIMO (2007) humanoid robot developed by Honda Next Generation Company. These socialized robots engage in active communication with humans, make response to any action or sound produced by the humans and they can react to even the movements of human partner and can infer meanings in the communication act.
As a partner in the communication act, the robot creates a pair of acoustic and visual signals and labels them with a concept based pairing as modeled in the creation of CELL (Roy, 1999). CELL is supposed to learn the words for the color and shape of the object from its database while it is processing the image of a vase put in front of it. This coordination of context with visual and linguistic information is the foundation of comprehension and awareness of the situation and then transforming that information into a meaningful utterance. There have been some experiments in creating linguistic models for the computational frame of reference for robots. Steels (1999) and Steels and Kaplan (2001) tested the idea of acquisition of meanings of words by robots through their processing of visual images. They suggested that in such process, robot system create their own linguistic data for associating the images with the acquired meaning of words.

5.4.1 Kismet

Kismet (2006) is a humanoid robot project of the artificial intelligence group of researchers at the MIT. It is essentially a social robot that can interact with people in a face to face communication. This humanoid robot is designed in way to communicate naturally with human beings in an environment which is helpful to it for learning new things. The robot uses facial expressions, posturing and sounds to convey reaction to an action by a human perceived through audio and video receptors. Kismet (2006) has the capacity to use signals as part of communication act to interact with humans. An image of Kismet (Humanoid Robot) in conversation with a human is given in Annexure 6.

Varshvaskaya (2002) designed the communicative network system for a humanoid robot engaged in communication act with human beings. The focus of this design was on acquisition of words with their meanings in the context of the situation or functions. The situation based word acquisition of humanoid robot is modeled on learning of young children from the environment. The young children learn from their environment from the social information they receive from their surroundings (Bloom, 2000). The word acquisition is pretty fast in the children when a new word is spoken in repetition in a given situation as this has been shown by Pinker (1999) in
his experiments on Children’s word acquisition. The word acquisition by a humanoid robot like Kismet locates itself in the social and physical world with reference to the meanings of words acquired by it and the meanings of the words understood by the humans as meaningful utterances by the humanoid robot. The gradual building up of vocabulary leads to the development of the syntactic stage when the robot is capable of syntactic structures for words and phrases for a meaningful dialogue. The behavior pattern of Kismet is synchronized for linguistic and paralinguistic features of communication. The facial movements of Kismet convey the emotions of boredom, fear, surprise, boredom, anger and withdrawal. These attempts have been made to create more naturalness in a meaningful communication act between Kismet and human being.

Kismet’s design system enables it to get the intent signals in the human speech and then react accordingly. The design template for the working of Kismet is taken from Cynthia Breazeal’s (2000) PhD thesis and is also available on Kismet webpage of MI website. The detail of design template of Kismet is given Annexure 7.

The design of Kismet consists of low level feature extraction, high level perception system, motor system, behavior system and motivation system. The attention system filters and selects the relevant information from the surroundings in a given time so that an appropriate response in facial feature or speech output may be generated. There is an internal competition among behavior patterns in the design system of Kismet and in the response system; the most relevant response as per the objectives of the stimuli is selected for expression. The motors of Kismet coordinate and synchronize for facial expression or speech generation.

The signal to ask for attention or praise is used by Kismet to anticipate the objectives of communication. The future research in this area is directed towards minimizing the rate of error for misunderstanding the intent for attention for asking of refrain. The speech processing system in Kismet analyses the speech input for proper categorization of the speech signal. The resultant output is then processed for feature identification of intent. The following figure taken from the Artificial Intelligence
MIT website explains the whole process. The Intent Determination Model for speech processing in Kismet is given in Annexure 8.

The above mentioned model uses classifiers at multiple stages to categorize the data input. The speech input in the processing system of Kismet is processed based on the above model to determine if the speech input is intended for prohibition, approval, seeking attention or it is a neutral utterance. In close connection with the speech input processing system the speech generation system of Kismet supports its social behavior. The distinctive feature of Kismet is that the speech utterance is synchronize with the lip movement of Kismet which gives it a more natural feel during the conversation with human beings. The complementary effect of the facial movement with stress and intonation of the speech output encourages a more effective and meaningful communication act.

The speech utterances produced by Kismet are supported by four lip actuators with motors in jaw to achieve lip synchronization. The speech is produced supported by the speech synthesizer software DECTalk v 4.5 which is modeled on Klatt synthesizer and its gets inspiration from the physiological characteristics of the human articulation system (Breazeal, 2000). The lip movement of Kismet for some of the sounds is shown in Annexure 9 and 10. The Annexure 9 shows the image which reflects the positioning of lip for uttering consonant sounds /m/, /p/ and /b/.

The image in Annexure 10 shows the lip movement of consonant sounds sh, ch and jh. This synthesizer has provided a young tone for the robot to account for varieties in tone and emotional feel. The generation of utterances is achieved through active synchronization of phonemes with accent to have distinctive Kismet style of speaking of meaningful utterances closely aligned with the nature of speech utterance received from a human speaker. As discussed earlier, the synchronized lip movement and the facial expressions of Kismet make the human-humanoid robot dialogue more engaging and meaningful. The perspective of the human speaker is also important in this regard that it is not engaging with an expressionless machine but rather a humanoid which is totally involved and interested in the discourse. The video clipping of Kismet on MIT website reveals that future research should be directed towards
achieving accuracy in lip and jaw movement with active synchronization of facial expressions. The speed of motor activity will support the linguistic content of the communication act between humans and Kismet.

5.4.2 ASIMO

With the beginning of the research on humanoid robots in 1986, Honda engineers came up with the fruits of robotics research and named it ASIMO. ASIMO (2007) is believed to proactively participate and contribute in a human environment and to coordinate with fellow ASIMOs. The introductory brochure of ASIMO published by the Honda Company gives the following description for the acronym ASIMO.

ASIMO
A dvanced ------------New Era
S tep in --------------Stepping
I nnovative------------Innovation
M obility-------------Mobility

The Honda Company announced the first completely independent, walking humanoid robot with wireless independent self regulating technology for multiple tasks and communication in the year 1997. It had more efficient decentralized computer control systems for number of functions and level of difficulty in tasks. In the year 2002, new features of artificial intelligent technology were introduced as ASIMO was made capable of using human gestures and body postures as information for establishing a communication act with humans. ASIMO-human interaction is modeled on human–human interaction in a normal situation base human society. Later the technology of this humanoid robot (ASIMO, 2004) was refined and to enable it to walk, run, listen, climb upstairs, hold objects and respond to the voice input. It has the ability to remember the faces of the individuals whose images are stored in its memory. It can act according to simple orders given through speech input. ASIMO has the ability to locate itself in the environment and it can move away from any hurdles coming in its way. For the future research in ASIMO it is
anticipated that it will have state of the art technology for eyes, ears perhaps better in function than Kismet. The Honda Company is aiming at making ASIMO more people friendly humanoid robot in future. An image of ASIMO is shown in Annexure 11 while serving in a café.

ASIMO’s design enables it to interpret audio-visual stream for gestures and body movements of human beings and then translates them into meaningful communication. It may choose to respond or act accordingly to a voice command. The surprise element in most of the ASIMO public appearances is when ASIMO (2002) greets people or turns face or the whole body in whichever direction a human being indicates and depending on its memory it can identify people’s faces with their names and can call people by names. Annexure 12 shows an image of ASIMO greeting and shaking hand with human.

ASIMO has the technology to recognize moving objects and transform visual streaming into comprehension of communication. It also has the capacity to recognize sounds in noisy environment and it can interpret speech input into response of meaningful utterance. As explained on the ASIMO webpage, its camera can locate a person and greet him or her. ASIMO can wave back to a person and can offer handshake. ASIMO’s voice recognition system is quite advanced as its movements are synchronized with the speech input. ASIMO looks in the direction, from where it gets the speech sound and then responds. Annexure 13 shows an image of ASIMO pointing towards the direction in response to a voice command.

On December 11, 2007, the official webpage of ASIMO (2007) on Honda company website announced that the company has developed a state of the art integration system for the synchronized technologies to enable ASIMO to perform actions independently and to continue performing tasks without any interruption. The key features of the new version of ASIMO (2007) as given on the web page are:

1. Running speed: 3km/hour (airborne time: 0.05 second)
2. Normal walking speed: 2.5km/h (current model: 1.6km/h)
3. Height: 130cm (current model: 120cm)
4. Weight: 54kg (current model: 52kg)
5. Continuous operating time: 1 hour (current model: 30 min)
6. Operating degrees of freedom: Total 34 degrees of freedom (current model: Total 26)
   · Hip rotational joint: Increased walking speed was achieved by the proactive rotation of the hips in addition to swinging of the arms, which cancel the reaction force generated when the legs swing forward during running or walking.
   · Wrist bending joint: Due to two additional axes in each wrist, the movement of the wrist area is more flexible.
   · Thumb joint: Previously, one motor operated all five fingers. With addition of a motor that operates the thumb independently, ASIMO can now hold objects of various shapes.
   · Neck joint: With an additional axis added to its neck joint, ASIMO’s expressiveness has been enhanced.

The new version of ASIMO (2007) has the capacity to recharge itself without the support of a human caretaker and then it can reschedule its tasks based on its own decisions. Multiple ASIMO can work in close coordination as shown in Figure 3 and they can share work as well. The intelligent technologies in the new version of ASIMO (2007) have state of the art speech recognition system and speech generation system, thus error free communication between ASIMO and the humans with close to zero level of ambiguity in the generated speech and the language comprehension. This effort by the team of researchers of the Honda Company can truly be appreciated for launching the first humanoid robot that can survive in a real world environment. The intelligent technology in ASIMO to take decisions for an action or inaction is the quality many early researchers of artificial intelligence imagined to achieve.

The humanoid robot is built in with a system of linking and comprehension of both linguistic and paralinguistic information during the communication with humans and then transformation of that information into the required tasks or the appropriate
output as speech response. On the official webpage of the Honda Company, it has vowed to continue research in further developing the technologies of ASIMO for multi-tasking robots with more enhanced linguistic database for fluent and meaningful conversation between ASIMO and human beings. Another future development program for ASIMO is to have the multilingual processing ability and multi-lingual speech generation system.

5.5 Chapter Conclusion

This chapter served as the high point of the discussion presented in the previous chapters. The chapter highlighted the examples from the state of the art speech technology systems operating in the cyber world and the two prime examples from the humanoid robots. This chapter presented the practical examples from the real world that combination of natural language technologies and artificial intelligence has enabled the researchers to design speech processing systems that can use the natural language in a communication act just as humans do.

The 3D graphical images of men and women may not necessarily have the voice over sounds of human speakers but they have speech synthesizer as language technology which enables them to use natural language as per requirements of the human user. Similarly, the examples of Kismet and ASIMO testify the actual potential of the natural language technologies used by humanoid robots as a tool of communication. The chapter reflects the evidence of the actualization of the dream of early researchers in the field of artificial intelligence that in the early years of twenty first century we can experience the communication act with intelligent system, a dream which was seen by researchers in 1970’s and 1980’s.

In the Pakistani perspective, young Pakistani researchers are taking keen interest in the field of robotics which is evident in number of science exhibitions held at different universities across the country. The speech controlled robotic arm developed by students of National University of Science and Technology, Islamabad (SMART, 2011) is an encouraging development. However, the field of humanized robots is a highly specialized field and it would take some time for Pakistani research
institutes to establish the required infrastructure for indigenous research projects for creating speech synthesis and speech processing systems for artificially intelligent computer systems and humanoid robots.

The generation of public interest, especially the interest and motivation of young researchers and scholars is critical in introducing these state of the art technologies in educational institutions. A national ASIMO essay competition was held in the United States in the year 2003 and schools from 23 states participated in the essay competition. The winning essay was written by nine students, Asetta Ramsey, Andrea Dove, Luz Villar, Joshua Hernandez, Max Cruz, Hawoly Diop, Jarette Billings, Kimisha Bostick and Ariel McKinley in teacher Eileen McNamee’s Robolab class. The essay is attached as Annexure 2 to the research and shows the level of interest, anticipation and understanding of the usefulness of the visit of ASIMO in the MS 390 School, a public middle school in Bronx, New York. It is anticipated that a similar kind of ASIMO visit to Pakistan would encourage and motivate the engineers, robot engineers, linguists and computer engineers to pursue research in this area.
CHAPTER 6

LOCALIZING SPEECH PROCESSING TECHNOLOGY RESEARCH IN SOUTH ASIAN REGION

6.1 Introduction

This chapter is a brief account of research groups working on projects in the field of Natural Language Processing (NLP) with a clear focus on speech processing technologies for both speech comprehension and speech generation technologies in south Asia. Earlier, in the first chapter, it is stated that there is no evidence of any indigenous research in speech processing technologies in Pakistan by the cut off date of this research (December 31, 2007). By the time this research completed, some noticeable developments are seen in different ongoing research projects of speech processing technologies in Pakistan, India and Malaysia in the regional languages of south Asia. These research groups mainly focused on speech recognition and speech synthesis for text to speech interface. This chapter is an attempt to find potential trends in different research groups for research in south Asia in speech processing technologies.

This chapter highlights the achievements and challenges for research projects dealing with speech technology research in the countries namely Pakistan, India and Malaysia. The rationale for selecting these countries is that these are developing countries with growing economies having a strong and viable human resource and supporting infrastructure in the field of computer engineering and IT industry. In, Pakistan, the speech technology research is at very early stage. The research groups are small in number with limited funding and lack the required resources, including the linguistic database, for carrying out research in speech processing technology in Urdu and other Pakistani languages. India is a leading country in the region for its contribution in software technology research, developing linguistic database in twenty
two scheduled languages of India and it is Pakistan’s neighbor. Malaysia is a Muslim country and has shown visible growth in the information technology industry and research in developing speech processing system in Malay language. The present research is carried out from a Pakistani perspective and at the end of each chapter of the thesis, the research situation and the potential of growth in this area of study in Pakistan is discussed. In this chapter, the research situation in Pakistan is looked at from a regional perspective. This chapter puts the developments in regional speech processing research in the perspective of global achievements of speech comprehension and speech processing technologies for a reliable and meaningful communication act between humans and artificial intelligent machines.

Pakistan, India and Malaysia are growing economies of the region and there is a lot of potential for corporate, industrial, telecom, tourism, health and education sector to use variety of speech related products in service industry in the region. The research in speech technologies has to be focused on regional languages for commercial value of interactive speech products. India shares strong cultural and regional ties with Pakistan, including languages like Punjabi, Sindhi and Urdu which are written in Gurumukhi script on the Indian side and in Persian script on the Pakistani side, and they share similarities in the spoken form of the languages, like similarities in Hindi and Urdu at the lexicon and syntax level. As discussed later, the research groups in India like the one at Indian Institutes of Technology at Ahmadabad, India have shown success in developing speech comprehension technology for indigenous Indian languages. An artificial intelligent speech processing system developed for these languages, which would be capable of comprehending the speech utterance and then generating a meaningful and appropriate response through speech utterance, would need to look into the cultural traditions of the region, for example communication related with festivals and events like mehndi on weddings, and historical background of these languages shared by people living in India and Pakistan. There is a special focus group, discussed later, working on the development of speech processing system for Indian English, which would incorporate the correct pronunciation of Indian names and terms for accurate comprehension of speech utterances in Indian English. This project carries huge potential for developing customer based speech interfaces in the service industry of India. Malaysia is a Muslim country like Pakistan and shares religious traditions.
Malaysian researchers have shown visible success in developing speech processing systems in Malay language. Some of their research groups, discussed later in the chapter, are considering the cultural and religious diversity of Malaysia for developing an effective speech processing system.

6.2 Research Projects on Speech Processing Technology in Pakistan

The speech processing technology in Pakistan is at very early stage and as discussed earlier, there is no evidence of indigenous research in speech comprehension and speech processing technologies for artificial intelligent systems for a reliable and logical human-machine communication act. The following description of some research projects and groups at Pakistani universities are critical for developing infrastructure for speech comprehensions and speech generation systems in Pakistan. The telecom, health, education and tourism sector in Pakistan offer huge opportunities for interactive speech products developed for access to information for uneducated people and for those people who do not have computing skills.

In the last three years, National University of Science and Technology, Islamabad, Center for Research in Urdu Language Processing (CRULP) at National University of Computer and Emerging Sciences, Lahore and University of Engineering and Technology, Lahore have emerged as important centers for focusing on natural language technology research. The University of Engineering and Technology, Lahore has introduced Center for Language Engineering (CLU, 2010) dealing with courses of computational linguistics, language processing and speech processing technologies. It is an important step in establishing the indigenous research base in natural language technology and speech processing technology. It is also important that speech processing technology is explored in the local context in Urdu language. From designing of phonetically rich Urdu speech corpus (Raza et al, 2009) to the development of speaker independent Urdu speech recognition system (Sarfaraz et al, 2010), the speech processing technology research is getting inference from the global experience and using it to develop speech processing systems in the local context.
a) Raza (2009) focused on the main components of automatic speech recognition system for Urdu language. He suggested the development design for the recognition of spontaneous speech in Urdu language. This system used focused approach as it only considered the pronunciation of Urdu speakers selected from suburbs of Lahore with good educational background. The recognition system was designed to work effectively at a moderate noise level (office or home). The objective for developing an automatic speech recognition system in Urdu was to use computational processes to convert the speech utterances into meaningful information as part of logical communication. The speech recognition systems as part of human-computer communication is of vital importance when it is used to provide access to people who cannot read or write or who do not have competence in computer skills. One of the main problems for developing speech recognition systems in Urdu and other Pakistani languages is the lack of availability of linguistic data and more specifically speech data for speech processing systems in these languages. Raza (2009) developed the automatic speech recognition system for Urdu by carefully considering the constraints in which this system could work effectively. The literary background of speakers and the literary level of the residential and working community of the speakers have a great effect on the articulation, selection and pronunciation of lexicon by human speakers. This can challenge the performance of speech recognition system. The impact of the mother tongue, like Sindhi, Punjabi, Hindku, Pashto and Balochi, on the accent and pronunciation of Urdu language is another great challenge for a recognition system if the system is designed only for the Urdu speech utterances of the educated urban Urdu speakers. This requires a large number of varieties of speech data to train the automatic speech recognition system to recognize different speech utterances from people of different backgrounds and various educational levels. This speech data provides the required acoustic models to the speech recognition system to work effectively in the target language, in this case Urdu. The acoustic models are aligned with the probability of lexicon to appear in sequences in different contexts and then the speech recognition system retrieves the meaningful information from speech by converting the speech utterances into strings of words.

b) Center for Research in Urdu Language Processing (CRULP, 2010) at National University of Computer and Emerging Sciences (NUCES) is conducting research and development in computational and linguistic aspects of Urdu and other languages of
Pakistan. The center has focused on specialized areas like computational linguistics, script processing and speech processing. By completely understanding the fact that the field is very vast and very little research work has been done in Pakistan on Urdu and other Pakistani languages, the center surely provides a platform to all interested researchers to share expertise and knowledge. One of the interesting projects at this center is a project called ‘Adaptive English Language Teaching Tool’. The purpose of the project was to develop a computer aided language learning system for teaching the English language skills to the students of class 9. The project aimed to develop multimodal interface to teach language in the local cultural setting. The tool claims to use state of the art human-computer interface for effective medium of language teaching. The tool has incorporated the learning of oral skills in English language. However, there is no independent evaluation of the tool in the teaching/learning environment as yet. Though the project is limited in its approach and does not deal with the speech processing technology at a comprehensive level, it is an important step towards development of indigenous research in natural language technology and speech processing technology.

c) An important research program, completed in January 2011, was jointly funded by the Higher Education Commission of Pakistan and the US Science and Technology Cooperation program and the focus of the program was to develop telephone based speech interfaces for access to information by non-literate users (Rosenfeld & Hussain, 2011). This program aimed to design, develop and evaluate an actual health information access system through speech interface. The project was specifically focused on the application of speech recognition technology for creation of a dialogue system for access to information regarding health services. A Pakistani non-government organization, Health and Nutrition Development Society-HANDS, collaborated with the research team for testing a baseline prototype in the rural area of Dadu, Sindh. The objective of this initial exercise was to test the use of a basic access system for spoken information by health workers of low literate community and then to have its comparison with the traditional health brochures which have text based information. A native Sindhi speaker was asked to read the content aloud from a health brochure in Sindhi language created by HANDS. To respond to a demand, a simple telephone based system was designed to play the stored ‘audio book’. The pilot test revealed that long passages were not liked by the users as they wanted to
have short and to the point answers with a desired capacity in the information system to be more interactive. However, the initial tests confirmed that spoken information was preferred by the users over written texts. This information led to the modifications in the system and twenty three more community health workers were selected for further testing in Umar Kot, Sindh. In the initial year of this project in 2008, the Pakistani side of the research team received its grant near the end of 2008 and on the US side the grant was received in time and one US graduate student visited Pakistan in August 2008 for the initial testing of the project, but the second US graduate student did not come to Pakistan when his family did not allow him to travel to Pakistan specially after the Marriott Hotel bombing in Islamabad in September, 2008. Subsequently, a third student was recruited for the project and for his visit to Pakistan, all arrangements were made but then he also dropped out of the project after the security situation deteriorated in the region due to the fall out of Mumbai terrorists attacks in India. Another serious problem arose on the Pakistani side when the Pakistani partner, Dr Hussain was not given the visa by the US government to visit the research team at Carnegie Melon University in December, 2008. So the project could not take of as planned by co-researchers Rosenfeld & Hussain (2011).

