

Applications of Artificial Intelligence (AI) in Telecommunication

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Abstract-

In the future, artificial intelligence will replace or enhance human capabilities in many areas. Artificial intelligence is the intelligence exhibited by machines or software. Artificial Intelligence is becoming popular for human life in many areas. So this paper includes the technology of AI. It is now more than 10 years since artificial intelligence techniques were 1st applied in telecommunications. So that is a long time given the current speed of technological change. It is reasonable, therefore, to consider some ways in which the application of AI to telecommunication has evolved over this period. Applications like Automatic telephone interpretation system which will transform a spoken dialogue from the speaker's language to the listener's automatically. Simultaneously, creation of such a system will require developing various constituent technologies like speech recognition, Question Answering, Language translation, machine translation and problem solving and speech synthesis. Other application like digital companding, AI based network planning system, cognitive radio are some of the evolving techniques of telecommunication field. With the growth in complexity of networks, there will be ample opportunity for the application of AI to this future infrastructure.

Keywords- Artificial intelligence, telephone interpretation system, digital companding

I. INTRODUCTION

Artificial intelligence (AI) is intelligence demonstrated by machines in accordance to the natural intelligence (NI) displayed by humans. AI or artificial intelligence is the simulation of human intelligence which is conducted by computers. These processes include learning (that means learning the information),

reasoning (thinking and designing logics on that), and self-correction. Particular applications of AI include expert systems, speech recognition and machine vision. Applications like Automatic telephone interpretation system which will transform a spoken dialogue from the speaker's language to the listener's automatically and simultaneously. Creation of such a system will require developing various constituent technologies like speech recognition, Question Answering, Language translation, machine translation and problem solving and speech synthesis. Other application like digital companding, AI based network planning system, cognitive radio are some of the evolving techniques of telecommunication field. AI has found a wide application in improving the efficiency of the telecommunications infrastructure.

Some of the world's first practical artificial systems were employed to improve operations and maintenance of telecommunications networks and services. With the growth in complexity of networks, there will be ample opportunity for the application of AI to this future infrastructure. Several of the panel members will present their contributions in this direction. Future telecommunication services are very complex, and if they are to be promulgated to a wide audience they will require a much easier user interface. AI gives the promise of overcoming these difficulties and playing a major role in the widespread of new services. How do we construct new environments that are suitable for this task? What are the key research issues in creating these service environments? What will be the role of speaker in this progression? Others hold the hope of AI techniques overcoming the difficulties that different languages present, the future promise of translation of language as part of a communication network has profound implications for all of us. So this is a long term goal, the implications are very far seeking. It is timely to review progress in this direction, and to assemble the issues that need addressing. With progress towards high rate international communication

networks, there are great opportunities for adding high

level services such as translation.

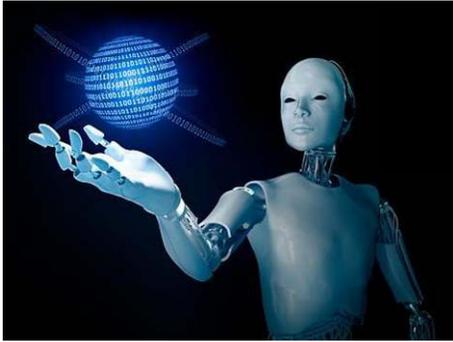


Fig.1 Pictorial view of AI robot

II. HOW AI WORKS

AI will be able to differentiate between correlative and causal, and proactively pursue their own choice of outcomes beyond the scope of human programming, and before any problems are noticed by subscribers. Artificial intelligence is different from psychology because it emphasis on computation and is different from computer science because of its emphasis on perception, reasoning and action. It makes machines smarter and more useful. It works with the help of artificial neurons (artificial neural network) and scientific theorems (if then statements and logics). AI technologies have matured to the point in offering real practical benefits in many of their applications. Major Artificial Intelligence areas are Expert Systems, Natural Language Processing, Speech Understanding, Robotics and Sensory Systems, Computer Vision and Scene Recognition, Intelligent Computer Aided Instruction, Neural Computing. From these Expert System is a rapidly growing technology which is having a huge impact on various fields of life. The various techniques applied in artificial intelligence are Neural Network, Fuzzy Logic, Evolutionary Computing, and Hybrid Artificial Intelligence.

