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An Overview of Natural Language Processing

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Abstract: ***Natural Language Processing is branch of machine learning that deals with text and speech. Natural Language Processing is a way for computers to analyze, understand, and derive meaning from human language in a smart and useful way. By utilizing Natural Language Processing, developers can organize and structure knowledge to perform tasks such as automatic summarization, translation, named entity recognition, relationship extraction, sentiment analysis, speech recognition, and topic segmentation.***
Keyword: Natural Language Processing, Speech Recognition, ML, Personal Assistant, Text-To-Speech (TTS) , Chatbots

I. INTRODUCTION

In 1950 Turing published an article titled intelligence which proposed what is now called as the turing test for machines.[8]
In 1954 GeorgeTown experiment involved automatic translation of more than 60 russian sentences to english.
In 2006 IBM Watson - Question answering system capable of answering questions in human like language.

A. Natural Language Processing

Natural Language Processing is a hypothetically driven range of calculative techniques for analyzing and representing naturally texts at one or more levels of linguistic analysis in order to achieve human-like language processing for a range of tasks or applications [1]. Below are set of terminology required for familiarity with NLP.
Token: Linguistic units of an input text, such as words, punctuation, numbers or alphanumerics.
Parse Tree: Describes the syntactic structure of the sentence as defined by a formal grammar
Speech Synthesis: An artificial production of human speech. TTS (Text To Speech): System to convert normal language text to speech i.e. Google Translate

II. LITERATURE REVIEW

Natural language processing (NLP) has gained much attention for representing and analysing human language computationally. It has spread its applications in various fields such as machine translation, email spam detection, information extraction, summarization, medical, and question answering etc. The paper distinguishes four phases by discussing different levels of NLP and components of Natural Language Generation (NLG) followed by presenting the history and evolution of Natural Language Processing, state of the art presenting the various applications of Natural Language Processing and current trends and challenges.[9] where another researcher Natural Language Processing (NLP) is a way of analyzing texts by computerized means. Natural Language Processing involves gathering of knowledge on how human beings understand and use language. This is done in order to develop appropriate tools and techniques which could make computer systems understand and manipulate natural languages to perform various desired tasks. This paper reviews the literature on Natural Language Processing. It also covers or gives a hint about the history of Natural Language Processing. It is based on document analysis. This research paper could be beneficial to those who wish to study and learn about Natural Language Processing.

III. MAJOR EVALUATIONS OF NLP AND TASKS

Below are set of tasks in natural language processing some of which have real world applications while others can be used as sub-solutions to other set of problems

A. Syntax

Token Generation :Tokens are often loosely referred to as terms or words, but it is sometimes important to make a type/token distinction. A *token* is an instance of a sequence of characters in some particular document that are grouped together as a useful semantic unit for processing. A *type* is the class of all tokens containing the same character sequence. A *term* is a (perhaps normalized) type that is included in the IR system's dictionary. Part of Speech Tagging : Given a sentence determine the part of speech for all the words. Many words specially common ones can serve as multiple part of speech i.e. book can be a noun or a verb Parsing is the process of analysing a string of symbols, either in natural language, computer languages or data structures, conforming to the rules of a formal grammar.

B. Semantics

Optical Character recognition - Given an image representing text determine the corresponding text.
Question Answer - Given the human language question determine the right answer. Word sense disambiguation - Many words have more than one meaning to select which one makes more sense in given context. Optical Character Recognition : Given an image representing printed text, determine the corresponding text.

C. Discourse

Automatic summarization - Produce readable summary of given chunk of text

D. Speech

1) Given a sound clip of a person speaking determine the textual representation or from given set of text generate a sound.
2) Speech Segmentation - Given a sound clip of person speaking separate out it in words.
3) Text to speech - Given a text transform this into spoken representation, which can be widely used for visually aid people.

IV. RELATED SYSTEMS

Ability of computers to understand natural speech has evolved a lot in last decade by using deep neural network i.e. Google Voice Search. However Generating Text To Speech (TTS) can be largely categorized in 3 categories.

1) *Concatenative TTS:* In this approach large DB of short voice fragments are recorded and then combined of utterance. However it makes it difficult to modify the DB as it needs re-recording of all the DB.
2) *Parametrized TTS:* Here instead of storing plain audio fragments, information is stored in data model which can be modified based on certain set of input parameters. However it sounds less natural than concatenative TTS.
3) *Neural Network Approach:* Extracting features from audio samples and using deep generating model to create raw audio, i.e. wavenet [6] which gives more natural sound and easy to extend.

Machine learning in context of Natural Language Processing:Machine Learning and Natural Language Processing have some overlap, as Machine Learning is often used for NLP tasks.

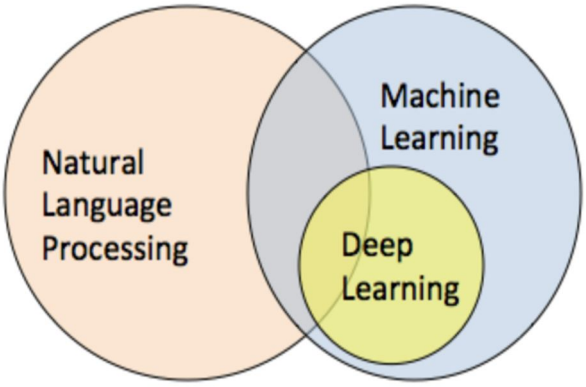

Fig 4.1 Machine learning in context of Natural language processing

4) Supervised Training : In supervised training, both the inputs and the outputs are provided. The network then processes the inputs and compares its resulting outputs against the desired outputs. Errors are then propagated back through the system, causing the system to adjust the weights which control the network. This process occurs over and over as the weights are continually tweaked.
5) Unsupervised Training : In unsupervised training, the network is provided with inputs but not with desired outputs. The system itself must then decide what features it will use to group the input data. This is often referred to as self organization or adaption. At the present time, unsupervised learning is not well understood. This adaption to the environment is the promise which would enable science fiction types of robots to continually learn on their own as they encounter new situations and new environments.