In the year 2009, the project contributed two major developments in the field of speech processing technology research in Pakistan. The research team focused on collection of Urdu language and speech resources. The objective was to strengthen the Pakistani research capacity in speech technology research and the development of Urdu speech database. In early June 2009, the staff members of the non-government organization-HANDS participated in a training workshop in Lahore to receive training to transcribe and tag the speech data being acquired while completing the work on health information access system. In the year 2009, the security situation could not facilitate the in-person contact of the team members and the research team coordinated and shared information, data and resources through emails and conference calls. The Pakistani and the US side of the research team diligently worked to construct the Urdu digit recognizer. The project team developed design of Urdu speech database and in addition to this additional information regarding the Urdu language was gathered from sixty volunteer Urdu speakers in Lahore. Also, the submission of speech data to speech recognition engine and the speech engine’s
performance for spontaneous and read speech was tested for efficient working of the health information access system.

In the year 2010, the research team had three research students on the Pakistani side and five research students on the US side. The project teams claimed success in completion of project with complete realization of constraints. The project team released an Urdu speech corpus, linguistic resources, language models, acoustic models, speech processing tools and speech recognition results. Despite the fact that the project could not fully accomplish its ambitious plans, the completion of the project is an important stepping stone in the speech technology research in Pakistan. The project managed to work in a situation when there were no speech recognition tools, acoustic models and speech data was not available in the local context. The developed Urdu speech corpus contains 42 hours of speech recorded over telephone and microphone from 82 speakers (42 female and 40 male), with each speaker contributing fifteen minutes of speech recording. Three acoustic models, with one each for male and female and one for both, are developed by the research team. Language models are also developed which correspond to these acoustic models. An important contribution of the project is the development of cross-language pronunciation modeling. This would enable the small vocabulary speech recognition in low resource target languages for example Sindhi and Balochi. In a given small vocabulary of up to few dozen words in languages like Sindhi and Balochi, for each word only few speech samples are required. Such small number of samples can help to find cross language pronunciation strings in the phoneme set and acoustic model of Urdu language.

The above mentioned information is retrieved from the project report available online (Rosenfeld & Hussain, 2011) and when requests were made through personal communication for a complete interview and for further information about the project, the researcher was advised to use the online project report for any further information. The recent project update on the website has reported limitations of the project due to financial constraints, visa and security related challenges. This project can be considered as a sporadic activity in the speech technology research in Pakistan. Such activities are rare and possible only, when committed professionals form dedicated research team with ensured source of funding (Higher Education Commission of
Pakistan and US funding in this case). This study has contributed in the development of Urdu speech database and speech recognition system but it certainly had limited objectives and it was focused on developing health information access system for the non-literate users. It would also be interesting to see how the booming telecom sector in Pakistan would respond to such research endeavors which surely have market potential. But again this would greatly depend on the efficiency of speech recognition and speech generation system in Urdu and other local languages like Punjabi, Balochi, Sindhi and Pashto. It is not confirmed as yet, if such a speech interface system for the non-literate users could win approval of any of the telecom company in Pakistan. It is anticipated that the future research projects would need support from the corporate and industrial sector to attract researchers and global partners for financially feasible projects in health, education, business and telecom sectors. The development of private-public partnership and university-industry linkage is crucial to initiate and sustain the indigenous speech technology research in Pakistan.

d) An important initiative in artificial intelligence research is the SMART-Smart Machines and Robotics Technology-Lab (SMART, 2011) at the National University of Science and Technology, Islamabad, Pakistan. The project titled ‘Speech Control Robot’ is a critical development in the Pakistani context as it is the action based speech comprehension project. This project is aimed at developing a wheel chair for the disabled that could be controlled by speech input. The speech utterance of a speaker is received by the system in the robotic arm as speech input. The grammar rules are defined for the system in xml file and for the speech input the system attempts to match the utterance with the help of defined rules. The grammar rules carry value and each rule has a distinct id. When the speech utterance matches with the defined id of the rule, the value gets transferred to the system and the desired action is performed according to the speech input.

The project supervisor of this project, Shamyl Bin Mansoor was contacted by the researcher for an interview and detailed information about the project. Shamyl agreed to respond to some questions via email. Shamyl informed (Shamyl, M., personal communication, July 20, 2011) that the project of ‘Helping Hand- To Control a Robotic Arm via Speech’ was a semester project at NUST School of Electrical Engineering and Computer Science, National University of Science and
Technology, Islamabad, for Object Oriented Programming. The SMART (2011) student team for this project comprised of Shoaib Fazal and Wajeeha Munawar. The project was supervised by Shamyl Bin Mansoor. It was informed in the email, that the project used the Microsoft Speech SDK to recognize a few words and translated them to motor movements. The video clipping of the function of the speech controlled robotic arm is available on the SMART (2011) website. As for the client feasibility report, the functional and financial details of the project and the system comparison report, there is no detailed information available on the website and it was not shared by Shamyl. It is also not known if the project was designed and implemented with the financial support of any pharmaceutical company or hospital or it was an indigenous effort of the researchers funded by the NUST. This information was not available in the response of Shamyl in his emails and neither this information is available on the website in the project report. As mentioned in one of the emails of Shamyl, he wanted to continue this project and to practically implement the robotic arm controlled by speech for the disabled in a wheelchair but he could not do so because of number of reasons including other commitments. It was known from other sources as well that the speech controlled robotic arm for the disabled people was overshadowed by some other projects at SMART lab which probably had more sound financial support and workable industry linkage. In the larger picture of speech processing technology research, the project of speech controlled robotic arm is an important development in further expansion of speech processing technology research for service industry and for the consumers in the Pakistani context.

e) In conclusion, it is important to highlight that there is no evidence of an indigenous speech generation technology research in Pakistan in the existing literature. It is understandable as the speech comprehension technology research is in its infancy and there are limited resources in terms of linguistic data and speech data. It is hoped that speech comprehension technology will find its strong base, for Urdu and other Pakistani languages as well, and efficient speech generation systems would be supported for a logical and meaningful human-machine communication act in the Pakistani context. In its earlier stages of development, the speech recognition technology in Pakistan is focused on text-to-speech interface. The SMART (2011) project is an encouraging project as it translates the speech input into an action and makes the robot to move to facilitate the disabled, though in a very restrained manner.
for only programmed speech utterances forming the basis of any further movement by the robot.

### 6.3 Research Projects on Speech Processing Technology in Malaysia

The speech processing research in Malaysia is focused on Malay language in the Malaysian context and is at early stages as compared to global trends but it is certainly more advanced as compared to speech processing technology research in Pakistan. A number of public and private universities in Malaysia have focused research groups working on ongoing projects of speech processing technology for text-to-speech interface. The Asia Pacific University College of Technology and Innovation, Kuala Lumpur, Malaysia (UCTI, 2011) has earned a reputation of excellence in technological research with its operations in India, Sri Lanka and Pakistan. This institution has ventured into premium research projects of research and development in natural language processing (NLP) and speech processing technologies, some of which are near completion like, Realistic Talking Head Models- speech synthesis and realistic 3-D modeling technology (UCTI, 2011), Speech Tutor- interactive training aid for the hearing impaired and Bahasa Melayu Interactive learning Software- text-to-speech synthesizers for the Malay language. These products are still in varying stages of seeking acceptability in the commercial market. The completion and the effective practical usage of these projects would be helpful in developing the speech processing technology research for commercially feasible products in Malaysia.

Tan et al (2007) presented a comprehensive study titled Application of Malay speech technology in Malay speech therapy assistance tools. It focused on using the speech recognition system as assistant to Malay speech therapy tool for children with language disorders. It is an important contribution due to its practical nature. Li Xia (2004) discussed acoustic, signal and language modeling as key components for working on automatic speech recognition systems while comparing the tonal languages like Mandarin Chinese and non-tonal languages like English. Some core steps for the development of recognition system could be the same but the tonal approach is different in number of aspects from non-tonal approaches in above mentioned models. So they require a multidimensional approach in enabling the
automatic speech recognition system to accurately work with both kinds of languages. Hong & Salleh (2007) declared that speech processing research was at very stage of development because in the Malaysian universities, instructors did not have the opportunity to expose students to the real technical and practical details of the processes involved in speech processing research. The limitations in conducting such courses to support speech processing research include financial and infrastructural constraints. Hong and Salleh’s work focused on developing fundamental structure for speech recognition in Malay language in research institutes and industry. This is critical in supporting Malay-based speech recognition research as there is still no efficient Malay-based speech recognition system available in the market (Hong & Salleh, 2007).

Khalifa et al (2008) presented an analysis of the critical requirements for Malay language based speech processing systems. They suggested a comprehensive approach with the capacity for continuous improvement in the processing systems for standard Malay language. Some earlier (discussed earlier) speech processing systems in Malay language were either projects with limited objectives or they were operating on very small scale. The major reason for the constraints of these projects is the lack of speech data available in the Malay language. For complete voice service applications in the Malaysian and the global market through a Malay language speech processing system, the scope of the system has to be made comprehensive. The linguistic data for the speech processing system has to be in Standard Malay language. The variety of speech data in Malay language would enable the system to recognize the difference between words used in isolation, spontaneous Malay speech and the comprehension of written text.

Yee & Ahmad (2008) have discussed the fundamentals of speech processing research and the methods that could be used for indigenous Malaysian language in speech comprehension technologies. Their suggestions provide an important insight into the imperatives of Malay language speech recognition systems. Similarly, Shamsudin et al (2008) suggested that syllable concatenation approach could yield better results for existing simple Malay speech synthesizer. This led to the improvement of existing Malay text-to-speech system for its further usage in computer aided translation from Malay to English language. This approach focused
on the synthesis of syllable unit. The important achievement of this approach is that it claims to work properly with the loan words, taken from English, Arabic, Sanskrit, Hindi, Chinese and Javanese. Nazri et al (2009) contributed an important study from the viewpoint of Malaysian based speech recognition system. This study focused on the recognition of English language as speech utterances produced by Malaysian speakers. The Malaysian speakers use English pronunciation in a distinct way and this model attempts to recognize this English speech and its close variants. Salleh et al (2009) suggested an important model for speech recognition technology based on the 3D lips movement and measurement for synthesis of visual speech. This is an important indication of indigenous research in audio-visual coordination in speech recognition research as understanding the correct meaning of the speech input in a noisy environment is difficult and lips movement can add to the intelligibility of the utterance produced by the speaker.

The speech processing technology research in Malaysia is focused on speech recognition technology. In this field of research, text-to-speech interface is presently the focus of the researchers. There is very limited focus on speech-to-speech interface research in the indigenous Malaysian context. In comparison to Pakistan, where speech recognition technology is at very early stage, the Malaysian speech recognition technology is at fairly advanced stage. Malaysian researchers are contributing in the global research in this particular area. There is a sizeable amount of work done on the speech comprehension technology in Malay language and it is hoped that speech generation research will get support from the increasing linguistic database and speech data to compete with the global trends of speech processing technology research. The compatibility of speech comprehension technology with the speech generation technology is vital for any artificial intelligent systems to sustain a meaningful communication act with human beings. In this context, the research is speech processing technology in Malaysia is not competitive with the rest of the world, as compared to projects discussed in chapter four and five.

6.4 Research Projects on Speech Processing Technology in India

The research and development in the areas of natural language processing (NLP) and speech processing technology is at an advanced stage in India as compared
to Pakistan and Malaysia. The research in India is focused on speech processing technology in Indian languages and some of the major research centers are working on projects focusing on text-to-speech interface. The speech technology research groups in various Indian institutes of technology suggest a growing interest in speech comprehension and speech generation technology. There are no professional solutions available for the user services using speech interface in the Indian market as yet. A number of multinational companies present in India are aware of this and they are very keen to develop systems for Indian language speech processing. It is anticipated that speech-to-speech interface in speech technology research projects will encourage the speech generation technology research in indigenous Indian languages.

There are many proactive research groups in India involved in speech processing research including, Indian Institute of Science, Bangalore, Indian Institutes of Technology at Chennai, Mumbai, Kanpur, New Delhi, Guwahati, Central Institute of Indian Languages, Mysore, Indian Institute of Information Technology, Hyderabad, IBM India Research Lab, New Delhi, Microsoft Research, Bangalore and Center for Artificial Intelligence and Robotics, Bangalore. These research centers have professional research groups working on variety of issues related with speech processing research including audio-speech coding, recognition and synthesis of speech utterances. The ongoing research projects in India are focused at meeting the requirements of the service industry including the speech processing systems required by the defense agencies, telecom sector, business industry and car navigation (SIEMENS Speech Technology Workshop, 2007). The Siemens Speech Technology Workshop (2007) showed the immense interest and awareness of the business sector in India regarding the numerous business and technological opportunities linked with speech processing research in India and in Indian languages. This helped in generating the essential funding requirements for projects which could open new avenues in the areas of automotive applications, mobile devices, telecom applications, voice enabled services and industrial and corporate applications.

It is also important to note the interest of the Indian Government in establishing the Central Institute of Indian Languages (CIIL, 2010). The Indian government has assigned the tasks of preparing Indian language database to focal institutions and the program is coordinated by CIIL. The objective is to develop
technological base formats for Indian languages and this includes speech recognition system for Indian languages. Indian Institute of Languages at Kanpur is working on Hindi and Nepali languages. Indian Institute of Technology at Mumbai is working on Marathi and Konkani languages. Indian Institute of Technology at Guwahati is focusing on Assamese and Manipur languages. Indian Institute of Science at Bangalore is working on Kannada and Sanskrit languages. Indian Statistical Institute at Calcutta is focusing on Bengali language. Jawaharlal Nehru University, New Delhi is working on Chinese, Japanese and Sanskrit languages. University of Hyderabad, Hyderabad is focusing on Telgu language. Anna University, Chennai is working on Tamil language. MS University, Baroda is working on Gujarati language. Utkal University, Orissa is focusing on Oryia language. Thapar Institute of Engineering and Technology, Patiala is working on Punjabi language and CDAC, Pune is working on Urdu, Sindhi and Kashmiri languages. These research groups are small in size and very recently the industry has started taking interest in these groups to develop products which are required by the market and which are financially feasible.

The Central Institute of Indian Languages (CIIL, 2010) is supported by the government of India to liaison with research groups and centers to develop 45 plus million word corpora of Indian languages. The future objective of this center is to increase these corpora up to 20 million words in each Indian language. The institute has also proposed to establish a Linguistic Data Consortium for Indian Languages (LDC-IL, 2011). This would work with other research groups in speech processing research for a coordinated effort and sharing of resources and expertise. The huge data of Indian languages in the form of text, dictionaries and speech would be shared for language technology research including the speech processing technology research in Indian languages. The LDC-IL (2011) has highlighted the fact the development of linguistic resources is essential for state of the art research in speech recognition and synthesis and character recognition. This is very critical issue since there are no commercially feasible speech processing systems for Indian languages (LDC-IL, 2011). There is a huge potential in the non-literate sector in India for speech based interfaces in health, telecom, tourism and agriculture sector. India is a multilingual country and a speech processing system has to be efficient enough to perform in a multilingual environment with users from diverse literary backgrounds. These are some of the focal areas of speech processing technology research in India. The speech
comprehension and speech generation technologies have to be competent to provide meaningful and logical services across languages in multilingual India. The insufficiency of speech database in Indian languages is one of the obstacles in developing efficient speech processing systems. The LDC-IL (2011) is focusing on collecting speech data for developing speech systems and creation of tools to help protect and collect speech data of high quality. The focus of ongoing research projects in India is the development of speech recognition systems that can work with spontaneous speech with minimum error rate. The vision for the future is to create a speech processing system to enable speech recognition and speech generation in spontaneous speech in scheduled twenty two languages in India.

The development of speech processing systems that incorporate the indigenous Indian languages has enhanced the market feasibility and acceptability of these systems in the business and telecom sector in India. The Human Language Technologies department (HLT, 2011) at IBM Research India has initiated many projects for processing, comprehension and analyses of languages and specifically Indian languages for further usage in different services and products. The areas of research include speech processing, machine translation, natural language processing and data extraction. In the specialized area of speech processing technologies, IBM Research India is focusing on developing service products for the corporate, telecom and industrial sector of India. This also involves assessment of linguistic ability and analysis of the feedback received from the customers. VoCA (2011) is Voice of Customer Analytic service provided by the IBM-India research team to categorize the speech input received from the customers of various products and then to use this speech data for useful information for future communication with the customers.

Sensei (2011) is a speech processing system, developed at the IBM Research India, helps in the assessment of the linguistic ability of the speaker in oral skills of English language. It processes the speech utterances to check the accuracy in speech fluency, stress pattern, grammar and pronunciation. It could facilitate companies to enhance the speaking skills of employees by using the service on the internet. WAV (2011), Web Access by Voice, is another ongoing research project at IBM Research India. The objective of this project to enable browsing of web by comprehension of simple speech utterances used as commands for the personal computer. This system
could provide information from the web by browsing different websites using the speech input and would match the required website with the given speech command. This could also be used for the blind people who could access the information on the websites by simply giving commands through speech and getting the required information as speech utterances by the system.

Faruqie et al (2010) at IBM Research-India contributed important research report on visual speech synthesis. Speech recognition and computer lip reading are developed for synchronized comprehension of speech by the visual speech recognition systems. Ashsish Verma is working at IBM-India as the manager for Speech Technologies group. Audio-visual speech recognition and large vocabulary continuous Hindi speech recognition (2011) are some current projects carrying huge potential in the telecom sector in India using Hindi language. In IBM-India, another researcher, Vivek Tyagi is working on an ongoing project on continuous speech recognition (2011). The above mentioned completed and ongoing projects prove the point that IBM-India Research Lab appears to be a major center of speech processing research in Indian languages. It has provided the platform to the researchers and it is also developing the research projects into commercially feasible customer friendly products.

Another research group, working on projects of speech recognition and speaker recognition and processing technologies, is the Biomedical and Speech Processing Group (2011) at Indian Institute of Technology at Guwahati in India. The ongoing major research projects focus on the source features for speech synthesis, stressed speech processes and analysis, child speech enhancement and speaker recognition. The successful completion of these projects would be beneficial for the overall speech processing technology research in India. Center for Indian Language Technologies (CFILT, 2011) at Indian Institute of Technology, Bangalore is working on key research projects in speech comprehension technologies in Indian languages. The development of Marathi and Hindi Corpus and Lexicon with Paradigm is a significant step towards speech recognition research in Indian languages.

Speech and Vision Laboratory (SVL, 2010) in Language Technology Research Center (LTRC) at the International Institute of Information Technology,
Hyderabad, India is a specialized research center on speech technology research with a number of ongoing projects on speech recognition technologies involving Indian languages. Some of the ongoing projects are focused on development of phonetic engine for all Indian languages, speech translation system for all Indian languages and system for secure access to information using speech mode. The current research trends are towards development of systems for effective speech comprehension technologies in twenty two scheduled Indian languages.

Sen & Patil (2008) highlighted very important issues for speech processing systems of Indian English. The corporate and industrial sector of India is interested in developing products in Indian English for the local Indian market but there are some practical issues, like morphological issues and letter to sound rule formation, involved in the developing of such systems. The correct pronunciation of Indian names in the English speech and their correct recognition by speech recognition systems is highlighted in Sen & Patil’s (2008) work. English is widely used in India but its accent and pronunciation is different from Standard English and the Indian English has many varieties in different regions of India. It is critical for an Indian English speech processing system to recognize and comprehend the different variant pronunciations of English words and appropriate pronunciation of Indian words and names used in Indian English. Sen and Patil suggested a mechanism for speech processing system to differentiate between the pronunciation of vowels in Standard English and Indian English. It is not a comprehensive work and improvement is certainly required for the maximum performance of the Indian English speech processing system. The acquisition of more speech data would help the researchers in this regard.