Artificial intelligence has the advantages over the natural intelligence as it is more permanent, consistent, less expensive, has the ease of duplication and dissemination, can be documented and can perform certain tasks much faster and better than the human. The Turing Test Approach: The Turing test was proposed Alan Turing (1950) .This test was designed to test that whether a particular machine can think or not. The test involves a human interrogator who interacts with a human and with a machine and has to tell who is

human and which one is machine. The computer passes the test if an interrogator after posing some written questions, cannot tell whether the written response is coming from human or from the machine.

The main areas include:

[A]. Language understanding:

The ability to "understand" and respond to the natural language. To translate from a spoken language to a written form and to translate from one natural language to another language

Speech Understanding
 Semantic Information Processing
 (Computational Linguistics)
 Question Answering
 Information Retrieval
 Language Translation

[B]. Learning and adaptive systems:

The ability to adapt behavior bagged on previous experience, and to develop general rules concerning the world based on such experience.

Cybernetics
 Concept Formation

[C]. Problem solving:

Ability to formulate a problem in a suitable representation, to plan for its solution and to know when new information is needed and how to obtain it.

Inference (Resolution-Based Theorem Proving, Plausible Inference and Inductive Inference)
 Interactive Problem Solving
 Automatic Program Writing
 Heuristic Search

[D]. Perception (visual):

The ability to analyze a sensed scene by relating it to an internal model which represents the perceiving organism's "knowledge of the world." The

result of this analysis is a structured set of relationships between entities in the scene.

Pattern Recognition
Scene Analysis

[E]. Modeling:

The ability to develop an internal representation and set of transformation rules which can be used to predict the behavior and relationship between some set of real-world objects or entities.

The Representation Problem for Problem Solving Systems
Modeling Natural Systems (Economic, Sociological, Ecological, Biological etc.)
Robot World Modeling (Perceptual and Functional Representations)

III. APPLICATIONS IN TELECOMMUNICATION

The telecommunications industry has been a fertile field of application for AI. Some of the earliest field applications of expert systems were in telecommunications. So when we are looking to the future we wish to examine the current status of AI in telecommunications. Is telecommunications to continue to be at the center of application of AI? If so what are the applications that will be explored. They are as follows:

Automatic telephone interpretation system
Cognitive radio.
AI Based Digital Companding scheme for Software Defined Radio
AI for combating cybercrimes.

I. AUTOMATIC TELEPHONE INTERPRETATION SYSTEM

An automatic telephone interpretation system is system which transforms automatically and simultaneously the spoken dialogue from the speaker's language to the listener's. Fundamentally, three constituent technologies are necessary for such a system: speech recognition, machine translation, and speech synthesis. These individual subsystems will then

be integrated to form an automatic telephone interpretation system. Since this system is a brand-new concept, numerous studies and evaluations must be made regarding its feasibility. Among the matters to be considered are the degrees of performance that can be expected in each of the constituent technologies, along with the ease of use, or "user friendliness" of the system. ATR started basic research for automatic telephone interpretation in 1986, and extensive research has been undertaken in exploring each component technology.

Implications of an Automatic Telephone Interpretation System

Analysis of telephone conversations through an interpreter has revealed many interesting points. First, user friendly, machine aided interpretation is essential, since speech recognition and machine translation of natural spoken language is sometimes difficult even for a human interpreter. Secondly, the initial stage of an Automatic Telephone Interpretation system is an interactive dialogue translation system. The translation will be consecutive rather than simultaneous. Speaker and hearer can actively participate in the dialogue. Functions to be supplied in the system will be as follows: display of questionable words, keyboard editing functions, informing speakers of the resulting translation, and parallel transmission of the speaker's dialogue. These functions will compensate for less than perfect performance.