V. POSSIBLE APPLICATIONS

Possibilities with NLP are endless, below are some of them.

A. Sentiment Analysis : NLP is a great tool to comprehend and analyse the responses to the business messages published on social media platforms. It helps to analyse the attitude and emotional state of the writer. It is implemented through a combination of Natural Language Processing and statistics by assigning values to the text (positive, negative or neutral) and in turn making efforts to identify the underlying mood of the context. This application of NLP helps business organisations gain insights on consumers and do a competitive comparison and make necessary adjustments in business strategies, whenever required. Such data is also useful in designing a better customer experience and enhancing the product.

B. Chatbots : Chatbots are the solution for consumer frustration regarding customer care call assistance. Intelligent Chatbots are going to offer personalised assistance to the customer in the near future.

C. Advertisement Management : NLP matches the right keywords in the text and helps to hit the right customers. Keyword matching is the simple task of NLP yet highly remunerative for businesses.

VI. CONCLUSION

As NLP have various application including customizing your personal virtual assistant. This helps in creating more intimate user experience, which is missing in the present. This can not only improve the experience, it can revolutionize various industries. Voice mirroring will really take the personalization with machine and computers to a whole new level.

VII. FUTURE SCOPES

Possibilities with systems with voice as input for interaction with computers are endless. The very need to of having the most fluid and easy to use medium of communication with machines makes it challenging yet super exciting piece of puzzle in computer science domain.

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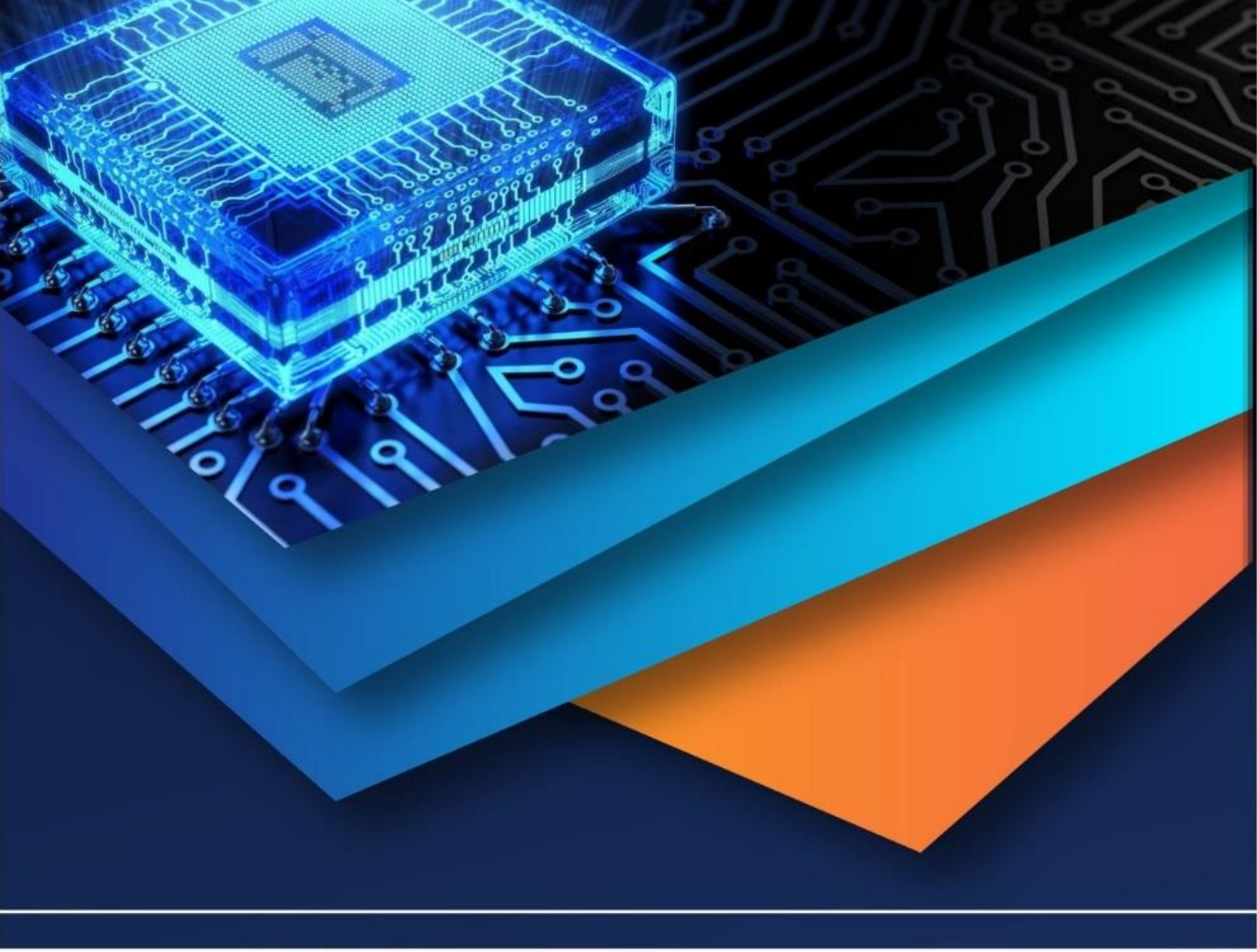

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