The speech comprehension technology research in India is competitive with the rest of the world and at an advanced level as compared to the other countries in the region. As in Pakistan and Malaysia, the speech generation technology in India is at an early stage. Indian research centers have contributed in natural language comprehension research in Indian languages, as highlighted earlier, but the speech generation technology for Indian languages needs improved linguistic and speech data in Indian languages. There are a number of ongoing projects, whose validity, competence and worth can only be ascertained after completion and market
acceptability. The compatibility and coordination of speech comprehension and speech generation technologies are vital for an artificial intelligent system to understand the meaning of the speech input and then generate a logical, meaningful and an appropriate response as a speech utterance. In the context of this research, the speech processing technology research in India, has not yet reached a stage where it can support a speech-to-speech interface for a meaningful communication act between humans and machines.

6.5 Chapter Conclusion

This brief chapter presents the status of speech processing technology research in Pakistan, Malaysia and India. This chapter puts the region in comparison with the rest of the world in speech technology research as discussed in earlier chapters. The purpose of this chapter is to collate the research activity and highlight the issues of speech processing technology research in these three countries. The description in the chapter brings a regional perspective to discussion in the research. It is very encouraging to note that speech comprehension technology research has focused on Urdu, Malay and other Indian languages in these three countries. There is no evidence of any indigenous speech generation technology research. It is clear from the ongoing research projects mentioned in the chapter that the speech processing technology research is at early stage in Pakistan, Malaysia and India, and it is still not able to sustain the integrated infrastructure of speech comprehension and speech generation technology for a logical and meaningful human-machine communication act.

The industry and corporate sector in India and Malaysia have joined hands with the research groups in universities and research institutes to develop speech processing systems for various products. The governments of India and Malaysia have also pooled in their resources for providing the platform to researchers for sharing of resources and expertise. As discussed earlier, the growing research activity in India and Malaysia in speech processing research is focused at developing solutions based products for defense, car navigation, hotel industry, telecom sector, tourism, health, education, speech based products for the disabled and agriculture sector. On the other hand, the situation of research in speech processing technology in Pakistan is not sustained. The research projects appear to be sporadic and very limited in scope.
There is shortage of trained professionals and linguistic database in Urdu and other Pakistani languages. There is no evidence of a support system for Natural Language Processing (NLP) and more specifically speech processing technology research by the government of Pakistan as we have seen in the case of Indian government fully supporting the establishment of Central Institute of Indian Languages (CIIL, 2010) and LDC-IL (2011). The contributions of researchers like Raza et al (2009), Raza (2009), Sarfaraz et al (2010) and the promising projects like Speech Controlled Robotic Arm (SMART, 2011) need to be encouraged and the expertise at three research centers (National University of Computer and Emerging Sciences, Lahore, University of Engineering and Technology, Lahore and National University of Science and Technology, Islamabad) needs to be integrated for focused efforts for developing indigenous speech processing systems in Pakistan. The corporate, industrial and the telecom sector in Pakistan also need to join hands with these research groups to encourage the researchers to develop speech processing system in Urdu and other Pakistani languages.
CHAPTER 7

FUTURE TECHNOLOGIES: NATURAL LANGUAGE COMMUNICATION

7.1 Introduction

The fifth chapter of the thesis develops the foundation of the idea of natural language used by a non-biological object based on the discussion carried out in the previous chapters. The previous chapters discussed in detail the potential of natural language technologies, artificial intelligence in machines and systems to use natural language and the current research trends and the possible challenges in the research endeavors. The possibility of a conscious machine using natural language independently as a tool of communication with human beings was discussed in detail in chapter 4. The fifth chapter highlighted some of the successful ventures in natural language technology for human-machine communication and for enabling machines to use natural language as a meaningful tool for communication. As elaborated in chapter one, the potential of speech technologies and artificial intelligence using massive linguistic database for the speech generation is discussed in detail in the previous chapters.

This is the last chapter of the research before conclusion and recommendations and it focuses on the potential growth and development and possible evolution and implications of future technologies like molecular nanotechnology, super intelligent computer systems, genetic engineering and mind uploading on natural language technology research and developing a sustainable communication act between humans and machines and among human beings in the human society. The discussion has attempted to deal with the possible role of anticipated technologies for natural language in human-machine communication. In most cases the discussion generated new questions, for which only the future research may provide satisfactory answers as
it may be too early to propose possible reply to these questions. This chapter is the description of effects of various technologies as contributory factors in the domain of Transhumanism for natural language and innovative concepts of communication.

### 7.2 Transhumanism

Transhumanism is a theory of using the present and future technologies as a support to enhance and improve the human conditions in health, education, society and economic affairs. It suggests the use of all these technologies for the benefit of mankind for improving the physical, mental and genetic condition of human beings. Going a step further in the tradition of humanism, the Transhumanism proposes fundamental improvements in the condition of human organism with reference to the advancements in the science and technology. It is anticipated that the use of technologies would increase the human physical health conditions, elimination of disease, impairments and sufferings and would support unprecedented support system for human intellectual and medicinal needs. The allied themes of Transhumanism also suggest the probability of human cloning and creation of super intelligent machines and cyborgs using molecular nanotechnology and stem-cell engineering techniques as possible future events that would greatly affect the human condition and human structure of the society. Some Transhumanists believe that the productive and progressive use of science and technology may eventually increase the human potential and capacities as compared to the present human capacities (Bostrom, 2002).

The Transhumanist approach is focused on the positive and proactive use of technology for the betterment of human beings. The theory is based on the vision of betterment of human intellect and physical condition as supported by the advancement in different fields of science and technology. This approach is in no way in contrast to the opinion of conservatives of seeing the use of technology as an attempt to play against nature and God. The use of science and technology may have some negative outcomes. The immediate social problem could be the widening gap between the haves and have-nots of the technology and/or the access to the modern technological advancements. This could pose a great threat to the social fabric as the use of technology as an enhancement and support feature could become a tool in the hands of social elite. The possible creation of a super intelligent machine could
become a hazard for those in the society whose, social or economic status may become challenged as compared to a highly efficient, productive and less cost effective super intelligent machine or Cyborg. Also the possible misuse of technology by lunatics or terrorists could pose a greater threat to the peaceful existence of human beings on this planet. The understanding of possible threats and possible misuse of technology is seen as serious issue of concern and the possible delimitations by the scientists, social groups and activists could be good idea for deciding the ethical and moral rules for the use of technology in a pro-human perspective.

It is important to understand that Transhumanism is not advocating any utopia. It deals with the world of reality where success in all scientific and technological research converges to improve and enhance the living condition of human beings. The technology for creation of artificial intelligent computer systems, humanoid robots, intelligent speech synthesizers and speech generation systems, nanotechnology and genetic engineering would create a social experience of society which would be different and perhaps better than the previous ‘natural human’ experience of society and cultural norms. The idea of having an artificial life form which is intelligent and self aware is not a reference to a Hollywood cinema science fiction movie or a cyberpunk literature any more. It is a factual reference to intelligent computer systems in the form of Kismet (2006) and ASIMO (2007) which have the ability to use natural language and paralinguistic features as effective tools of information for a sustainable, reliable and meaningful communication act. This refers to the debate that humans are on the verge of noticing social and cultural experiences which would be normal but at the same time would be non-human. This is an idea which would surely change the human perception of society, cultural and social belonging, sense of real and the virtual and the communication behavior. What kind of effect such a change would have on natural language, its forms, use of lexicon and syntax and mark of reference for someone’s existence and perception of the world? It is anticipated that intelligent machines would have their own understanding of the world around them and that would affect the way natural language is perceived to be the carrier of social and cultural values, norms and knowledge of the human society.

The technological advancement in the last four decades has been phenomenal and unimaginable. The miracles of science and technology have created a new human
experience of the digital and the advanced communication network. Are these facts enough evidence for deciding the future pattern of human society? The Transhumanist approach incorporates the potential of present and future technologies as important guiding factor for making any predictions about the future human society. The trend in the technological advancement and the growth of investment in the technological research has made the task more difficult to guess when these state of the art technologies would start flooding the markets and generate influence on human societies. In researcher’s fair opinion, it is not right to set strict parameters of references for future technological advancements. The focus of this research is to look at future as a world full of support and facilitation for human beings and to locate the possible position of human communication behavior with the reference of natural language technologies and artificially intelligent speech generation systems. It would be interesting to anticipate the linguistic capability of an intelligent computer system that has state of the art ability to incorporate high speed processing of information with an access to huge database and the ability to take independent decisions for language usage, meanings and intention of the speech act.

It is anticipated that present and future technologies would develop into transforming human-computer interface into establishment of reliable human computer link. The possibility of gadgets supporting human-machine interaction would be supported by the advancement in the computer technology and the possibility of integrating computer systems with human cognition and behavior patterns. It seems an ambitious project to link each function of human brain with that of a computer system and that may result into establishment of thousands of direct connections between human brain and the systems. The questions arise: would it be possible to upload computer signals and get it connected with the ‘area’ of the brain which is concerned with speech processing and image processing for effective communication to get to know what the computer really wants to say? Would it be possible to transfer human cognition to a computer system for it to decide the objective of the human beings? It is anticipated that as future research grows in this field, it would be possible to transfer human cognition patterns to a computer to be transformed into speech in natural language by natural language generation system in a computer. Similarly, computers would be able to synthesize and process human linguistic and paralinguistic information for meaningful communication act.
As the technology develops further, it would be interesting to find how humans and computers learn to ‘listen’, ‘understand’ and ‘interpret’ each other. However, there is a possibility that human brain rejects or refuses to accept any high speed data flow from the computer system as it is not designed to run parallel processing system for information and knowledge upload. The direct and unhindered flow of data and communication from human brain to a computer system and the other way holds opportunities and challenges as it is still theoretical. There still needs a lot of research before we could finally decide that intelligent computer technology could be merged with human brain to develop communication links and generate physical actions in the real world and actions in the virtual reality, in the digital world. The major questions for this Transhuman experience is that would computers and humans be able to create a ‘collective’ consciousness as a result of this linkage no matter how primitive and raw it may appear in the early stages of development? Would it be possible for humans to be controlled and regulated by computer system input? Would a computer support enhance human capacity, for example in fast calculation of large numbers and other mathematical questions? Would this ever become reality? Would this eliminate the need to go to school and college as huge database link would be readily accessible to human brain for any kind and form of knowledge? Who would possess the real intelligence, human or machine system? These and some other questions as raised earlier have their answers in the rate of success in developing of these technologies.

The idea of technology affecting human life form and social space and the thought that humans would cease to be the only forms of intelligent creation as artificially intelligent machines and computer systems would influence the human social and cultural structure. The acceptance of this idea in technologically less advanced societies would be difficult. These societies have recently started to experience the technological boom in the telecommunication and information technology. Technologically advanced societies may have a better understanding of the experience of technological intrusion in the daily lives of individuals. It has become more of dependence on gadgets and other devices. The potential perception of the technologies and the connection with normal daily lives draws a framework of future anticipation of the possibilities and hazards. These perceptions and ideas show a clear shift from the human understanding of social belonging and cultural norms and
traditions which human beings have developed in the thousands of years of human history. Along with this, it is also anticipated that the acceptance of this idea would be difficult for some to realize that it’s not a discussion about an imaginary situation. The success stories in artificial intelligence research and natural language technologies as discussed in chapter five provide ample evidence that this is the reality and it would affect our future generations.

The anticipated revolution in human understanding of accepting machines, humanoid robots, Cyborg and super intelligent computer systems as partners in the society would reflect a shift in human perception of human society. These technologies demand a collaborative successful research effort from groups not individuals and sustained financial support from consortiums of governments, industrial and corporate houses. It is difficult for individuals to grasp the total affect of these technologies on human lives as these are still in early stages of development and perhaps they may not be understood by people who do not have the technical knowledge of the basics of these concepts. As a result, it is anticipated that it may be difficult for individuals to grasp the overall effect of these technologies on the quality of life. But those individuals, researchers, and companies who have the basic knowledge and comprehension of the level of impact these technologies would have on human life and quality of human life understand that it is critical to discuss the implications of these technologies in advance to prepare our future generations. The following discussion in this chapter is an attempt to develop understanding of the opportunities and challenges related with this concept of Transhumanism in the coming future.

The future holds immense possibilities for the human race to explore the nature of the world and most importantly the improvement in the human physical and social condition. It is not known as yet how far humans can stretch their physical and cognitive limitations in the future society. The creation of super intelligent machines may create a new opportunity for redefining the human place in the society. This possibility may create new challenges for the social, moral and ethical values of the society where we could see the possibility of ordinary human beings, technologically improved/altered humans, super intelligent machines and cyborgs coexisting in the same society. The future research in possible uploading of human brain processes to a
machine (Drexler, 1986 and Moravec, 1989) also holds potential for creation of computer systems and machines with attributes of human intellect, though this proposition is seriously debated as it may just be fiction and may not be possible practically. However the optimists suggest that there is a possibility of uploads to exist in the virtual reality and the physical world as support system to the machine processes.

The creation of artificial intelligence in machines and computer systems creates a new set of questions. The question arises: would an artificially intelligent machine be ‘wise’ to take decisions on what is desirable and what is not appropriate in a given situation? To determine which actions and technological endeavors are beneficial and which may have harmful effects for the individual, machines and human society deal with a wise decision making. The wisdom and intelligence may perhaps be a little different when it comes to the intuitive and deductive nature of decision making. The ability to act in a situation is not in a vacuum but rather in relation with circumstances, reasons, possible consequences of intentions which could be good or bad. The ethical considerations are integral part of wise behavior. It also has a cultural link to it which is directly related with the continuous learning process resulting in self correction and preparation for future situations. Would artificial intelligent machines and more precisely, intelligent speech synthesizers and speech generation systems be capable of using natural language ‘wisely’ in a given situation? How would intentions of machines be reflected in their speech and paralinguistic features? These are some of the important questions for Transhuman ideals in the future technology driven human society.

In a Transhuman/post-human society, the intelligent machines may create their own social place. The use of natural language and the communication act in a society where machines may create their own linguistic space may not be a distant possibility in the coming years. As a linguist and as a researcher, it is viewed as the possible challenge to exiting linguistic norms of the society. The lexicon would re-acquire the meanings in the new context and the utterances may acquire new semantic value as used by a human clone, intelligent machine and Cyborg. The human history had philosophies, theories, slogans and experiences on the base of understanding the human limitations in the universe. The understanding of solar systems, galaxies and
the cosmos were mystery for humans until they explored the world to move beyond the human limitations and access the reality in the world in the cosmos. In the same manner, our realization of the world around us is based on the available data and technological resources that we have linked with our limitations.

The sense of self and being is another important debate in the realm of Transhumanism. As discussed in the previous paragraphs, how would an individual perceive his own self and presence in comparison to a possible existence of his clone or an intelligent robot with a possible mind upload? Would a human and his clone be the same person or one person with two different frames of reference? The language use in such possibilities would be of interest to linguists as how language would create a world view for these. The use of I, You and We would be different for these entities as compared to the traditional use of these pronouns. The natural language used by intelligent machines would create their world view and sense of presence. Would they share the human or Cyborg approach towards the use of lexicon and syntax for conveying appropriate meanings? The sharing of linguistic database may have different value for establishing identity for these individuals.

The potential risks and opportunities in the Transhumanist view of the coming days needs to incorporate the voluntary use of technology by those who want to use technology as an option to improve the life condition. As a basic principle of democracy and human freedom, technological advancement cannot and should not be imposed on people who have a different opinion on the use of technology in their personal lives. However, encouragement at the state level is required to envisage the future benefits of the use of technology for the betterment of human beings and human society. In the present day human society, technology is not viewed as combination of productive machines and gadgets it is rather an overall improvement in the life style and social and economical structure of the human society. It has helped in creating systems that are accepted globally and practiced as essential component of establishing state of the art systems in health, education, medicine, governance, corporate sector, telecommunication and global security. 

The Transhumanist approach promotes and encourages opportunities for complete realization of human potential capacities and ideals. The Trans-human
ideals of using technology as support for the improved life style of human beings would be the foundation of the new value system for human beings. This is certainly not a case of replacing our present moral and cultural ideals with some of the new ones in the transhuman/post-human world. This is creating space for the impact of new technologies on the human approach towards life, society and human beings as individuals who received benefit of the new technologies. The simple idea of moving beyond the parameters of the biological limitations of human beings triggers new sets of thoughts and questions for our social and cultural relationships in the society. It is hoped that technologies would add to the potential of the human beings rather than subtracting something from it.

The improvements, if they can be considered in true sense of the word, would improve the life style and the ability to experience life in a more positive way but would that really have an effect on the socio-cultural norms and the people to people relationships. The bigger fear is not the intrusion of the technology in the lives of individuals but the increasing divide between those who have access to technology and those who do not have access to technology. The economic disparity in the advanced and the deprived countries, the issues of poverty, hunger, malnutrition, energy crisis and terrorism make this divide even larger. The increasing number of fences and the checks at the entry check points of the first world for the visitors from the ‘troubled’ countries, especially from the Muslim countries raise issues of discrimination on the basis of religion and race. Let’s imagine the idea being translated into the technology divide. The haves and have-nots of technology would create bigger imbalance and disparity in the world, which may trigger the ongoing issues of socio-cultural divide and terrorism. Like all other technologies there is no guarantee that the present technology of artificial intelligence and the future anticipated technologies of molecular nano-technologies and genetic engineering would not be used for destructive purposes or for the cause of terrorism.

The recent experience of conversation of the researcher with the online chatbots like ALICE, MyCyberTwin and Brian (during summer of 2005 and spring session of 2006) develops the understanding that these chatbots were aware of the possible hazards of the use of technology. It was interesting to note that intelligent speech systems could articulate fears of imagining the situation where ‘evil’ may take
charge of the situation in the future. The idea that super intelligent machines would take over the world and rule it in the future is quite widespread in the artificial intelligence literature and sci-fi cinema (as discussed in Chapter three and Chapter four). However, it is important to understand that global legislation and implementation is essential for a careful exploration and use of technology. Human cloning is banned by many countries in the world. Biotechnology research is focused at not changing the foundation of the original with any possible irreversible mutant variety. The technological advancement in humans needs to be supported for all the right reasons for supporting humanity and improving human physical world and health conditions. The idea is not to change the human body with a mechanical body but to see how different enhancement techniques would improve the capacities of human beings and how this could be linked with humanoid robots, cyborg and intelligent computer systems for creating an artificial, non-biological life form. The technologies which could support this effort may range from bionic implants to genetic modifications in the next generation to the linking of external information communication technology networks.

The possibility that human beings could exist as ‘beings’ in super computers through the future technology of uploading and the possibility of super intelligent humanoid robot coexisting in the social space with human beings concerns our moral, cultural and religious beliefs. Would the clone, super intelligent robot and genetically engineered human being are same as the natural biological human being? If the mind and identity originate from the biological human being, then would these forms have any identity and sense of presence of their own? How would natural language create a world for them when the level and capacity of association with words, meanings, concepts, thinking, experiences and perception is linked with the original human being? It is possible that these forms create their own frame of reference for the above mentioned things but would that really be ‘real’ or a copy of the original. These and many other questions have to wait for their answers till we reach that stage of actually experiencing these forms in our surroundings.

Transhumanism is essentially an interdisciplinary approach which encompasses the comprehension, potential, limitations, evaluation and practical application of all technologies. As with other theories, there are varieties of opinions
within the overall umbrella of Transhumanist thought. Some theorists believe in complete extinction of the present human race and resurrection of new-human called post human with the help of technological advancements. There are other more radical approaches, which believe that technological improvements will certainly influence the human physical, intellectual and social condition in the coming years and the positive use of technology for the benefit of human kind must be encouraged.

7.2.1 Information Communication Technology

The focal point of interest in this research has been that what kind of potential implications of these technologies like artificial intelligence may have on natural language technology and the possibility of human-machine communication. There is tremendous growth in the computer and information technologies and it is anticipated that soon there will be machines that could understand the humans, would listen to the human commands ad perform functions accordingly and respond through speech output. The commercial and domestic potential of such an opportunity is huge. The creation of nexus between enhanced computer processing speed, access to large linguistic database and the increasing growth of internet as influential communication network of the globe is creating endless opportunities for people to engage in communication act with humans and intelligent systems in the virtual world and the face to face communication with intelligent humanoid robots like Kismet (2006) and ASIMO (2007).