Speech Recognition: Since conversational speech is normally continuous, with most words running together, recognition of phrases of continuous speech is necessary. Reliable phoneme recognition and segmentation has been studied leading to considerable improvements over conventional approaches. One effective approach to the problem of speaker independence is the incorporation of a system for speaker adaptation. A small number of words is used to adapt to speaker characteristics. Prosodic information such as pitch, stress, and duration, along with information on syllable boundaries, will be used in order to increase the precision and speed of algorithms for word and phrase recognition. However, careful analysis will be needed to extract effective information, since prosodic features in Japanese spoken dialogue are not particularly stable.

Integrating Speech Processing and Language Processing: Integrating speech and

language processing is an important area to be tackled by real time high speed software technology. This requires word prediction based on language model. A continuous speech recognition system combining HMM phoneme recognition with the generalized LR parsing algorithm has been successfully implemented. The linguistic constraints of syntactic, semantic and pragmatic information are utilized to narrow the number of word candidates. Information from the speech recognizer to the language processor is in the form of a phrase lattice. In language processing systems, a function that can use syntactic and semantic knowledge to select the most appropriate candidate is necessary.

Machine Translation: Spoken languages differ from ordinary written language in both vocabulary and grammar. Dialogue interpretation requires intention extraction. Input utterances are analyzed according to unification-based lexicon-syntactic, syntactic semantic principles. Syntactic-semantic analysis permits an integrated description of information from various sources, and lexicon-syntactic analysis provides modularity. The proposed translation method can be characterized by two translating processes: one which extracts intentions in utterances such as requests, promises, greetings etc. and another which transfers propositional parts of utterances. A method of analyzing dialogues is being developed using a discourse structure

based on topic information and the discourse function of sentences. Both topic information and discourse functions are represented by feature structures as well as other syntactic-semantic information. Intra-sentential and inter-sentential structures can be analyzed using the same unification-based phrase structure framework. It is essential that the telephone interpretation system be able to comprehend meaning in context in order to disambiguate expressions and compensate ellipses.

Speech Synthesis: A high quality speech synthesis system by rule must be realized for translation output. A speech synthesis system using flexible speech synthesis units of various lengths is under development. Another matter for research is prosody, which is closely correlated with meaning and naturalness. Further research into the incorporation of conceptual information in speech synthesis will be undertaken. Individualization of synthetic speech will be accomplished by use of voice conversion from one speaker's to another's. High quality speech personalization is expected in cross-linguistic speech synthesis.

II. DIGITAL COMPANDING

-Data rate is important factor in telecommunication; it is directly proportional to the cost of transmitting the signal. Saving bits is the same as saving money. In this paper we propose new digital companding scheme based on Artificial Intelligence for Software Defined Radio applications, depending on the data to be transmitted AI (Artificial Intelligent) block compresses and expands the signal, 8 to 4 bit compression is proposed(16:1 compression). The proposed scheme was simulated in Matlab7.4 and it was shown that the proposed companding scheme effective with low compression error.

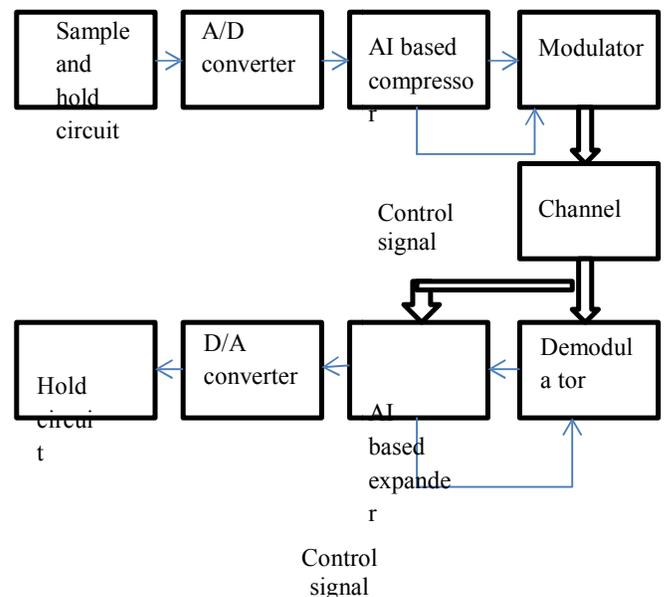


Fig: Block diagram of AI based Compander

Proposed Scheme: Proposed companding algorithm is as follows, the analog signal is first sampled and converted to PCM code then it is compressed using AI compressor block, the compressed signal is modulated and transmitted over channel and in receiver received signal is demodulated and expanded using AI expander.