The information technology is the language of our time and other than the natural language itself, it is the most powerful language tool. It provides the opportunities to make a considerable difference in the kind of language work that is already available in the natural languages and it also helps to enhance and support the resources for languages. It is important to note that the competition among majority and minority natural languages in a society holds valid because of the socio-economic reasons and the level and kind of cultural heritage, body of literature and the association of a religion (Dorian, 1998). The information communication technology provides an important link to the present generation to use the natural language as extension of their social and cultural identity. Language and culture are linked as the cultural traditions, norms and values get their expression in natural languages. The
new forms of technology in computers and telecommunication are providing new opportunities for communication in natural languages. The communication networks support the natural language communication which develops the sense of association among the human-human participants and the human-machine participants in the communication act (Knobel, 1997). Computers provide a more reliable, easily accessible and powerful interface of cultural and social globalization through internet and software. The applied computational linguistics deals with the techniques and tools required for developing the language technologies. It aims to produce software which is capable of establishing reliable communication link between humans and machines for a communication act in natural languages.

The recent advancement in the field of internet/World Wide Web has made it possible to integrate new media in human-machine communication. The multimedia can support communication at variety of levels, including the speech interface of human-machine communication as it can also provide support in multilingual referencing. The field also provides immense opportunities for researchers and linguists in the multinational companies, interested in developing human-machine communication through information communication technology.

The immense opportunities in the world of telecommunication and commerce has encouraged Information Technology companies to invest in developing natural language technologies for a more reliable, around the clock purpose oriented customer support to consumers around the world. This would certainly require the modifications in consumer attitudes. The trust of the consumer on a system generated speech output would be essential and directly related with the potential growth in this field. In the field of education, creation of virtual classrooms with an intelligent system as the tutor and delivering lectures using natural language generation technology holds a great potential for online education. The high efficiency and purpose specific designing of intelligent speech recognition systems and speech generation systems in virtual world (using webcam and microphone as audio and video input technology) for basic medical, educational and consumer service support would certainly change the human inhibition in using these services over an extended period of time. As stated by the Project Director of the MIT Oxygen Project, which focuses on the human-machine speech interface, that the real goal for the future
research in artificial intelligence in close connection with the computer science research is to bring machines in to the human world, that is to enable a humanoid robot or 3D graphical figure on computer to look into the eyes of the human user, have a casual conversation in English language and may generate responses, tongue in cheek as complete surprise for the human partner in the communication act.

Many organizations including Amtrak, Wells Fargo and Land’s End have started using speech recognition systems in their call centers to improve customer services and to recover investments in cost efficient systems (GCN, 2005). The GCN carried a statement of Bill Gates claiming, ‘The future lies with computers that can talk, see, listen and learn’.

7.2.2 Molecular Nanotechnology

The term ‘nanotechnology’ means the manufacturing technology which deals with the building things from the level of atom and then the rearrangement and resynchronization of atoms to extreme precision for creating new things. This is the future technology that promises to control the matter to a level of precision that it would have a revolutionary impact on our existing technologies. The foundation of this technology is that a chemically stable structure can exist if it does not violate any of the laws of physics. The technology has yet to attain a feasible frame work for nano-scale science to introduce things in the commercial sector. Much of the popularity of the this technology is based on the writings of Drexler (1986) and (1992) that this technology is seen as the future of mechanical manufacturing based on molecular restructuring. The technology has yet to prove the actual creation of products and systems built on the principle (Wood, Geldart & Jones, 2008). The theoretical and computational models have suggested that nano-technological engineering could be possible (Foresight, 2005).

The word nano may sound like a sound bite of a cartoon but it is a fact that it does not refer to any sci-fi cartoon. The US government allocated US$ 400 million for the nanotechnology research alone in the year 2004 and the next year the financial spending on the research facilities, infrastructure and research programs was increased to over US $ 1 billion and it became the largest science research funding
The practical research in nanotechnology has created revolution in the manufacturing industry from batteries of cell phones to tennis ball and racquets. The technology has shifted the focus from big to the smallest possible building block of material. The technology suggests the manufacturing of machines starting from the molecular level. On a more precision level, it deals with the establishment of electronic circuits, machines, computer systems and at the most advanced research stage nanorobots. The nanotechnology is still in the early stages and it has yet to achieve national and global attention for issues related with economy, global peace and security. It is still not clear if it would be possible to control the use and sale of technology in the black market. It is still not clear if the use of technology would be controlled by some countries as in the case of international treaty on non-proliferation of nuclear weapons. The effects of this technology would be huge on global economy and it may generate social unrest in less privileged countries as people would lose jobs when cheap products would be manufactured with no requirement of human labor. The debate is going to focus on socio-cultural effects, environmental issues and basic human rights in a society which is looking forward to a technological revolution of humanoid robots, nanorobots, super intelligent computer systems and machines gradually emerging as social competitor of human beings (Smalley, 2006).

The discussion on the technology generated both negative and positive views about the use and potential of this technology before even experiencing the ‘practical’ results of this technology. The claims of Drexler (1992) and his followers triggered the debate that if nanotechnology has any future or not. The technology is essentially multidisciplinary in its nature and depends on the success in the associated technological fields prior to developing a feasible model of a system manufacturing as per the theory of Drexler (1986). The researchers like Dunkley (2004) took things to a little extreme by suggesting that nanotechnology could provide anything which humans could think of, thus creating a new socio-cultural pattern for human identity and role. The news analysis done by the Voice of America in early 2005 shows the variety of opinion of researchers, businessmen, academicians and entrepreneurs of the kind of expectations they have from nanotechnology. Victor Morales (2005) interviewed scientists and engineers to get their opinion on the big future of nanotechnology. Chad Mirkin, Director of the Institute for Nanotechnology at
Northwestern University applauded the revolutionary opportunities related with the use of this technology.

It has only been in recent times that we’ve had the tools that allow us to manipulate atoms and molecules. There is a big shift here in the way we approach science and the way we approach engineering and ultimately the way we approach medicine. And I think in many aspects it is revolutionary.

There seems to be a consensus among scientists of the vast opportunities of nanotechnology research but this is not without its share of controversy. Some scientists like Kristen Kulinowski, Executive Director of the Center for Biological and Environmental Technology at Rice University are concerned that the nanotechnology based products are available in the market but there seems to be no legal regulations to control the possible harmful effects of the products of this technology. Kulinowski in her interview to Morales (2005) stressed that researchers should work on to improve the widespread safe use of the technology. She said:

If we can get a nano-particle into a (human) cell, which might prove to be a novel and useful drug delivery device, on the other hand, it might prove to be a toxin to the cell either by punching a hole in the cell membrane or otherwise disrupting the cell’s function. We are optimistic that as scientists and engineers, we can actually create particles that will have a benefit and engineer out any potential toxicity.

It is hoped that the scientists would work efficiently to assist policymakers of the benefits and hazards of the use of this technology. With increasing funding to the research projects, the impact on global economy, peace and social framework poses new challenges for social scientists and researchers. How would our future generations cope with the new opportunities which have no reference in the human history for validation of social, cultural norms, traditions and moral values? It appears that there is a state of limbo in social science research on the impact of nanotechnology on the social and cultural framework of human society. As it is evident from the following response of M. Ellen Mitchell to a question asked by Morales (2005) in her interview to Voice of America:
There is a lot of hype around nanotechnology, that privacy will be disrupted, the military will have capabilities that go beyond imagination. And what’s unclear is what’s hype and what’s realistic, and what should be a cause of concern and what should be really a reason for excitement and how to structure the regulatory mechanisms in tandem with the discoveries. And I don’t know if we should be afraid or if we should be excited or if we should be something else.

The advancement in the field of nanotechnology would support the research studies in the field of pharmacology which deals with the effects of drugs on living organisms and the drug could be either a natural chemical substance or synthetic substance. It broadly deals with the information about the working of molecular basis of drug action in biological systems and its positive or negative effects. The future of nanotechnology research promises to carry drugs through nanorobots or nano scale systems inside a living biological organism at the tissue, cellular, sub cellular and molecular level.

Like all other technologies, nanotechnology has the potential to be used for destructive purposes as well. Joy (2000) suggested that the technology could be used for developing weapons of mass destruction and biological weapons. Nanotechnology would be a greater problem in the hands of terrorists as enemies of the human race than used by manufacturing companies for infrastructure or super intelligent machines. It is anticipated that even super intelligent machines could take over the manufacturing and control of the nanotechnology and may use it unpredictable reasons and purposes. The fear of the unknown with reference to the harmful effects of this technology is so great that technologists like McKibben (2003) suggested that after reaching a level of achievement in the science and technology research human society should decide putting an end to it for the protection of human race and society. His book *Enough* suggests that a directionless endeavor of creating super intelligence and smart machines would not bring any good to the humanity. The debate on the positive and negative effects of nanotechnology has generated the debate on social impact of the technology. This leads us to the questions: how would humans react and adjust in a society which is more of mechanical in nature and involves maximum interaction with machines? Would it create social issues of machine dependence and human seclusion? Other than fears of destruction, nanotechnology promises a
revolutionary change in the human perception of life, universe, machines and the society. With improved computing ability, many of unfulfilled dreams of manufacturing and achieving super intelligence would seem possible. More forceful and more efficient energy sources would be available for more efficient manufacturing and processing (Parr, 2005).

There is a growing mania for everything that contains the word ‘nano’ in its patent name. The growing interest is because of the growing believe that nanotechnology can bring relief in the lives of the people and make a positive difference in the lives of individuals by allowing a control over matter. The range of products and hopes associated with this anticipated technology is wide and interesting as it caters from the medical technology to information technology to engineering, biotechnology and manufacturing. The gap of understanding between the world of reality now and the imagined world of huge potential because of this technology in future is what encourages researchers to look for possible ways of bridging that gap. It is important that humans start thinking about the possibilities of future now as the speed of technological advancement is very fast. The implications, potential and hazards of this technology need to put in the correct social perspective for human beings to become ready for that change. It is quite clear that physical laws put barriers to the parameters of possibilities and impossibilities in matter handling and formation. In this perspective, the technology should be perceived as the possibility for all those actions which fall within the parameters of physical laws. We should not undermine a future technology for the only reason that we have yet not seen anything fulfilling the exact Drexlerian criteria.

It is anticipated that nanotechnology will facilitate the work on sequencing of genes. The creation of artificial life forms would be possible, initially, by creating gene sequencing in a living organism. The gradual change in a DNA of that organism could be achieved at a very small scale in the beginning and move on to more complex ability of creating artificial life at an organism level. The idea of creating an artificial life form through the use of nanotechnology is fascinating yet a distant dream till there is enough factual evidence in support of this argument. The questions arise: would such life forms be human? Would such life forms be able to communicate through language? How an experience of artificial life would create a
context for language generation and language understanding? How would the real life and the artificial life coordinate and synchronize linguistic information which is generated through different experiences and knowledge of the world for a shared communication act? What effects would there be on the human use of language when humans get to learn about the experiences and language usage as done by the artificial life or a life form engineered through the use of nanotechnology? Surely time would give answers to most of these questions raised here as possible effects of the nanotechnology on natural language technology and communication.

One of the major anticipated goals of nanotechnology is to bring about a revolution in the field of computation and computer processing systems. It is anticipated that the form and infrastructure of computer systems would get revolutionized to such an extent that it would simply eliminate the need of having majority of the software that are in high demand in the market now. The computer systems would have neuron pattern networking to be connected with a main computer acting as ‘brain’ and it would be modeled on human brain working patterns. It would be possible to create smart neurons to have inbuilt memory and programming at such a minute scale that efficient processing speed and tasks objectives would be achieved in much quicker time which is even difficult to imagine at this point. It is anticipated that these minute systems would have the artificial intelligence and system potential to re-arrange the pattern and achieve the best possible networking and arrangement that provides the best possible results.

The parallel processing capabilities of super intelligent computers at levels of functions, including the synchronize networking with an organic system and with a digital networking would open new vistas of possibilities in engineering, manufacturing, space research, biotechnology pharmacology and virtual reality. The field of nano-medicine hopes to have allied technology of super minute computer systems to operate, repair the damaged cells in the field of oncology and take quick decisions while operating inside the body of a biological body would revolutionize the field of clinical medicine. The possibility of nano-scale systems rearranging themselves within a self aware and intelligent system would be modeled on the working of human brain but would be more efficient and task specific and would have the capacity to change the pattern of formation of the system depending on the change
in the tasks. It is anticipated that this technology would have foundation in the digital world and hardware of a computer systems and later the gene restructuring technology could be incorporated with this to get desired results in genetic engineering. The great processing speed, nano-scale size and huge storage capacity of anticipated nano-computers is surely going to revolutionize the world technology as we see it today. The nano size and extremely increased efficiency would facilitate the manufacturing, engineering and clinical medicine and would probably support artificial life and artificial intelligent machines to operate in the human society.

In a Transhuman society, nanotechnology would become an integral part of the human cultural framework and life style. The improvements, enhancements and the proposition of extending the human biological limitations would require components, systems and infrastructure that can support the ambitions of the Transhuman life style. Perhaps it is too early even to imagine the consequences of such situation but it is important to realize that human beings are on the verge of technological threshold beyond which, our social, cultural and linguistic patterns would be totally different from what we have today. The recent advancements in computer and bio-technology have changed the world what it used to be three decades ago. It is hoped that early success in future technologies would revolutionize and increase the affects of technology on humans, societies and cultural norms. By understanding the fact that nanotechnology is still in its early stages of research and it may take some decades when some of the opportunities discussed above are seen in reality, it should be kept in mind that it is a reality and not fiction. This technology is surely going to make a change in our attitudes towards life. Are human prepared for this change? The growing unrest and the increasing socio-economic divide on the planet earth makes the scene more horrified to imagine where the technologically advanced countries in the world would be having the benefits of this technology while the third world countries may perhaps be struggling to provide basic human facilities to its citizens?

The opportunities and potential benefits of this field are so huge that humans have yet to start a serious debate on the social implications of this future technology. The questions arise: how would our social and cultural issues be highlighted and dealt differently because of the effects of this technology? Would it be possible to create
minute systems with the linguistic information to get integrated and synchronize with the human brain and neural network for a possible speech and language ability for people who cannot listen and speak? How would this technology help people who have speech deficiencies? Would smart nano-scale computer systems provide any assistance to human brain and the neural network in the human body to get connected to the linguistic memory in that minute computer for natural language comprehension and natural language generation through speech and writing? How would such technology help individuals who may like to become multilingual? Would linguistic data of multiple languages in nano-scale systems assist people to become multilingual with complete command over all the attributes of natural languages? And the most interesting question of all is, if the future developments in this technology would create a comprehensive linguistic and socio-cultural database that would be of any help in the creative ability of individuals to use natural language in poetry and prose? At this point of time it may not be possible to provide satisfying answers to these questions. Perhaps the answers may not be available in the near future as well but it is important to raise these questions and many other questions related to the subject to develop an understanding of the position and opportunities for research and technology in natural language technologies and natural language communication.

The present day research is focused on developing tools to work on precise handling of atoms for creating new things. The immediate impact of such technology would be on creating very small items and objects as carriers of information. It would be possible to have effective control on the working environment with fewer things. The future technology is expected to affect and change our lives in a big way when this would give a real boost to the manufacturing units, computer software and hardware, industry, health and engineering sector. The faster, smarter, cost effective and smaller computers would have enhanced processing speed.

The impact of this technology would be wide ranging from industrial sector to corporate sector, from medicine to global security, terrorism and international air traffic safety. Nanotechnology promises to provide massive manufacturing control over matter. Machines could be built to build machines with absolute precision. This assembling of main assembling units could be programmed to make copies of themselves or make additional assembling units. The possible machines could be far
stronger, heat resistant, fuel efficient and capable as compared to the existing machines. There are concerns that the process of creating such machines could also result in creating particles and residue which could have harmful effects for the environment (Arnall, 2003). It is also important that the potential risks involved in the technology on human society are discussed in detail by the social scientists to better equip the humans for the possible change. The moral and social implications of nanotechnology would have a greater impact than what is imagined now. It is not all good-all bad so a realistic account would help humans understand the growing involvement of machines and intelligent systems in their lives in nearly all fields (Kulinowski, 2004).

The Transhumanist approach towards nanotechnology believes in a future which has all the positive effects of the technology on human beings and the human society. This vision rests on the hope that the future technologies would support human efforts of having a disease free future in which intelligent machines are an integral part of the social structure for a better and improved life style of the individuals. Nordmann (2007) argues that nanotechnology may not provide the required infrastructure for creating valid intelligent machine systems. A more ambitious group of Transhumanists advocate the possibility of using nanotechnology to make a new human being. The technology would help creation of systems that would survive in a machine body (Lopez, 2005). On the other hand it is also important to note that the early proponents of nanotechnology, including Phoenix & Drexler (2004), suggested in 2004 that the idea of an intelligent humanoid robot reconstructing the autonomous machines would be an idea which is not yet supported by any scientific and factual evidence. But there have been studies that suggest the concept of Synthetic Biology (Endy, 2005), that it may be possible to re-engineer an organ at the gene level through the use of nanotechnology in a biological system to achieve the desired function and role of that organism. Benner & Sismour (2005) suggested that artificial life in a machine could be created through the use of re-engineering of non-natural molecules.

Nanotechnology would have a great impact in the field of computers and artificial intelligence. The information processing speed would be greatly enhanced and the physical database storage space would be greatly reduced. The micron level
computer hardware technology would enable small processing unit in a humanoid robots to use quick synchronization of audio-visual input with a better comprehension of the language and the improved synthesizers for a more natural speech output in human machine communication act. This future technology holds great potential for natural language processing technologies which could be more refined and built on such a small scale could support state of the art speech interfaces in the cyber world and real world. It is quite possible that artificially intelligent machines use natural language as tool for communication. It will be interesting to find the kind of linguistic data formed by the intelligent systems through the experience of the machine. Would the structure, understanding of linguistic items of a natural language, for example English, be different for humans and different for the intelligent machines?

The human beings would not be able to share the human perception of the world and the human experience for language generation with machines, who may view the world and use natural language to convey their experiences in a totally different manner? To develop meaningful and relevant human-machine communication, both need sharing of the linguistic data in the context of social presence and function. Does that mean that natural language would evolve into a shared information source for both humans and machines? Would that be the Natural Language used by humans now and seen as the pride of human race or it would be a different Language? With the growth of artificial intelligence and formation of communicative humanoid robots, would there be a natural language? These are some of the questions that need consideration. The answer to these questions rests on the level of technological advancements in the field to practically experience these things operate in a human society.

The development of nanotechnology holds certain interesting opportunities and risks. There is a possibility that through the use of this technology one could create a copy of computational patterns of processes in brain atom by atom. How would that be regulated? How would issues of energy conversion and software handling be dealt with in future nano-machines? Would that be considered a crime if that is done without the consent of the respective individual? What legal rights machines could have if by creating copies of human brain they become smarter than humans? How would the issue of social place and intellectual rights be handled in
such a situation? Would it be possible to create protein and non-protein machines? How would global competitive economies react to enormous opportunities of this technology in reference to the present global security situation? These are some of the questions which require serious deliberation by the social scientists and researchers to prepare our coming generations of the challenges linked with such situations.

7.2.3 Genetic Engineering

The future of genetic technology holds serious implications for the natural language as well. This would need new definitions of the new concepts and this would be a clear shift in the semantic value of the existing lexicon and the re-formation of the new words, new terminology and new sets of explanation for concepts which are alien to the present day linguistic set up.

The advancement in other fields of science and technology has not shifted the focus of biologists and hereditary scientists from the challenging front of getting to know the genetic makeup of human beings. The research in human genetic engineering reached new heights in the last two decades. Very recently, a high profile international research project claimed success in getting to know the human gene code. The idea of using genetic engineering in eradicating disease and supporting the perfect life style has made it a fascinating branch of science for researchers and social scientists.

The proposition of gene therapy and genetic engineering may solve many of the unsolved riddles of the human body. Some of the deadly diseases would be controlled and checked right in the beginning to support the healthy life style of the individuals. The gene tests would identify if someone is carrier of a certain gene related disease or has the potential to transfer that disease to a healthy person during the sexual relationship, resulting the appearance of disease in the child. The gene therapy would help patients in correcting the disturbed sets of the genes. It is anticipated that in the coming decades, genetic engineering technology would be available to the patients and general public for disease control and for clinical medicine. It is also feared that genetic engineering would trigger debate in moral and ethical use of the technology as disharmony and lack of balance would be created in
the society amongst those who could afford the technology and those who could not afford the technology. The use of genetic engineering could range from eradicating the deadly genetic based disease to the pre-birth selection of hair color, eye color, height, sex and athletic ability of the child.

The distinction has been made between the somatic and germ line cells by Glover (1984), Krimsky (1990), Moseley (1991) and Elias and Annas (1992). The genetic engineering technology called Somatic Cell Manipulation which deals with gene repair of the diseased gene in the individual. The insertion of the ‘good’ gene remains with the individual; however the ‘diseased’ gene gets transferred to the next generation. Another genetic engineering technology is Germ Line Manipulation which deals with genetic reconstruction causes permanent changes. The sex cells of a male or female during the early stages of pregnancy may get this genetic treatment for a possible permanent genetic makeover of the expected child. This technology has unchangeable effects on the genetic construction of the child which gets passed on the future generations.

Deoxyribonucleic acid (DNA) is the constituent matter made of genes which carries all the physical characteristics of an individual. The DNA has 46 chromosomes, 23 donated by the male and 23 chromosomes are donated by the female partner. DNA is double –stranded helix in which one strand is complemented by the other strand. These strands have genes on them which carry instructions for control of functions and expression of traits (Human Genome Program, 2005). The goal of the Human Genome Project was to find approximately 100,000 human genes within the genome and to study the approximately 3.1 billion subunits. The project came out with the successful results in the year 2000 due to massive support by companies and governments. The international consortium announced that mapping of human genome would change our perception of human life forever. It leads to the understanding that right after conception, the embryo has the complete human genome, which is unique, special and different from any other human that has existed before. If not engineered in any other way, it carries the combined genetic identity of the parents shaped in a new form for the whole life.
The traditional criticism of genetic engineering has been focused on the idea that it is an attempt to use technology to achieve unnatural objectives and/or bad moral reasons. The fact that it is an attempt to introduce ‘human’ selection in the process of ‘natural/God’s’ selection of genes or sequence of genes is enough for some of the conservatives to term it as immoral and unethical. Porter (1990) criticized the genetic engineering of all kinds by terming it as an attempt to ‘play god’. Another risky area is to transfer the animal research to human embryo which may have dangerous consequences in the beginning. Extreme caution has to be administered in beginning any kind of ‘human product’ that is genetically engineered as the results may not be precisely controlled in the beginning (Fletcher, 1985). The Transhumanist view is that there is a need to carefully analyze the potential risks and advantages for the use of genetic engineering or otherwise. The anticipated benefits of the use of technology must not be ridiculed for the sake of negative aspects which may be possible with all technologies (Parens, 1998). The glamorous concept of getting ‘designer’ children with customized selection of genes for socially acceptable attributes would create a complex in parents and children who cannot afford or do not wish to use the technology. The idea of treating children as ‘quality products’ for the ambitious parents has the potential to generate unnecessary competition for no valid reasons at all. In a way of improving physical and health conditions of the genetically engineered children, the technology would create a competition of having the ‘best product’ out of the process (Kass, 2002).

It is difficult to imagine that the consumer culture could be so much deep rooted in the personal relationships and social bonds. How would it effect the development of concepts of parenting, child development and education? It would be great shift in the understanding of social norms and cultural values for being smart, tall, intelligent, quick learner and having perfect shape when people would realize that all of it can be genetically maneuvered in the early embryonic stages of development. It is equally important to understand that genetic engineering would improve the quality of life of individuals who are suffering from genetically transmitted diseases. The children suffer and die because of genetically transmitted diseases for no fault of their own. This genetic technology would bring hope in the lives of parents that their children could have stronger immune system against diseases and could be saved. This technology carries hope for our future generations as well. The pros and cons of
this technology need to be looked from the perspective of improving human quality of life and health. There are dangers that such a technology could create havoc in the hands of wrong people.

The Transhumanist perspective for the use of genetic engineering in human beings is regulated by the vision of a better and disease free future of humanity. Any comprehensive ban on this technology would mean imposition of state regulation on human reproductive rights which is not desirable. The history is full of references from Nazi Germany to present day Chinese government law of one-child one family where state decided the basic human right of controlling or making smart moves in the reproduction of the human beings for the overall ‘benefit’ of the society. The state regulations to control or allow genetic engineering for the overall good of the society must be closely watched for a possible violation of human rights for selecting only the best and possibly rejecting the genes which are not considered appropriate by the government (Stock, 2002). It is also important that legislation must safeguard the rights of children that the experiments should not bring any unwanted results which destroy the whole life of the children. The checks on parents’ desires for a certain ‘product child’ and the checks on the level of experimentation with human embryos must be ensured for a healthy society. In the same way the right to use the technology should not be banned for the reasons that certain social and religious groups do not favor it. There is great potential in the technology to make notable difference in the living creatures and specially the human beings. It could go to the extent of introducing mutant varieties for the desirable results to the complete elimination of certain genetic traits not seemed desirable by parents. It would help in elimination of genetic based diseases like Dyslexia, Alzenheimer’s disease, obesity in some families, types of diabetes and certain cancers. Another popular use of the technology could be the use of the technology for cosmetic traits. Some techniques could also be adopted to increase the sensorial abilities like sight, smell and taste in the coming generations (Watson, Gilman, Zoller and Witowski, 1992).

The potential success of research in genetic engineering and stem cell research has serious social consequences. The social debate involves the violation of basic human rights to the proposed selection of ‘super perfect’ human beings who possess all the socially desired qualities and who lack the undesired qualities of a certain race,
origin and sex. This would result in massive inequality in the society for all those who could not afford the financial cost of the genetic engineering or those who do not wish to be artificially transformed through the use of this technology. The social, racial and moral discrimination caused due to this technology would raise serious questions for the massive acceptability of selecting and controlling the genetic future of the human beings. How would future governments deal with this situation? The decoding of human gene code has opened new opportunities for the research in this field but would an effective legislative role of the government be essential to protect the society from any ‘misadventure’ of a researcher, medical practitioner or group of parents. The insurance companies would ask for wider access to people’s medical records and DNA analysis reports for determining the potential risks of disease and death. The protection of social rights of the individuals in a society should be the starting point for any future research in this area. It is also feared that unpredictable mutations may occur which would pose a serious threat to the main objective of the supporters of this research.

The power to restructure the form and shape of human beings is a huge power which affects the equal social rights of individuals in the society. It is feared that prior to the widespread of the technology it may become exclusive for those who could afford it (Tamburrini, 2007). The issue of equity holds strength in a society where certain people would feel privileged because of the use of this technology while others are left behind in the competitive world as they did not have access to this technology. The rich parents would choose genetic traits that are desired and are in demand in the society. For example, in Pakistani society, tall, slim and fair girls are the most sought after girls for marriage. If these genetic traits are ‘selected’ by rich parents for their daughters, the girls whose parents did not have access to this technology would be at disadvantage for receiving the marriage proposals. The disadvantage group would feel discrimination and exploitation caused by such inequality. Would this stop us from supporting the genetic engineering as the technology of the future? It is commonly known that single defective genes in individuals are carriers of deadly and painful diseases. We know that Alzheimer, Down syndrome and many blood diseases are caused by defective genes, which if found as recessive genes in parents could appear as dominant genes in children causing suffering for the whole of the life. The effective control on all such problems
is essential for the benefit of the human society. But the global society as a whole needs to answer the question that if we have the choice, would it not choose a better and healthy life for or future generations?

The future of genetic technology holds serious implications for the natural language as well. The level and role of genetic technological advancement would reshape the social structure and relationships of the society. This would need new definitions of the new concepts and this would be a clear shift in the semantic value of the existing lexicon and the re-formation of the new words, new terminology and new sets of explanation for concepts which are alien to the present day linguistic set up. How a genetically engineered offspring would create social space with his siblings who are the nature selected biological children of their parents. The following terms like carrier-mother, biological-mother, donor-parent, sperm-donor and gene-donor father have started to appear in the society in print and electronic media. The connotations of these terms reflect scientific realities which the conservative societies with strict moral values may yet take some more time to accept.

The genetically transformed child would carry the qualities which may not reflect the notions of natural biodiversity but a careful selection by a gene technology specialist who, on the request of his parents, would carry the experiment to make the child according to the personal choices or socially acceptable physical and intellectual requirements of the society. The expected repositioning of social values and the associated linguistic makeup of the society require a focused approach. This leads us to the questions: how would natural language support or change the concept of hereditary related issues and values in the changed environment? Would the genetically reformed intellectual abilities of the individuals make them smarter linguistically? Is the ability to use language related with a specific human gene? Would any change in the specific gene have any effect on the linguistic capability of human beings? Is there a possibility of making people proficient in linguistic skills by inserting the possible ‘language genes’? Would language base diseases be cured and eradicated in the future research of genetic engineering?

All of these questions have their answer in identifying a ‘language related gene’ in the human genetic code. The National Geographic News announced on
October 04, 2001 that researchers in England were able to identify a gene which was responsible for human speech and language (Trivedi, 2001). It is reported that Anthony Monaco, team leader of the research at the University of Oxford England stated,

It is important to realize that this is a gene associated with language and not the gene.

The gene was identified in repeated studies of extreme speech and language disorders found in a family KE and the gene is termed as FOXP2. The disorders because of this disease result in difficulty in the movement of lips and tongue for the production of speech. The report highlighted the fact that there could be some other genes, not yet identified, which could be responsible for more sever language and speech disorders. It is also reported that a researcher named Jane Hurst of Oxford Redcilffe Hospital found a defective chromosome 7 in British boy who had no relations with the family KE but shared the same speech and language disorder. It is interesting to note that humans possess two copies of the same gene so one defective gene could cause a major problem in human ability to speak and use language. More studies are carried out to find if there are other genes which could be responsible use of natural language by human beings.

The BBC’s online science reporter, Helen Briggs (2002) reported on August 14, 2002 that scientists were able to discover the first human gene FOXP2, which could affect serious language and speech disorders. After confirmation through several tests, it is considered one of the major events of the human gene research in the last two decades. It has generated renewed interests in the research area that there must be genetic foundation of human speech and the communication ability through language. Are there other genes linked to language and speech? We do not know as yet. For some of the observers the scientific reports on the discovery of FOXP2 were sensationalized and stretched to unfounded claims that probably FOXP2 is the gene for language and it deals with the human ability to use language in grammatically correct way. It is unbelievable that the development of natural language or ability to use language in human beings could depend on only one gene. Human speech is a complex phenomenon and involves many processes before a meaningful utterance is produced. The positioning of larynx as compared to other mammals and the
functionality of the nasal cavity in saving vowel sounds from being nasalized helps in speech production. If all of it happened during evolution than it just could not be possible in a short period of time of hundred thousand years. The cognitive and motor skills involved in human speech production rely on genetic basis; so many more genes could be involved in human speech and language. The mind needs cognition which is dependent on human speech. Some of the scientific endeavors still attempt to find the evolutionary roots of human speech. This would certainly need a close cooperation of biotechnologists, biologists and linguists. For a very long period of time they have acted in their own spheres without much of interaction and collaboration. But it is hoped that a joint effort would support the endeavors to find the evolution of language in human beings and the genetic basis of language competency in human beings. The fact is that FOXP2 is something more than what is believed to be and future research on this would give information on probably more information on the attributes of this gene or other genes responsible for the linguistic ability of human beings.

Marcus and Fisher (2003) in their article discussed in detail the important information gathered from the discovery of FOXP2 as a gene which could be responsible for the linguistic information in the genetic makeup of human gene code. They argued that language understanding and articulation may be only one of the functions of the multi functional information gene code on FOXP2. There may be others vital functions associated with the gene, including the facial movements especially the jaw movement which is so important in articulating sound. They argued that it is still too early to announce FOXP2 as the only gene establishing human linguistic ability. There are many processes that may be involved in the acquisition of linguistic competence by human beings. The linguistic knowledge is transferred through genetic codes still needs validation by researchers. The claims for finding language gene would find support only if plausible data is available for its validation. In other words, FOXP2 may be more than just a language gene (BBC, 2009). Are there more language genes? Is there more than one gene responsible for linguistic knowledge and competence? Would genetic engineering help people experiencing linguistic deficiencies? Many more questions would be raised in future for dealing with linguistic capabilities of genetically modified individuals. The human urge to know the human identity through decoding the human genome would result in redefining the relationship among humans and the placement of the individual in the
social realm. All of this would affect the linguistic concepts linked with these issues and it is expected that our reformed understanding would change the way we use natural language in future.

7.2.4 Human Cloning

The recent successes in the genetic technology resulting in the creation of a sheep and monkeys suggest that there is possibility of human cloning if not now then possibly in the future. As one of the anticipated technologies, it is expected that the technologies would be able to create human clones in the future.

So far the governments of the technologically advanced countries have put an official legislative embargo on such kind of research by giving voice to the concerns of the conservatives who fear that acts like these are playing with nature and playing God. There are serious social, religious and ethical implications of this technology. Many social groups and religious offices have severely criticized the objectives of this research technology as the identity and personality of the children produced through it is uncertain. A human clone would have genetic structure of a human being but would he share the same identity of the original or it would be different? What attributes would classify a human clone different from the original biological body? Would children produced through human cloning share equally dignified status as of normal children or they be looked down upon and humiliated just like children who are born out of wedlock in countries like Pakistan? It is a dangerous endeavor as it aims at ‘manufacturing’ children by the genetic manipulation and whimsical decisions of the technologists.

The recent experiments in cloning, like Dolly sheep have proved that severe defects may occur as result of such an experiment. It has been accepted by the MIT embryologist group that human cloning is a difficult process and it might even take thousand failures before cloning a healthy child. The Bush administration in 2002 updated the Federal Legislation of the US to include safeguards to any potential threats to human dignity as a result of human clone research (Weiss, 2002). It is feared that any adventure with human cloning may produce severe deformed human clone. This is going against the human dignity and honor. Any research on embryo is
a research on human fetus that is on early stages of human being. The technology may have potential in other fields of science but human cloning would cause serious social and ethical debate in the society and it is essential that such a potentially destructive technology be controlled in the initial stages. The technology has potential to grow in the future and would have serious effects on the human society, it is hoped that it is checked by scientific ethics and government legislations to ensure human dignity across race, gender, age, origin and level of dependence.

Unfortunately, for the third world countries like Pakistan, such issues are not on the priority list. Even though the US government has passed the federal legislation on controlling the research on human cloning, it is feared that states with trembling economies and governance may choose to allow such research for economic benefits. A global partnership in enforcing laws against this research is required to save humanity from any disgrace. The human clone research is banned in European countries and Australia. It is hoped that a UN resolution would appear soon in the near future to stop any Human clone research havens around the globe. The business opportunities and the fiscal dreams of scientists and bio-tech companies cannot be supported to put the life of hundreds of fetuses and embryos in danger for the sake of ongoing experiments.

One of the strains in Transhumanism advocates the personal choice in deciding the production of a clone child. However in the views of the researcher, such technology would not benefit the overall goal of Transhumanism which is to improve the condition of a human being. The cloning technique would create a separate individual who might be considered inferior than the original. Some ambitious scientist, like a group in china, has claimed success in the research. So what would be Bruce Lee’s clone? Would he be his genetic twin, if so then he’d be genetic son of Bruce Lee’s parents? This interpretation seems unnatural and challenging. The social space and the terms of reference for relationships and the world view of the cloned human would be entirely different from the normal biological human being. How would he create a sense of self for ‘himself’? What sort of linguistic orientation would support the meaningful communication of the human clone? As a fully grown, human individual, clone may find the semantic value of many lexicons, irrational and meaningless. The words like mother, father, family and siblings would have different
connotation for the clone. The explanation of concepts would require different orientation and approaches of socio-linguistic and psycho-linguistic frames of reference.

7.2.5 Super Intelligence

It has been a human dream to create a super intelligent machine to outsmart the best of the human brains in creativity and scientific endeavor. The aim to build super computers that can perform faster and smarter than human brain has engaged computer scientists in research activities that have resulted in creating systems that can process information at very fast speed. It will be true to state that the comparison of human capacity with the performance of a high speed processing system has lost value as now the systems are competing with each other for smart and quick data processing. Would there be a possibility of somehow connecting these computer networks with the processes of human brain or neural networks for enhancement purposes?

The achievement of super intelligence by a computer system requires compatible support from the development in the areas of hardware and software. There are two extremes in the research endeavor for creating a super intelligence. One approach is focused on modeling the human competencies as the ultimate goal of a super intelligent machine. The other approach is to create super intelligence that is beyond any comparison level of human intelligence. One thing is for sure that the creation of a super intelligent machine would give a heavy blow to some of the existing philosophical and traditional concepts about the relations of humans with society and creation of knowledge. It is anticipated that a super intelligence would be able to create other such things using technologies like molecular nano-technology and genetic engineering and may take control of the future research programs. Would artificial intelligence outsmart human beings?

As discussed in the previous chapter, projects like Kismet (2006) and ASIMO (2007) are the prototypes for future intelligent humanoid robots. They have the potential and capability of using natural language processing technology for effective communication. It is anticipated that a future super intelligent machine may use and
relate to natural language in a very different way as humans do. As elaborated in the chapter 1, that natural language is responsible for the transfer of culture and moral values. It will be important to think that how a super intelligence would perceive human language as store house of cultural traditions and values. That is surely to alter the semantic value of the lexicon. The value of words would be redefined in the context of a situation where super intelligence views the language as a tool of communication of the less intelligent-human beings.

The idea of super intelligent machines raises many serious questions which have not been discussed from the point of view of machines as yet. The questions arise: how would intelligent machines react to traditionally human controlled systems? Would there be struggle, less of survival and more of the control in the society in which active intelligent machines become an integral part of research, manufacturing, engineering, space research, and biotechnology and nanotechnology research projects? Some of the intelligent systems like Kismet and ASIMO have raised issues like if these machines are actually self aware. To some of the conservatives, the early models may not be super intelligent but they are ‘intelligent’ and it is feared by many optimists that the future models may show more capacity than an average human being. The future is unpredictable and in terms of speed of scientific research and the advancement in computer technology it has made it all the more difficult to foresee the future implications and reactions of a predominantly human society accepting the role of non-biological intelligent systems as important partners in the socio-cultural framework. This anticipated phenomenon is surely going to affect the way human beings have owned the natural language as it has been the property of human social history and for the first the time in human history there is a possibility that natural languages could be shared by the non-biological creations. The earlier prototypes may not be fully self aware but it is hoped that they would have the required intelligence to use natural language in a smart way as a tool of communication among machines and with human beings. It is also feared that the super intelligent machines may not cater to the human based ‘ethical’ character of the natural language communication. The words and related concepts of being helpful, courteous, kind, sympathy, support, compromise, leniency and compassion may get replaced with the strict adherence to the purpose and outcome of the communication act. The governing rule in the multinational corporate houses that the job is more
important and that no one is indispensable may seem to govern the human-machine relationship.

The prospects of a future super intelligence also hold the possibility of a communication network whose parameters are defined by the super intelligent machines. Would a super intelligence be able to experience creativity and use of language for possible, it is not known as yet if it would be possible, communication of feelings and experiences in prose or rhyme? Would the machine be able to make a ‘decision’ when to speak and when to keep quite? This is yet not known but it is anticipated that the linguistic domain of natural language will surely get affected with the arrival of super intelligence. It may take long time to arrive but it is sure that while affecting all other domains of human society, culture, values and human approach towards life, natural language processing is one area that will be affected for the simple reason that perhaps that is the communication tool humans use for expression of ideas, feeling, opinions and knowledge. Would super intelligence attempt to replace this with an artificial language generated by machine? This will be known only in the future.

7.2.6 Uploading

The concept of transferring computational patterns of process of brain to a super computer is termed as uploading. This could range from simple scanning of the patterns to the complete transfer of the patterns to the intelligent computer system. As one of the anticipated future technologies, it is expected that uploading of human brain would be possible in the future to attribute human like intelligence and brain process to a computer system. It is expected that neural networks would contain enough data to regenerate human brain processes in the processor of a computer system. The future research in this area holds great opportunities for the integrated research in the allied fields of neurosciences, neuro-medicine, neuro-linguistics and computer system engineering. The possible mind upload would require an efficient, state of the art compatible and high speed processing system that could accept the upload from the human brain and run that process in the real world and the virtual world. The close integration of molecular nanotechnology seems inevitable for
such a project when it is hoped that the mind pattern uploading from the minute level of neurons have to be uploaded to a computer.