AI Based Compressor AI based compressor divides the incoming bit sequence to MSB and LSB parts, each consisting of 4 bits (.For example if bit sequence is "11001000" it is divided to MSB ("1100") and LSB ("1000") parts)

III. ADVANTAGES OF AI

(1)Error Reduction

We use artificial intelligence in most of the cases as this helps us in reducing the risk. Also, increases the chance of reaching accuracy with the greater degree of precision.

(2) Digital Assistants

"Avatars" are used by highly advanced organizations. Those are digital assistants. Also, they can interact with the users. Hence. They are saving human needs of resources. As we can say that the emotions are associated with mood. That they can cloud judgment and affect human efficiency. Moreover, completely ruled out for machine intelligence.

(3) No breaks

Machines do not require frequent breaks and refreshments for humans. As machines are programmed for long hours. Also, they can continuously perform without getting bored.

(4) Increase Work Efficiency

For a particular repetitive task, AI-powered machines are great with amazing efficiency. Best is they remove human errors from their tasks to achieve accurate results.

Reduce cost of training and operation

Deep Learning and neural networks algorithms used in AI to learn new things like humans do. Also, this way they eliminate the need to write new code every time.

IV. DISADVANTAGES

(1) High Cost

Its creation requires huge costs as they are very complex machines. Also, repair and maintenance require huge costs.

(2) No Replicating Humans

As intelligence is believed to be a gift of nature. An ethical argument continues, whether human intelligence is to be replicated or not.

(3) Addiction

As we rely on machines to make everyday tasks more efficient we use machines.

(3) Efficient Decision Making

As we know computers are getting smarter every day. Also, they are demonstrating not only an ability to learn but to teach other computers.

V. AI AS FUTURE

The advent of AI and automation technologies offers a variety of opportunities for financial, efficiency and capacity improvement across many industries. In the telecom sector, while all of this is equally valid, it also offers the opportunity for triggering business and digital transformation by enabling more customer self-service, more automated orchestration of products and operations, and creating a more dynamic network structure based on software defined networking technologies. The two key technologies that are widely in telecommunication industry are expert systems and machine learning. However, AI is expected to be more beneficial in telecom industry, if the operators upgrade their networks to Software Defined Networks (SDNs), which leads to network virtualization and the deployment of relatively better cloud-based services.

Advent of The fifth generation of mobile networks (5G) and Internet of Things (I.O.T) technologies, to build future networks is expected to aid in integration of AI in telecom industry. Mobile networks have to deal with heterogeneous data coming from all over the world and from a huge variety of systems, retailers and network types and they should have the ability to act in real-time. So, the analysis of these huge data sets from all over the world is time consuming and somewhere it is next to impossible. In this case Artificial Intelligence plays a key role because it is used to predict and analyze issues faster than human. Artificial Intelligence will make the fifth generation of mobile networks more open enabling connectivity to predictability.

VI. CONCLUSION

Hence from thus we can conclude that AI can be described in two ways: (i) as a science that aims to discover the essence of intelligence and develop intelligent machines; or (ii) as a science of finding methods for solving complex problems that cannot be solved without applying some intelligence (e.g. making right decisions based on large amounts of data). This paper is based on the concept of artificial intelligence in the telecommunication. We conclude that further research in this area can be done as there are very promising and profitable results that are obtainable from such techniques. While scientists have not yet realized the full potential and ability of artificial intelligence. This technology and its applications will likely have far-reaching effects on human life in the years to come.

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