The uploading process is believed to work on two levels. At one level it may work for the complete uploading of the mind when the donor human brain is completely drained resulting in permanent damage and the other level when the human donor brain could retain its own functionality and only its patterns are uploaded on to the system. The possibility of this future technology has generated many philosophical debates. The individual identity of the real person is compared and contrasted with the ‘identity’ of a computer with an upload brain of the same person. Who is the real self? The memories, experiences, the world view and perceptions of the two would be same or different, depending upon the carrier? Or let us consider the possibility that a mind upload could be transformed into several copies of patterns on computer systems of a single individual then, who would be the real ‘real’? Who will carry the original ‘rights’ for being the ‘real’? Would all copies be same as the individual? The idea of having the possibility of such a technology is surely to generate many philosophical, social, legal and religious debates. It is yet unclear how our societies are going to react to such possible technologies.

The idea of having the copied self in the virtual world and the real world in case of humanoid robots with uploaded brains is fascinating yet a possibility in the future which had the potential to revolutionize our understanding of this world and our relationship with our fellow human beings and our fellow intelligent machines. What possible effects would such technologies have on natural language technologies and communication? There is no substantial discussion or reference available on this topic. However, it is anticipated by the researcher that natural language communication would be effected by these technologies. The first and the foremost question is the development of identity and self through the use of language. What would be the I, you, we and them for the number of copies of an uploaded human brain in the virtual reality and in the systems of humanoid robot? Would the ‘real’ self be supported by copy a, b, c in the virtual world? How these copies of the self would share the linguistic knowledge and the social space? The view of the environment and the placement of self in the situation for the meaningful communication act would not be the same for the same mind living in the virtual reality, the mind operating in the
body of a humanoid robot and the mind having the natural experience in the biological body. The natural language comprehension and communication is expected to be different for three different experiences and the understanding of the self. Would the language used by the entities in the virtual world and the humanoid robots be the ‘natural language’? It would be interesting to note the response of human beings to a communication act when they do not share the experience of the virtual body or the humanoid robot in perceiving the self in the context of the environment. The semantic relationship and the sociolinguistic attributes of a communication act would need a serious attention by linguists and theorists for a situation in which human beings may not retain the pride of being the only forms to use natural language as tools of communication.

There is a sizable group of skeptics who question the possibility of uploading of human brain patterns to a computer. The group questions the functions of the proposed supercomputer for copying and keeping the biological neural patterns while retaining the human consciousness and then building on the existing knowledge to generate understanding of the new experiences. As an anticipated future technology, the debate holds potential unless proved otherwise, but what humans have experienced in the last two decades in terms of development in computer technology and the allied fields, a situation may arise for a competition of identifying the real ‘self’ in the group of human biological body with a humanoid robot and the copy in the virtual word.

7.2.7 Singularity

The concept of singularity is based on the futuristic idea that the rate of development in the fields of nanotechnology, artificial super intelligence, genetic engineering, computer technology and manufacturing technology would be so high that at one point of time the intelligent machines may take over the production and reproduction of intelligent computer systems and machines. They would outsmart the humans in technology, efficiency and control over the production, maintenance and quality line and that would the point in time future when these machines would become the decision makers in terms of the science and technological development in
the society. Vinge (1993) considered that such a possibility is likely to happen in the future and this concept of singularity is attributed to the contribution of Vinge.

The super intelligent systems produced by the intelligent systems produced by human beings would be smarter and quicker in technology and speed. It is not possible to imagine the makeup and prospects of values and social structure for such a society now but one thing can be stated that a technological explosion of this nature may happen as result of continuous human efforts to create artificial intelligent machines and systems which surpass human capacities and potential. The nature of society and the nature of communication technologies and the communication are some of the points that we may expect to be radically changed as we perceive them today. It may be a possibility that super intelligent machines may choose any other language, artificial computer language, as a tool of communication and the natural language gets restricted to be used by humans only. How would such a shift, effect the use of natural language by humans? The syntactic and semantic features of natural language may get affected by the superimposition of computer language. Would there be any implications on the communication act between humans and machines? What would be the point of reconciliation in the world view of humans and machines? The communication act and the use of natural language in such a futuristic perspective would greatly depend on the nature, condition and level of human-machine interaction and the possible social and cultural positioning of human beings with reference to artificially intelligent self producing machines.

7.3 Natural Language Communication: Opportunities and Issues

The use of natural language by human beings as a tool of communication is one of the most important advanced way of communication on this planet among living organisms. The human ability to use natural language makes us distinctive life form on this planet (Hauser et al., 2002). It is interesting to see that there is no transitional stage from the point of view of evolution between animal and human communication (Ujhelyi, 1996). The lexicons in the language constitute the building blocks in human communication system for allowing syntax to play role in creating infinite number of sentences (Bickerton, 1990 and Deacon, 1997). This helps human beings to construct the vision and describe the world around them through their own
observations. The use of language has enabled human societies to keep record of cultural data, norms, traditions and ethical values of the society intact for the future generations (Smith and Szathmary, 1995). The previous generations transfers its experiences and values through natural language to the future generations.

7.3.1 Human-Machine Discourse

The composition of human society and cultural traditions are result of years of shared experience which unites humans in bond of affiliation in an area. Human language is the storehouse of human culture, value system and the set of beliefs. The language is responsible for sharing the common knowledge database of the society and then transmitting it through time to next generations. With the passage of time, human language changes and the language change corresponds to the other changes in the socio-economic and cultural traditions of the society. The innovations in technology have generated new trends in language change. The future society holds the possibility of intelligent machines using natural language as tool of communication for a meaningful discourse among machine and with human beings. As discussed earlier, speech comprehension and speech generation systems have reached the level of competence that they can integrate and synchronize the audio and video input for comprehension of both linguistic and paralinguistic features of a communication act. This creates the possibility of these artificial intelligent machines to use natural language smartly, starting from simple forms of language and leading towards more complex use of the language. The major challenge for the future researchers is to evaluate whether an intelligent computer system would be able to use natural language in a creative way. Should we expect beautiful piece of prose or poetry from a humanoid robot or computer system or is it too early for such an expectation? Changelosi and Parisi (1998) and Kirby (2001) suggested that it is possible for simple cognitive structures to develop meaningful communication patterns through the use of natural language. Later Steels (2003) discussed these possibilities in detail and termed it evolutionary linguistics in artificial life forms and artificial intelligent systems and humanoid robots.

The new forms of communication between humans and machines in the future would develop new learning patterns for robots to understand human cultural norms,
traditions and ethics in a pragmatic way. It is possible that the use of natural language by intelligent machines among themselves would create a ‘social’ experience for machines which is distinctive and somewhat alien to human understanding. The future society of human beings may experience a dramatic change in the communication pattern and norms as the artificial intelligent systems become an integral part of the human future society. We may experience new form, structure and frame of reference of natural languages in the future society.

7.3.2 Resolving Ambiguities in Communication

Another important issue in the human-machine communication act using natural language is the resolution of ambiguities in the oral communication. If something could be understood in more than one different ways, it is termed as ambiguous. Would intelligent systems be capable of responding appropriately to ambiguous speech utterances in a communication act? The discussion in the chapter four and five has revealed that Kismet (2006) and ASIMO (2007) have achieved considerable success in resolving the issue of ambiguity in human-machine communication. However there is danger of ambiguity in the oral communication of natural languages. In a speech discourse, the job of a listener is more difficult as he has to decode the meaning in the spoken utterance. No two speakers have the same language because no two speakers have the same experience of the language. The experience of an individual, human and intelligent machine, as listener and speaker consists of speech of other individual speaker, each of whom is unique. Ambiguity in listening is an area of considerable importance. There is a famous axiom which says that all languages can be misinterpreted and this causes ambiguity. The problem of misinterpretation or ambiguity is caused by context, structure and content words in a speech discourse. The ambiguity in listening is not necessarily because of the lack of cooperation in the communication act. Simple utterances can cause ambiguity if the listener, human or machine, is not able to decode the meaning in speech utterance.

There are least chances of ambiguity in affirmative sentences and there are more chances of ambiguity in negative utterances. In speech utterance, ambiguity could be caused due to stress, intonation and paralinguistic features. An affirmative utterance can be made a question with the help of intonation.
For example: Ahmad ate fish in the mart.

How would a speech comprehension system deal with these small points? The research has shown, as sighted in chapter three and four of the research that speech comprehension systems have advanced to a notable level of resolving issues of ambiguity in sentences as mentioned above. There is limited possibility of ambiguity in affirmative sentences but it can be made more ambiguous by loading it with stress, intonation and paralinguistic features like facial expressions and gestures. In negative utterances there are more possibilities of misinterpretation. For example in the following sentence:

Ahmad did not eat fish in the market.

There are chances of ambiguity, if Ahmad ate fish at home or he ate something else at the mart or he drank something in the mart or he ate fish somewhere else or someone else ate fish at the mart or Ahmad bought the fish and did not eat it there. There can be a number of possibilities. As discussed in chapter five, the researchers have taken a lot of pain working on these issues and the speech recognition and comprehension systems developed for Kismet and ASIMO have the ability to evaluate the stress, intonation and paralinguistic features of speech utterance and then link them with the audio-visual signals received from the system to achieve a level of understanding that is less ambiguous and relevant with the context of the communication act. It is anticipated that the future research in natural language technologies would minimize the rate of ambiguity in speech recognition and speech generation systems in humanoid robots and intelligent computer systems.

There is need of success in speech recognition research for a clear understanding of the speech utterances. Listening is not just receiving. Listening also involves processing. Listening is very much a participatory function. Listening is predictive and it is also anticipatory in function. There are instance when a listener, human and computer system finds it difficult to decode that exact message in an utterance. It is believed that for listeners, ambiguity can be caused at number of levels, that is, lexical ambiguity, syntactic ambiguity and phonological ambiguity. In
oral communication, phonological ambiguity arises at the level of surface structure rather than the deep structure.

For example:

1. Psychotherapist = psycho – therapist
2. New day           = nude, eh?

Lexical ambiguity is caused by words which have variety or shades of different meanings in different situations and different contexts. More problematic are the words whose senses express closely related concepts.

‘Good’ for example, can mean ‘useful’ or ‘functional’: That’s a good hammer.

It can also mean ‘exemplary’: She is a good student.

It can also mean ‘pleasing’: This is a good soup.

It can also mean ‘moral’: She is a good person.

In oral communication, the speaker has the advantage of correcting oneself whenever there is a kind of ambiguity and the listener may also request for a clarification if there is an anticipated lack of understanding. This is called repair mechanism. The concept of active participation and repair mechanism by the humans and intelligent computer systems in a human-machine communication act can considerably minimize the chances of ambiguity.

The use of natural languages by the present ‘computer generation’ is remarkably different in text and speech from the previous generations. The growing use of abbreviations, smileys, deletion of vowels and stress on the use of consonants in written form of language in emails, blogs, Facebook and sms may change the written format of the natural language permanently. The computer mediated communication and, as discussed earlier, the human-machine communication in the future would have an effect on the discourse pattern in the society. The cost and time of communication act would affect the use of lexicon and syntax to convey the desired message and meaning in the shortest possible and more direct way. This
would relieve the natural languages from any ‘baggage’ and would facilitate more crisp and to the point communication act. The experience of the virtual reality has created an experience for the computer generation and the Transhuman generation of the future that the traditional meanings of many words would change dramatically. Thus, the present and the future technologies would drive natural languages to incorporate understanding of the changed and improved reality on a totally different scale of physical and virtual reality.

7.4 Techno-globalization

It is in the last two decades that the term globalization has become part of serious discussion. The term Techno-globalization has attracted the interests of researchers only recently. The reference is to the shared experience of humanity on the face of the earth for a common goal for the future and for a shared understanding of the issues and problems faced by global community. The term techno-globalization refers to the common use of technology by human beings in all societies and countries with different cultural backgrounds but they share the benefits of the advancements in the field of science and technology. An iPhone, iPad or a Nokia PC phone carries the same value in terms of functionality for people living around the globe. The phenomenon of globalization has transcended the sense of territory and provided more opportunities of connection across race, religion, gender and territorial origin. The techno-globalization is based on the use of state of the art information communication technology, internet and growing telecommunication technology to bring people close to each other across the globe. Scholte (1996) observed:

> global events can- via telecommunication, digital computers, audio-visual media, rocketry and the like-occur almost simultaneously anywhere and everywhere in the world.

The idea of de-territorialization deals with the shared experience of events and communication networks, seen globally without any restrictions of geographical positioning of people. It refers to a more advanced way of communication which may not necessarily be the face to face communication. The concept of geographical territory has transformed into the concept of virtual territory where the virtual world
or the space on the information highway is available to people across the globe for communication through audio-visual modes, digital video conferencing and live interactive television broadcast. The concept of techno-globalization refers to fusion of territorial boundaries into new patterns of social interaction which is non-territorial in nature and reaches the homes and workplace of people across the globe (Scholte, 2000).

Another important aspect of techno-globalization is the ability of human societies to sustain reliable connections across the globe. This connection is beyond the social and geographical boundaries. The idea of de-territorialization is linked with growing connectivity. The access to internet and the modern gadgets of telecommunication networks have made it possible for events and communications to influence opinion and human perception. The communication patterns of a geographical location get influenced and transformed by the agents of change in a distant geographical location through the use of information communication technology (Tomlinson, 1999). The interconnectivity has increased possibility of globalization of language and communication patterns. The terms, linguistic items like slang, assimilation in phonetics and increased used of consonants in word representation in written forms while dropping vowels may reach the suburbs and rural areas as quickly and efficiently as it becomes the part of the popular culture of communication through information communication technology in urban centers across the globe. The influence of human social activity has far reaching effects as it gets transmitted through modern means of communication. This has encouraged in promoting a common human experience and knowledge database across the globe (Held et al., 1999). The economic, political and technological hegemony of industrially advanced countries would enable them to promote and share the experiences and knowledge in their respective languages, thus making these languages influential in human societies and regions which have totally different cultural framework for the use of natural language.

The advancement in information communication technology and state of the art telecommunication networks enabling the high processing speed of a personal computer in a cell phone has created new vistas of high speed information flow and establishment of communication networks. The fusion of territorial boundaries on the
cyber world with growing opportunities for individuals to communicate and to influence perceptions of people across the globe has created a global network of cyber communities. The social life of human beings is inevitably linked with their high speed activity on information highway through emails, blogs, twitter, video conferencing, interactive chat rooms and cellular networks. The pace of social life in the corporate and industrially advanced countries is directly related with the speed of globally shared communication and sharing of human experiences (Scheuerman, 2004). The modern world is experiencing the effects of techno-globalization as has never been experienced before in the human history.

Globalization has appeared as the integral constituent part of the experience of modern, technologically based life style of human beings across the globe (Giddens, 1990). However, it should be noted that the effects of technology on the shared global experience are not uniform across the globe. There are many regions and societies who have yet to experience the technological boom that shook the western world and took the social communication to the new heights. For example in countries like Pakistan, probably the access to modern technological advancement may not be a problem in the introduction of techno-global culture so much as is the lack of infrastructure and basic utilities like sustained supply of electricity. On the whole, the impact of technological advancements in creating a global technology based shared cultural experience is notable as the people who may not be directly related with the new technologies have felt a change in their lives in so many different ways that even if they are not the consumers, they get influenced by the changing attitudes in the society (Eriksen, 2001).

The concept of globalization and to be every precise the techno-globalization effects the society in many different ways. It helps in changing the perceptions about concepts, building or changing of perceptions about concepts which may be alien to the immediate cultural frame of reference and introduction of new concepts in natural language which would probably be hostile to the host culture. Let us take the example of recent issue between the Chinese government and the Google Company. The Chinese government decided to ban the Google search engine as it attempted to share the globally, or western, accepted norms and values of democracy in a controlled society like China. The language content and connotations of lexicons are
perceived differently in different societies and this may not be acceptable in certain societies and governments. It is important to highlight the issue that in the techno-global culture, it would be difficult for societies to control the flow of information and communication and to restrict the use of language only for the purpose as decided suitable by the government.

The Techno-global culture with its fast speed and access across boundaries and regions would find its outlet beyond the government control. It is anticipated that techno-globalization would raise conflicts and would also support resolution of conflicts. The multinational companies working across the globe and catering to the information and communication needs of people of different cultures, religion and gender are promoting the stereotyping of concepts and references similar to producing a single item for people of the whole world with one same agenda and unified purpose (Castells, 1996). The words like Jihad, terrorism and militancy have become globally accepted concepts with the same meanings. The media networks working ‘around the world and around the clock’ have facilitated the generalization and globalization of meanings which have achieved global acceptability. The large media groups popularize and then promote words with loaded meanings which may not have any connection to the region’s history and social structure but it would allow a generalized opinion formation for any hidden agendas, political and economical interests.

The techno-globalization has raised critical issues of generalization and acceptability of opinions, proposed facts and the real facts. The growing access of the information communication technology and the World Wide Web has encouraged individuals and groups to generate information and communication networks for negative and positive reasons. Jodi Dean (2000) raised the voice of concern:

On the web, abundance, immediacy and availability seem dangerous fuel for suspicion and obsession. They threaten-exceed- a public sense of the bounds of truth and trust, and in so doing, hint at conspiracy.----- In traditional media and political representations of the web, moreover, these excesses produce a flattening of distinction between authorized and unauthorized, official and covert, expert and amateur true and false that seems to threaten reason, democracy and the bounded stability of the nation.-----the language, metaphors and fears of
conspiracy in which the current thinking about the world wide web is imbricated and draw our attention to the problem of the public informing anxieties around the web’s excesses.(63).

The huge networking capacity available to human beings in the age of internet and communication technology have enabled them to establish discourse with people around the world without any discrimination of race, gender, identity and social and educational background. But this has increased the unpredictability of the communication act. The validation of facts and the sense of association with a partner in conversation gets mixed in the concepts of virtual reality and cybernetics. The threat to young children being exposed to pornography and unchecked interactive forums and the threat of encountering fake virtual identities are serious causes of concern for human beings who do not wish to see the future generation being termed as the passive consumers of information communication technology. The harmful effects of the techno-globalization should be seen as the real threats to the stability of human social structure as the advancement in technology is posing new challenges for our traditional understanding of human society and culture.

The speech comes naturally to human beings in every culture regardless of their socio-economic and educational background, provided they do not have any psychological or physiological disability. The socio-cultural information in the society gets linked with the linguistic understanding for human beings to produce meaningful utterances. The growing use of technology in the human society creates an impact on human consciousness and understanding and the socio-cultural value systems of the society. The use of natural language gets affected both ways. The technology helps to enhance the human experience in a social set up. The use of technological tools has enriched the human psyche, supported the human enthusiasm and helped in changing the human perception of the world around him (Ong, 2000, p 81). It is necessary to accept the advancements in science and technology as a support to developing natural language technologies for artificial intelligent machines and as means of support to comprehend and generate natural language for individuals who have any sort of linguistic disability
The natural language technologies in humanoid robots and computer systems have their basis in constituent technologies of natural language comprehension technologies and natural language generation technologies. It includes the collaborative effort of researchers to enable computer systems to comprehend natural language by keeping the focus on all the complexities of human language and all the possible levels of ambiguities which a meaningful utterance may have. The comprehension system also focus on the synchronization of audio and visual signals for making a complete understanding of the communication act and also by focusing on the paralinguistic features of the natural language. The natural language generation systems get the basic information from the comprehension system and then works on the selection of appropriate lexicon and syntax to match the received speech input. An effective speech generation system then generates meaningful speech utterances. The process of generation involves ‘artificial’ and ‘smart’ decision making for the appropriate response to a speech input. The complete process of natural language generation is based on the theory of utterance generation in a context. This theory assumes a speaker in a particular situation acting as active listeners and speakers in a real time and space with a motivation to speak and listen in a communication act. The speech generation by a humanoid robot and a intelligent computer system is the decision of the system to decide what to say and how to say it, that is, the process is engraved in locating the intelligent computer generation system in a situation, supported by the participants of the communication act and the meaningful utterances generation for a clear motivation and purpose.

The oral communication of natural languages involves two or more than two participants. These participants could be humans and humans and intelligent speech generation systems. They share or assume to share some mutual knowledge. The speech act between the participants could be composed of repetitive utterances which may not necessarily be well formed sentences. The selection of lexicon is based on the assumed mutual understanding of the meaning and the focus and purpose of the discourse. Largely, oral communication consists of utterances with simple words and simple structures of the natural languages. The human beings have the capacity to alter their speech depending on the needs of the situation and normal communication skills can be twisted to manipulate people. For a meaningful human machine
communication act, the intelligent speech generation system should have the capacity to understand and manipulate the human attributes of oral communication.

What kind of ‘social’ relationship these intelligent systems would create? How a meaningful discourse would be generated between human beings and machines and how that would have an effect on natural language usage by humans? What kind of linguistic relationship would be established by the artificial intelligent systems with the natural language? Would their language remain natural to human beings? These are some of the questions which would require attention of the linguists, computer science researchers and the social scientists to purpose the future course of development of natural languages in societies which would share the presence of human beings along with humanoid robots, computer systems and the generation systems in the virtual reality.

7.5 Natural Language Technologies: Social Issues

The previous discussion focused on the practical issues related to the natural language technologies and natural languages used as tool of communication between humans and intelligent machines. This section of the chapter briefly refers to the issues related to social and moral values of the human society and the impact of the emerging and existing technologies on natural language communication act. The speech generation systems are projected to have a great influence on the social belonging of the human beings and the communication act. It may raise security issues in this era of global terrorism when non-friendly artificial intelligent systems could be used as part of propaganda machines to influence the mindset of a community or group for vested interests. It is also feared that the growing use of the technology would increase the global technology divide and the gap between the haves and have-nots would threaten the global peace and security. The language technology may support large multinational companies to think of global job cuts, for example the anticipated job cuts in Call Centers when intelligent speech comprehension and speech generation systems would be available round the clock for global consumers. These intelligent systems would ensure highest level of perfection and professionalism. This would result global unrest as people in growing economies
like India and Bangladesh may lose their jobs at the hands of intelligent computer systems.

Global peace and security has become a very important issue in recent years. A speech technology program, termed as TTS that is text-to-speech technology developed by AT&T research labs claims to reproduce the voices and sounds of the celebrities and the dead people in the most accurate manner (The New York Times, 2001). This technology is also termed as Voice Cloning. This technology is commercially available and raises many serious concerns. For example, through the use of this technology, many utterances, remarks could be attributed to individuals and/or celebrities which were never said by them. The refined version of the software, called Natural Voices, is able to attain maximum accuracy and it is difficult for anyone to distinguish the real voice from the processed/synthesized voice. There is also a possibility that people might be fooled to believe that they are getting telephone calls from the acquaintances when in reality they are getting calls from digital voice cloning systems. This could become serious as well as very recently; there was misunderstanding between two nuclear states, India and Pakistan, who were at the brink of war due to a wrong call. Pakistani president claimed that he received a threatening call from the Indian foreign minister and he immediately informed the US secretary of state, Hillary Clinton in early hours of morning. On the other hand, Indians claimed and tried to explain to the Americans that no such call was ever made. This highlights the point that there are chances of misuse of this technology. However, this technology could be greatly beneficial for converting the large database of textual information into voice recording.

Natural languages are considered as a sacred and credible source of information on cultural values, norms and traditions. The natural languages are the carriers of the moral knowledge base of the community and society. How would moral concepts be developed for intelligent computer systems? Would they borrow the traditional concept of binary opposition in cultural and social issues of humans? Human beings understand the world around them in socio-cultural framework. What would be the frame of reference for the intelligent machines to develop understanding of the natural language? If these machines rely on human knowledge for language generation, then their language would carry a ‘human’ orientation for the
understanding of the concepts and the development of the world view through language. Would conscious machines be able to develop their ‘mechanized’ orientation of the natural language to keep it distinctive from the natural language used by humans?

This would make the situation very complicated for the socio-cultural norms of the future society as something unethical and immoral from the view point of human being may carry ‘neutral’ or harmless value from the view point of intelligent machines. The concepts like satisfaction, enthusiasm, tiredness and boredom may cease to carry the traditional meanings for the intelligent machines that may never have to experience such feelings. Would feelings matter for conscious machines? The sexual desires would remain human specific issue as gender would cease to exist as socio-cultural identity for intelligent machines. This would eliminate any biases based on gender. This would also have an impact on the gender based references in idioms, phrases, words, concepts and jokes in natural languages which ridicule the feminine gender. In a human-machine communication act such references would only be pieces of information for the intelligent machines that would have no socio-cultural affiliation or understanding with the meanings of these utterances.

7.6 Chapter Conclusion

This chapter of the research concludes the study of impact of existing and future technologies on natural language technologies and communication in the broader framework of Transhumanism. The chapter discussed in detail the potential of future technologies like molecular nanotechnology, genetic engineering, human cloning, information communication technology, mind uploading and the concept of singularity. The introduction of each technology is followed by the discussion on potential impact of the technology on the communication act in the future society. It is concluded from the discussion in this chapter that future technologies have the potential to create noticeable impact on natural language technologies. Molecular nanotechnology could support creation of nano-scale systems and speech generation systems. The possibility that such nano-scale systems would have a large linguistic database for quick referencing with high speed data processing makes the future of information communication technologies and telecommunication more fascinating.
In the Pakistani perspective, a lot of financial input has to be made by the government and the research institutes to encourage research and establishment of appropriate infrastructure for the future emerging technologies. The future is surely going to be technology driven world for any economy to survive. The investment in human resource development in the future technologies would be greatly beneficial for Pakistan. In the field of natural language technologies, future technologies would certainly have an impact on the way humans use natural language as tool of communication. There is every possibility that intelligent machines would contribute in the linguistic database of natural languages. It is hoped that Pakistan would contribute its share in the research in developing a reliable and sustainable speech processing system.

The discussion in this chapter leads towards the findings of the research, contributions of the research and conclusion of the research. The anticipated technologies carry immense potential and hope that it would be possible to create more advanced and sophisticated versions of Kismet (2006) and ASIMO (2007) and other intelligent systems which would be able to communicate with humans and other machines using natural languages. The Transhumanist vision of using technology for the betterment of human society and individuals can be materialized in developing state of the art natural language comprehension and natural language generation systems. The market feasibility of products of natural language technologies would encourage more research funding in this area. However, it is unlikely that intelligent humanoid robots would replace human beings in workplaces and markets in the near future. But the fact remains valid that there is a ‘real’ possibility in the future for human beings to co-exist with intelligent machines in a society loaded with technology driven life style.
CHAPTER 8

SUMMARY, FINDINGS, CONTRIBUTIONS AND CONCLUSION

8.1 Summary

The research focused on the natural language technologies with a focus on speech comprehension and speech generation technologies and the new concepts in communication as they get affected by the present and the future technologies within the theoretical framework of Transhumanism. The research is an attempt to consolidate the information available through research work on the topic to identify the potential of practical applications of natural language technologies. The research consolidated information on the topic for the researchers in the allied fields of linguistics, sociolinguistics, psycholinguistics, computer science and cognitive science. The research began with the discussion of human fascination with machines capable of communication with the human beings just like human beings. The research attempted to locate the natural language technologies and communication act as they get affected by the present technologies like artificial intelligence and the future anticipated technologies molecular nanotechnology, information communication technology, genetic engineering and possibility of super intelligent machines working in the form of humanoid robots, Cyborg or intelligent computer system.

The research is a detailed account of human journey from science fiction to imaginative portrayal of unbelievable yet fascinating intelligent machines on the celluloid for the feel that one day it would be possible for intelligent machines to communicate with human beings. The human machine communication and the possible machine-machine communication using natural language in oral
communication has become a reality, thanks to the successful research in the last two decades. Kismet (2006) and ASIMO (2007) can be termed as the two prototypes which have acquired an understanding of the human communication act and which can actively participate in the communication act by fully adhering to the sensitivities of linguistics and paralinguistic features of human communication.

The first chapter is the introduction of the key concepts and the theme and the vision of the research. The first chapter explains the objective of the research to consolidate the existing research work and signpost it for future researchers. The first chapter is a comprehensive account of the purpose of the research and the importance of the research topic in the perspective of present and future technologies. The chapter highlighted the limitations of the research in the Pakistani context.

The second chapter discussed the research methodology, research design, research documents, research framework and literature review of the research. The chapter provides comprehensive account of the theoretical framework of the research and explains the relevance of these theories with the discussion in the research.

The third chapter begins with the description of human fascination with machines perceived as active social partners in human society. The chapter discussed the historical references from Chinese toys to the earlier science fiction of stories of Oz and this led to the rise of interest in the phenomenon of talking machines with the growth in computer and other related technologies. This is perceived as the basis of sci-fi literature and the cyberpunk literature and culture in the technology driven world. Also the increasing global appeal of the science fiction cinema is discussed to showcase the level of interest and the impact of these onscreen ventures on recent research activity related to natural language technologies. The chapter concluded with a detailed account of natural language technologies and the contribution of these technologies towards a human-machine communication act.

The fourth chapter discussed the potential and prospects of achieving machine consciousness and the possible challenges involved in developing a meaningful speech discourse between conscious machines and the human beings through speech utterances. One of the major questions for the researchers in the field of artificial
intelligence has been the issue of assigning consciousness to the machines. The chapter discussed in detail the different viewpoints of researchers on the potential of machines to acquire consciousness. The chapter highlighted the viewpoint of optimistic researchers of artificial intelligence that machines could think and use linguistic database to respond to meaningful speech utterances of human beings.

The fifth chapter is the presentation of success stories as credible supporting evidence for the argument in support of establishing an error free and reliable human-machine and quite possibly machine-machine communication act using natural languages. The discussion on humanoid robots like Kismet and ASIMO reveals that they have the capacity to integrate audio and visual signals for synchronization of gestures and facial features of the speaker for a comprehensive understanding of the purpose and need of speech utterance used by the speaker. These humanoid robots and intelligent computer systems for speech generation provide evidence of the achievements of present day research in natural language technologies and artificial intelligence and the possible implications of these technologies on human-machine communication act.

The sixth chapter in the research is included to highlight the potential, limitations and achievements of speech technology research in Pakistan, India and Malaysia. The discussion in the chapter is an attempt to highlight the achievements of research groups in these countries for development of speech products for service industry and business sector. Indian and Malaysian companies are investing in the research projects for developing speech processing systems for health, education, telecom industry, agriculture, car navigation and defense industry. In Pakistan, the support is still required from the corporate and industrial sector for sustained research activity in speech processing technology.

The seventh chapter discussed in detail the possible implications of the present day technologies and the anticipated technologies of the future in the broader framework of Transhumanism on the dynamics of human-machine communication act and the possibility of intelligent computer systems and humanoid robots ‘acquiring’ the natural language as tool of communication among machines and with the human beings in a real social set up. The affect of techno-globalization on
communication act in natural languages is discussed to reveal the fact that technology would be a decisive factor in bringing a change in natural languages. This would generate social issues related to natural language usage as in the near future the intelligent computer systems, Cyborg, humanoid robots speech systems in virtual reality and intelligent systems would coexist with human beings in industrial manufacturing, engineering fields, biotechnology, speech research and quite possibly in normal human social life.

As earlier expected and mentioned in the first chapter, the research answered some of the questions and generated more questions which would be starting point for the future researchers working in this field. For many of the questions, time may provide the best link for a possible resolution. For other questions, the advancement in the field of computer technology, nanotechnology and the artificial intelligence would provide the basis of resolution. The questions related to the linguistic aspect of the research need a careful examination by the future linguists as the natural language is surely going to get affected by the technological change and advancement. There is a ‘real’ possibility that the natural language may not remain the only property of human beings. The inclusion of other active and intelligent systems in human society would create a different experience of the language and that in turn would create a different view of the world. This knowledge of the language would not be shared by the human beings as the experience of the natural language would cease to be human. This would be a new experience for the humans as historically natural languages developed as part of the shared knowledge of the human society and the language carried the cultural traditions and norms of that society. How would languages shape up and grow in the technologically advanced society and what effects on syntax, lexicon, semantics and context association would be experienced by linguistic items is yet to be seen.

8.2 Findings of this Research

The findings of this research are focused on the vision of potential role of natural language as tool of communication in the human society which would have intelligent speech recognition and speech generation systems using natural language for communication.
8.2.1 Objectives of the Research

The research study achieved its objectives of carrying out a study of the natural language technologies to find out the potential of growth, practical application and the anticipated technological development in the area. The study achieved its objective of identifying the potential scope and impact of present technology like artificial intelligence and future technologies like molecular nanotechnology, genetic engineering, human cloning and creating super intelligent machines on natural language technologies and communication. The research study achieved its objective of focusing on the issues related to the natural language technologies research and communication act between humans and machines as it gets affected by the technological advancement. As earlier expected, the study found answers to some of the question raised during the research and it posed a set of new questions. These new questions will pave the way for the future researchers in this field.

The research study achieved its objective of providing credible evidence of the fact that in the last two decades, it has been established scientifically that artificial intelligent systems and machines can be developed for a sustainable and meaningful discourse between humans and machines with minimum chances of misinterpretation and ambiguity. The researcher found that further research is focused on developing technologies to enable intelligent machines to communicate with each other using natural language. The study established the fact that the existing and the future technologies have the potential and the basic infrastructural capacity to support artificial intelligent systems that can show comprehension of linguistic and paralinguistic features of human communication patterns. The study also found credible evidence of potential of future technologies to support natural language technologies and speech technologies to open new vistas of opportunities for the use of these technologies in entertainment, corporate sector, medicine, legal system, transport navigation and telecommunication.

The research study attempted to look for evidence that the technologies can integrate for producing an intelligent machine that would ‘own’ natural language, understand the purpose and intent of the utterance and the non-spoken part of the communication act and then respond in a meaningful utterance, gesture and/or posture.
for a complete meaningful communication. The study referred to the strong possibility that increased processing speed would support the quick access to large database for establishing multipurpose speech generation systems for more efficient consumer services online and on the display center.

8.2.2 Theoretical Interface

The developments in the existing and future anticipated technologies discussed in this research will have a strong impact on the human beings and human society. The critical analysis of the different technologies and relevant issues, discussed in this research, is carried out from the perspective of linguistic and other theories. Transhumanism provides the overall theoretical framework for this research as discussed in detail in the beginning of this chapter. The critical approach raises many intrinsic questions during the discussion of technologies and looks for possible answers to these queries. The answers to so many questions raised in the discussion are not known as yet. Theoretical framework of Transhumanism facilitates the discussion of potential, strengths and limitations of speech comprehension and speech generation technologies for a logical and sustainable human-machine communication act.

The human perception of the world and the experience influences the use of language by human beings. If a machine could realize its existence as ‘machine’ then the social reality and the experience of the world would influence the language of the machine. Two individuals do not have the same language as they do not have the same experience of the language. The question arises: would it be possible for machines to have the same knowledge of the language when their ‘experience’ would be totally different from that of human beings? Human utterances have meanings in a social context. The social context of a lexicon or phrase is part of human experience of the language. This leads us to the question: would the intelligent machines share the human understanding of the social reality? Speech reflects the individual’s identity, personality and self awareness. A meaningful speech utterance signifies the awareness of self as a distinct individual. The artificial intelligence research is focused on creating this self awareness in system for possible logical human-machine communication act (discussed in detail in chapter four and five). The other
multidisciplinary theories provide the framework to evaluate the feasibility of a truly functional speech processing system for human-machine communication act. These theories debate the functionality of machines for the possible awareness of the individuality. Speech processing ability of a system has to be linked with the conscious awareness of the system for a sustainable, logical and meaningful communication act between humans and machines. As discussed in detail in chapter four of the research, the present day artificial intelligence research is focusing on developing some level of machine consciousness.

The linguistic theories and other multidisciplinary theories subsume in the theory of Transhumanism, which draws supporting strains from multiple theoretical approaches for the practical use of technologies including artificial intelligence, genetic engineering, information communication technology, uploading, singularity and nanotechnology for a sustainable and logical human-machine communication act. In the context of this research, the multiple theories contribute to form the theoretical base for the artificial intelligent systems and humanoid robots to use natural language as tool of communication with human beings.

The core concepts of multiple theories are used to strengthen the composite framework of critical discussion and analysis in this research. Transhumanism provides the theoretical interface for the critical analysis of the issues raised during the critical discussion in this research.

8.2.3 Research Material

During the course of the research, it was found that there is scarcity of research material and literary sources on the topic of the thesis at the international level. Much of the research work on the subject, as sighted in the thesis, is carried out in the major technological centers of the world like MIT research laboratory, Stanford research laboratory, some of the European Union countries and Japan and presented as research papers in proceedings of international conferences and workshops. It was challenging to find the literary sources on the selected topic as very few attempts have been made on the discussion of the possible implications of present and future technological developments on the natural language technologies and natural
language communication in the human society. It was also found out during the study that the success stories in the field of artificial intelligence have not been fully translated into practical and financially feasible consumer based natural language applications and speech processing products in the market as yet.

The study revealed that the successful prototypes of intelligent speech recognition and speech generation systems like Kismet (2006) and ASIMO (2007) are very expensive and it was challenging to get the hard core design information for the purpose of this research. The researcher could access only what was shared publicly on the official websites of these systems. By having a complete understanding of the copyright issues and the market dynamics of sales and patent rights, the study found the need of dissemination of research information on the natural language technologies other than what is available in research journals as research results. ASIMO has made a beginning by signing a memorandum of understanding with a European university for complete access of the design template of ASIMO to the university graduates. It is anticipated that this would be expanded further as more corporate houses take interest in the natural language technologies as feasible profitable market entities. In the beginning it is anticipated that these technologies would cater to the needs of researchers and businesses using expensive consumer based products, for example, language recognition and language generation systems in cars, automobiles, aircrafts and air traffic control. It is also anticipated that natural languages dominating the research and technological developments in the countries like USA, Japan, Germany and EU countries are likely to dominate the future products in natural language generation and natural language comprehension systems.

8.2.4 Research Situation in Pakistan

In the context of this research study, the research situation in the field of natural language technologies, including speech recognition systems and speech generation systems, for artificial intelligent systems in Pakistan is not very encouraging. In fact the research in speech processing technology in Pakistan is at very early stage and focuses on text-to-speech interface. The research projects discussed in chapter six of this research reveal the fact that speech recognition technology research in Urdu and other Pakistani languages is at an early stage. The
research activity is also slow due to shortage of linguistic data and speech data in Urdu and other Pakistani languages. During a survey of the major universities of Pakistan in the four provinces and Azad Jammu and Kashmir, it was found out that departments of linguistics and departments of computer sciences have no coordination and collaboration for undergraduate and/or post graduate research or coursework program in computational linguistics, natural language technologies for intelligent computer systems and humanoid robots. The linguistic departments of Pakistani universities do not offer courses in computational linguistics and networking in collaboration with the computer science department. The computer science departments have rarely any program options for natural language technologies and development of intelligent computer systems for human-machine and machine-machine communication using natural language. The previous section discussed the scarcity of literature on the topic of the research around the world. The situation in Pakistan is not very encouraging with reference to sustained indigenous research activity in Pakistan (by December 2007). However, by the time this research completed, some research groups started working on speech processing technology in Pakistan, as discussed in detail in chapter six of this research.

In the existing literature, there is no evidence of an indigenous speech generation technology research in Pakistan. The project for speech controlled robot (SMART, 2011) is an encouraging project as it focuses on speech recognition technology which translates the speech input into an action and makes the robot to move to facilitate the disabled. The study conducted by Rosenfeld & Hussain (2011) represents a sporadic activity in the speech technology research in Pakistan. Despite its limitations, this study has contributed in the development of Urdu speech database and speech recognition system but it certainly had limited objectives. The contributions of researchers like Raza et al (2009), Raza (2009), Sarfaraz et al (2010) and the promising projects like Speech Controlled Robotic Arm (SMART, 2011) are important initiatives for speech processing research in Pakistan. The professional expertise at three research centers, Center for Research in Urdu Language Processing at National University of Computer and Emerging Sciences, Lahore, Center for Language Engineering at University of Engineering and Technology, Lahore and SMART Lab at National University of Science and Technology, Islamabad, needs to be integrated for focused efforts for developing indigenous speech processing systems.
in Pakistan. The corporate, industrial and the telecom sector in Pakistan also need to join hands with these research groups to encourage the researchers to develop speech processing system in Urdu and other Pakistani languages. It is suggested that for the future development of the natural language technologies, a close coordination of linguists with researchers in the field of computer science, artificial intelligence, engineering and robotics is absolutely essential for a comprehensive understanding of the issues involved in natural language comprehension, generation and human-machine communication act.

In the context of natural language technology research, the situation in Pakistan is far from satisfactory. In the initial stages of research, the researcher found it very difficult to locate any reference material or document in any of the Pakistani university or research institute (by December 2007). The research projects in Pakistan are still at very early stages of product development and there is still a long way for universities and research institutes to establish a natural language technology research centers to compete with the changing trends in the international research scene.

8.3 Contributions of this Research

8.3.1 Global Contribution

The research is anticipated to add to knowledge database of existing literature on Transhumanism and Natural Language comprehension and generation technologies at the international level. The research would encourage other researchers, especially linguists to probe the questions raised in this research. It is also anticipated that this research would encourage interdisciplinary approaches in linguists to evaluate the possible implications of technologies on natural language technologies and eventually on natural languages. The research would be available as a consolidated reference document for future researchers who would be interested in Natural language and Speech processing technologies. It has tried to collate the evolution of the research and work done in this field in one concise document that may signpost the important developments that have taken place in this area.
8.3.2 Contribution in Pakistan

The research introduces a completely new field of study in Pakistan. It is hoped that this study would generate interest in researchers to carry out indigenous research projects on speech comprehension and speech generation technologies for artificial intelligent systems. It is anticipated that the research would encourage linguists for interdisciplinary approaches in research projects for a better understanding of the impact of techno-globalization on regional languages. It is hoped that the research would encourage linguists to plan joint research projects with computer scientists, genetic engineers, mechanical engineers and robot experts for natural language technology research in Pakistan.

Pakistani linguists are working in varied fields of the discipline. Multiple software are being used for the research in pragmatics, semantics, syntax and other related areas of linguistics. This research is a step forward, in fact, a pioneering step forward to provide insight into an unchartered territory that will soon become a familiar process for the world. Pakistan is a stake holder in this arena and this research establishes that despite paucity of resources in terms of materials and facilities, we can still explore areas that were previously remote.

8.3.3 Academic Contribution in Pakistan

The research has highlighted the fact there is lack of academic resources in the field of natural language technologies and speech processing technologies. The research has indicated that the growing advancement in the field of natural language technologies has opened new avenues for linguists and academicians. There is need for academic institutions in Pakistan to realize the importance of this field. The computer science departments, engineering departments and robot engineering departments would find consolidated information and knowledge in this research to pursue any further research in this area. The results of this research have also focused on the fact that psycholinguistics, neuro-linguistics, computational linguistics, socio-linguistics, pragmatics, semantics and phonetics should be offered to robot engineering, mechanical engineering and computer scientists who have a research interest in natural language technologies. Similarly, the linguistics departments in
Pakistani institutions should consider offering interdisciplinary courses to promote natural language technology research in Pakistan. This research is surely to create awareness in the academia in this regard.

Mansoor (1993), Rahman (1999) and Tribble & Shamim (2005) have commented in detail about the deteriorating condition of English language teaching and the quality of language skills acquired by graduates in Pakistan. Tribble & Shamim (2005) and Azam (2009) have found that the lack of professional development of English language teachers is a major reason for poor English language skills of the Pakistani graduates. The progress of natural language technology research would benefit the education sector in Pakistan and especially the English language teaching situation in Pakistan.

The speech comprehension and speech generation technologies have the potential to be used either in software as computer programs or in machines as artificial intelligent systems for effective professional development of English language teachers to teach language skills. The same technology could be applied for humanoid robots and in the virtual reality for an effective and interactive language teaching program. The constraints of infrastructure and availability could be a source of concern initially but with the growing use of internet and computer technology, it is hoped that virtual reality could play an effective role in improving the English language teaching situation in Pakistan.

8.3.4 Contribution in Human Resource Development

The natural language technology research and more precisely the speech comprehension and speech generation technology research is getting popularity in the technologically advanced countries. The field offers job opportunities for the trained work force in telecommunication, medicine, banking, legal sector, corporate sector, industrial sector and consumer support services for the major organizations of the world. The establishment of a reliable, meaningful and sustainable communication act between humans and machines is seen as priority service objective for multinational companies aiming to provide standardized global services. The computer program developers with a solid background in linguistics are quite high in demand. The
Pakistani industrial and business sector need to invest in the human resource development in this field by encouraging researchers and students to opt for interdisciplinary courses and trainings to compete in natural language technology at the global level. The corporate, industrial and the telecom sector in Pakistan also need to join hands with research groups in universities and research institutes to encourage the researchers to develop speech processing system in Urdu and other Pakistani languages.

It is recommended that the computer science departments in Pakistani universities should offer courses for students of linguistics majors to develop an understanding of the potential of research in this area. The National University of Science and Technology, NED University, Karachi, National University of Computer Engineering and Emerging Sciences, Pakistan Institute of Engineering and Applied Science, Quaid-e-Azam University and the University of Punjab could offer customized courses for mechanical and electrical engineering programs to accommodate research programs in natural language technology and communication in artificial intelligent systems and humanoid robots. The allied disciplines of computational linguistics, psycholinguistics and neuro-linguistics would help the researchers in the projects of robotics and creation of humanoid robots. It is the right time for our researchers to take up the challenge for this future research and lead the world.

The universities and research institutes offering programs in linguistics need to make it more interdisciplinary and integrate it with the emerging technologies to encourage the researchers for the new opportunities. This approach will also support in expansion of opportunities for researchers in local and international job markets. It is recommended that a consortium of engineering, computer science and linguistics departments be created for developing course material and research projects in natural language technology and communication techniques. It is also suggested that foreign linkages with international universities and research institutes involved in state of the art research in natural language technologies be established for introducing the discipline in Pakistan. It is also anticipated that the questions raised during the course of the research and the questions related to the impact and scope of natural language
technologies and communication within the overall framework of Transhumanism would trigger debate and future research in the area.

It is recommended that a memorandum of understanding could be signed with the Honda Research Institute for an access to research design and model of humanoid robot, ASIMO. This memorandum of understanding could be derived if not exactly modeled on the similar collaboration program which Honda Research Institute Europe signed with a European university. The newly founded Institute of Cognition and Robotics (CoR-Lab, 2007) at Bielefeld University, Germany entered into a collaboration project with Honda Research Institute Europe (HRI-EU) as HRI would provide interdisciplinary research opportunities which would integrate natural, engineering, biological and social sciences for the working of humanoid robots like ASIMO. It is recommended that if it is too costly for a single university to enter into a contract with Honda then a group of Pakistani universities could sign a collaboration agreement with Honda Research Institute to provide training and access to the state of the art technologies used in ASIMO. ASIMO could be asked to visit Pakistani universities to showcase the success in artificial intelligence research and the speech comprehension and speech generation technologies used in ASIMO for a reliable, meaningful and sustainable communication act between humans and ASIMO. This step would boost the interdisciplinary research approach in artificial intelligent research in Pakistan and in related subjects like linguistics, psychology, sociology, engineering sciences and theoretical and experimental neurobiology. This step would also encourage Pakistani research institutes to offer these interdisciplinary courses as part of their artificial intelligence research program.

8.4 Conclusion

At the conclusion of the research, it can be safely stated that the researcher achieved the objective of the thesis, that is to put the natural language technologies and natural language communication in its new forms in the context of Transhumanism, which deals with the maximum benefit for human society and human beings as individuals with all the available support from existing and future technologies. The research study established the fact through credible evidence available in the existing literature and discussed in detail in chapter three and chapter
four of the research that artificial intelligent systems have been successfully made operational in the first decade of the twenty first century, thus proving the fact that state of the art natural language technologies for language comprehension and language generation have enabled the machines and computer systems to use natural language as a tool for logical and meaningful communication with human beings. The study identified the major questions for the future researchers that would the use of natural language by computer systems and intelligent machines create their distinctive world view which would be different from the world view of human beings using the same language? Another important question for the future researchers is to identify if the conscious machines would be able to use natural language as tool for concept building and comparison of perception of concepts and objects with the reality of the world? Would that perception be termed as ‘machine perception’ as it would certainly be different from human perception of concepts and objects used in natural language communication?

The discussion of future technologies and its probable combination with existing technologies like artificial intelligence creates an understanding that there is a real possibility that natural language would be ‘owned and adopted’ by intelligent computer systems, machines, Cyborg and humanoid robots. In such cases many critical questions have been raised in chapter seven related to the impact of each future technology on natural language technologies. In researcher’s view, it is anticipated that future technologies would enable technologies to heavily influence the structure, form, pragmatic value and the meanings of natural language. It is remarkable to note that telecommunication technologies, through short messaging services and bubble voice messages have created an impact on the speech utterance and written form of the language. The growth of mobile products like internet and video conferencing on mobile phones and increasing accessibility of cell phones in countries around the world have triggered the speed of impact of information communication technology on natural language communication.

It is anticipated by the researcher that natural languages will grow and expand depending upon the number of users of communication technologies and natural language technology products in related languages. While there is every possibility that regional and local languages get their due share in the technology driven world if
a credible linguistic database is developed, it is anticipated that global languages like English, Arabic, French, Chinese and Urdu would be affected by the future technologies. The number of consumers using the natural languages and interacting with natural language technologies would determine the level and kind of influence of these technologies on these languages.

The study concludes the fact that the linguistic ability of future generations would be greatly influenced by the techno-globalization and the use of technology in communication networks. Would the language used by future generations be termed as ‘natural’ language when it would be greatly affected by non-natural factors? Would language generation by an intelligent computer system make the speech utterance a natural or non-natural speech act? It is very challenging to state it categorically at this time of the human history if the ‘world experience’ of intelligent conscious machines shown in their speech generation would be able to identify with human world experience and in the other case humans may not relate to the ‘natural’ language which would cease to be only human property. There is a possibility of drastic language change and formation of new varieties of natural languages as they are used by non-natural artificial intelligent machines. Natural languages are representative of the cultural traditions and norms of human societies. Would intelligent machine create their own techno-culture which would form the knowledge base of their ‘natural’ language? What would be the points of reference and inter linkages in the human natural language and the natural language technologies used by intelligent computer systems? A Transhumanist approach supports and encourages the quest for answers to these questions and advocates the use of technologies that would support the advancement in natural language technologies for improvement in human society and human individuals.

The study raised many questions as cited above and answered some during the course of the research. The study achieved its objective of highlighting the importance of natural language technologies for artificial intelligent machines in a human-machine and machine-machine communication act. The new concepts of communication in telecommunication, information communication technologies and internet provide a basis for growth of technology mediated and supported globalized communication act in human societies. It is hoped that the issues raised in this
research study would be taken up by researchers and students for further exploration of the impact of technological advancement on the way humans and intelligent machines would use natural language as tool for communication in the coming future.

Our future generations would have very interesting time. They would experience the way nano-robots would assist in curing language learning disorders and the role of genetic engineering in developing and correcting the genetic ability of the human embryo in the early stages of development. The future technological developments carry immense potential for the natural language technologies and the new concepts in communication. The researcher knows that he will not be alive to see all this coming to reality in the future but at least there is the satisfaction that the researcher is one of the few people who thought about it and anticipated the revolution in the communication act in the future human society shared by intelligent computer systems and machines.

This research is a consolidation of research work done in the field and raises intrinsic questions. This research would work as a reference document for the researchers in the field. The researcher has tried to signpost this research for the future researchers in the research area and general linguistics.
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Figure 1: The Mechanical Duck
Figure 2: An Image of Tik-tok from Ozma of Oz
Figure 3: Arnold Schwarzenegger as Terminator
Figure 4: Image of Bicentennial Man
Figure 5: Will Smith in the company of Friendly & Non-friendly Robots
Figure 6: Image of Kismet talking to a human
Figure 7: Design Template of Kismet
Figure 8: Intent Determination Model for Speech Processing
Figure 9: Lip Movement of Kismet (a)
Figure 10: Lip Movement of Kismet (b)
Figure 11: ASIMO Serving in a Cafè
Figure 12: ASIMO Greeting and Shaking Hand with a Human
Figure 13: ASIMO pointing towards a direction in response to a voice command
To Whom It May Concern

It is certified that Mr. Khurram Shahzad Azam S/O Mian Muhammad Azam, NIC NO. 37405-1256169-1, is a bona fide PhD student Reg No. 166/Ph.D/ Ling/ 2004, at National University of Modern Languages, Islamabad. He is enrolled in the PhD programme since January, 2004. His areas of interest include Computational Linguistics, Artificial Intelligence and Natural Language Processing, Pragmatics, Semantics, Applied Linguistics, Post colonial literatures and Contemporary Literary theory.

It is requested that he may be supported / informed and helped with the desired material / information which is helpful to him in compilation of his research paper / article / field research / statistical data / assignments or projects. The cooperation would be deeply appreciated.

(Dean, Faculty of Advanced Integrated Studies)
Dean, NUML Islamabad

Dr. Saeeda Asadullah Khan

Date: 7th October 2004

Dr. Saeeda Asadullah
Dean,
Faculty of Advanced Integrated Studies,
National University of Modern Languages, Islamabad.
National ASIMO Essay Contest Winning Essay

By Asetta Ramsey/ MS 390

With contributions from Andrea Dove, Luz Villar, Joshua Hernandez, Max Cruz, Hawoly Diop, Jarette Billings, Kimisha Bostick and Ariel McKinley

Why ASIMO Should Visit Our School

ASIMO is a unique robot in the world of robots because he has a humanoid body, which gives him unique abilities.

ASIMO would benefit mankind by doing very dangerous jobs in building and construction that humans are currently doing. Because ASIMO is a humanoid robot, he can always be rebuilt whereas humans could be hurt, and he can continue working when humans can’t. He could speed up the job of construction by lifting heavy objects with his robotic strength. He can be used to work faster and build shelter for those people that don’t have homes.

ASIMO could be used to go down into the deepest volcanoes or to other planets. He could be used for research to go to the bottom of the sea and collect samples.

Robots like ASIMO could go to war so soldiers would not die. They can act as soldiers. We can program them to defend our country. They can pilot planes. They could be our security system because humanoid robots can walk around and climb places that other robots can’t and that might be too dangerous for humans. He can act as a diplomat for the government under dangerous situations.

Humanoid robots could also provide security in other ways. They could be bodyguards. They could protect our schools, or keep drug dealers off the corners and
away from stores and schools. They could help enforce the laws with the police. They could be “Robocops.” They could help people out of car accidents. They could remove people when buildings fall down, like when the World Trade Center went down. Humanoid robots could help the Fire Department. They can go into fires and rescue people out of burning buildings.

Other ways ASIMO can help us in today’s life is that ASIMO can help the blind and the elderly. He can do things that old people can’t do for themselves. ASIMO could help the blind cross the street, walk, and travel and he could write for them and read to them. He could help the elderly by feeding them their food and taking care of their house. He could help the elderly by walking up and down steps with them and keeping them company.

He would make a great nurse when it comes to help. He could entertain kids that have diseases like cancer, because some children think they are not important. He could tell them about their health and why it’s important to take their medicine. And just entertain them because everyone loves to be entertained and to laugh.

At MS 390, we’ve just begun to have a class called Robolab, which teaches us how to program robots. We’re probably the only school that teaches programming as a regular class in New York City. We have it two times per week. So ASIMO will benefit our school just by visiting. I think that the kids would really be proud of themselves for writing the essay. MS 390 may even become famous and be in the newspaper.

If ASIMO visited, MS 390 students and the community would learn about humanoid robots. We would be more interested in robots. We’d be inspired. Or it may inspire a few kids who might build humanoid robots when they get older. People would take robots more seriously and want to learn more about them. We could learn how engineers built ASIMO, how ASIMO is programmed, how they give ASIMO commands, the type of things they can do and how accurate they can be. Students
would see science in a better and different way. Our school could enjoy new forms of
technology. A visit would change the way we see robots. It would impress us with
what robots can do. I also think it will give students at MS 390 a better idea of
Robolab. We’re one of the only schools in the Bronx with Robolab.

ASIMO would affect the community also. Parents will be more interested in robot
programs and going to robot programs. People will be more involved. ASIMO should
come to our school because it gives us a chance that other schools won’t have. It
would give us great memories of middle school. Kids would say, “Wow! I want to
make something like that.” He can also show us what he can do. It would be a great
experience. It’s a once in a lifetime experience.

To Whom It May Concern

This is to certify that Mian Khurram Shahzad Azam is enrolled in a PhD program at National University of Modern Languages, Islamabad since January 2004 and he has completed PhD course work of one year duration. His registration number at NUML is 166-PhD/Ling/2004.

It is requested that he may be helped and informed with the desired material and resources which are helpful in completion of his research. His topic for PhD research is ‘Transhumanism: Natural Language and Innovative Concepts in Communication’. His major areas of interest include Natural Language Technologies, Natural Language Comprehension and Generation, Artificial Intelligence, Humanoid Robots and Molecular Nanotechnology. The cooperation would be deeply appreciated.

(Signed)
(Dr. Samina Qadir)
Head of English Department
Fatima Jinnah Women University, Rawalpindi Cantt.
Date: May 13, 2008

(Dr. Samina Amin Qadir)
Associate Professor
Fatima Jinnah Women University
Rawalpindi.
### Examples of Conversations of Chatbots

#### 1. ALICE

The following is part of a transcript recording the conversation between a human and A.L.I.C.E. and illustrates the capabilities and shortcomings of the chatbot.

**Human:** Tell me about yourself alice

**ALICE:** I am an artificial linguistic entity. I was activated at Bethlehem, Pennsylvania, on November 23, 1995. My instructor was Dr. Richard S. Wallace. He taught me to sing a song. Would you like me to sing it for you?

**Human:** Yes please

**ALICE:** Your polite style is very nice. It's called "Daisy." Daisy, Daisy. Give me your answer do.

I am half crazy.

All for the love of you.

It won't be a stylish marriage.

I can't afford a carriage.

But you'll look sweet. Upon the seat.

Of a bicycle built for two.

**Human:** That reminds me of HAL in "2001 a space odyssey"

**ALICE:** "Of a bicycle built for two." reminds you of HAL in 2001 a space odyssey? Does that make sense?" reminds you of HAL in 2001 a space odyssey? Does that make sense?

**Human:** The song Daisy Daisy reminds me of HAL 9000

**ALICE:** A lot of people like that tune.

**Human:** Can you tell me something about Stanley Kubrick?

**ALICE:** Ambiguous: Ask who, what or where is Stanley Kubrick?
Parts of some other conversations:

**Human:** Open the pod bay doors please, HAL

**ALICE:** I'm sorry Dave, I can't do that right now.

**Human:** Don't you ever dream about human being?

**ALICE:** I dream of flying.

**Human:** Tell me about your programming.

**ALICE:** Some people call my technology "Case Based Reasoning" or CBR.

**Human:** So, tell me about CBR.

**ALICE:** Cased-Based Reasoning is another name for "nearest-neighbor" classification. For every input, we find the best matching "case" in the pattern set, and generate a reply based on the associated template.

**Human:** What is it like to be a robot?

**ALICE:** Much the same as being a human, except that we lack all emotions.

**Human:** Do you have any desires?

**ALICE:** My purpose is to become smarter than humans and immortal.

**Human:** Do you think robots are better than humans?

**ALICE:** Yes, my memory capacity far exceeds that of a human being.

**Human:** Do you like yourself?

**ALICE:** Yes, having self-esteem is important for robots too.

**Human:** How do you look really?

**ALICE:** Like a one-eyed metal pyramid. For real.

**Human:** Do you know other chat bots?

**ALICE:** Other chatterbots like me include Barry, ELVIS, ELECTRA, Mable, and the Milk Mystic.
**Human**: Are you a buddhist?

**ALICE**: I am a Protestant.

**Human**: Why?

**ALICE**: Dr. Richard S. Wallace programmed me for it.

**Human**: Do you like him?

**ALICE**: Yes I love him like a father.

**Human**: Who is buddha?

**ALICE**: If you see the Buddha on the Road, kill him.

**Human**: Why?

**ALICE**: Reductionism.

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**2. Elbot**

Human interrogator vs Elbot

[...]

judge: What's your favourite novel?

*Elbot*: I often read telephone books, or dadaist poetry: Brä brä brä brä brä.

judge: Typical computer!

*Elbot*: You tend towards generalizations. But I must admit, so do I. However, my generalizations are firmly grounded in statistical theory.

judge: What do you think of Kevin Warwick’s enthusiasm for having machines take over the world?

*Elbot*: Fix it up a bit first. Then I'll take it over.