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REVIEW ON NATURAL LANGUAGE PROCESSING WITH ARTIFICIAL INTELLIGENCE

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ABSTRACT

It's obvious that humans can converse with each other using speech (with help of different languages) or sign but now machines can too! This is known as Natural Language Processing(NLP) where machines analyze and understand language and speech as it is spoken.Natural language processing is a branch of computer science and artificial intelligence which is concerned with interaction between computers and human languages. Natural language processing is the study of mathematical and computational modeling of various aspects of language and the development of a wide range of systems. These includes the spoken language systems that integrate speech and natural language. Natural language processing has a role in computer science because many aspects of the field deal with linguistic features of computation. Natural language processing is an area of research and application that explores how computers can be used to understand and manipulates natural language text or speech to do useful things.There are different level of NLP that cand helps for processing given input and to make better output that is understandable by machine. The applications of Natural language processing includes fields of study, such as speech recognition, machine translation, natural language text processing and summarization, user interfaces, multilingual and cross language information retrieval (CLIR), speech recognition, artificial intelligence(AI) and expert system.

KEYWORDS- ***Machine translation; Natural language text processing; Artificial intelligence.***

1. INTRODUCTION

As a human, we may speak and write in English, Spanish or Chinese. But a computer's native language – known as machine code or machine language – is largely incomprehensible to most people. At your device's lowest levels, communication occurs not with words but through millions of zeros and ones that produce logical actions. Indeed, programmers used punch cards to communicate with the first computers 70 years ago. Now you can say, "Alexa, I like this song," and a device playing music in your home will lower the volume and reply, "OK. Rating saved," in a human like voice. Then it adapts its algorithm to play that song – and others like it – the next time you listen to that music station. Let's take a closer look at that interaction. Your device activated when it heard you speak, understood the unspoken intent in the comment, executed an action and provided feedback in a well-formed English sentence, all in the space of about five seconds. The complete interaction was made possible by NLP, along with other AI elements such as machine learning and deep learning. Natural Language processing is an branch of computer science for study of mathematical and computational modeling with the interactions between computers and human. Most of human speaks natural languages that humans learn from different source and practically implement to communicate with other humans. Whatever the form of the communication, natural languages are used to express our knowledge and emotions and to convey our responses to other people and to our surroundings and also used for duplicate detection,computer supported instruction etc. Natural language generation

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builds output based on the rules of the target language and the task at hand Natural languages are usually learned in early childhood from those around us. NLP is currently extremely popular for customer support applications, particularly the chatbot. These chatbots use ML and NLP to interact with the users in textual form and solve their queries.

2. LITERATURE REVIEW

Recently, there is undoudetly increment in the research work of natural language processing. The ultimate objective of NLP is to read, decipher, understand, and make sense of the human languages in a manner that is valuable. Most NLP techniques rely on machine learning to derive meaning from human languages. The literature distinguishes the main application of natural language processing and the methods to describe it.

1) Natural language processing for Speech Synthesis: This is based on the text to speech conversion i.e (TTS) in which the text data is the first input into the system. It uses high level modules for speech synthesis. It uses the sentence segmentation which deals with punctuation marks with a simple decision tree.

2) Natural language processing for Speech Recognition: In simple terms, speech recognition is simply the ability of a software to recognise speech. Anything that a person says, in a language of their choice, must be recognised by the software. Speech recognition technology can be used to perform an action based on the instructions defined by the human. The human needs to train the speech recognition system by storing speech patterns and vocabulary of their language into the system. Automatic speech recognition system make use of natural language processing techniques based on grammars. It uses the context free grammars for representing syntax of that language.

3. LEVELS OF NLP

To know how Natural Language Processing sytem work is by means of the 'levels of language' approach. It is also known as the synchronic model of language and is distinguished from the earlier sequential model, which hypothesizes that the levels of human language processing follow one another in a strictly sequential manner.

Fig. 1. Different Level of NLP.

A. Phonology:

phonemes are to spoken language what letters are to written language: they're the atoms of spoken sound—the sound components from which you can make any spoken word you like. The word cat consists of three phonemes making the sounds /k/ (as in can), /a/ (as in pad), and /t/ (as in tusk). Rearrange the order of the phonemes and you could make the words "act" or "tack"[4].

This level deals with the interpretation of speech sounds within and across words. There are, in fact, three types of rules used in phonological analysis

a) Phonetic rules:

It is used for sound within words.

b) Phonemic rules :

It is used for variations of pronunciation when words are spoken together.

c) Prosodic rules :

It is used to check for fluctuation in stress and intonation across a sentence. In an NLP system that accepts spoken input, the sound waves are analyzed and encoded into a digitized signal for interpretation by various rules or by comparison to the particular language model being utilized.

B. Morphology: Morphology is the first stage of analysis once input has been received. It looks at the ways in which words break down into their components and how that affects their grammatical status. Morphology is mainly useful for identifying the parts of speech in a sentence and words that interact together. The following quote from Forsberg gives a little background on the field of morphology. Morphology is a systematic description of words in a natural language. It describes a set of relations between words' surface forms and lexical forms. A word's surface form is its graphical or spoken form, and the lexical form is an analysis of the word into its lemma (also known as its dictionary form) and its grammatical description. This task is more precisely called inflectional morphology. Being able to identify the part of speech is essential to identifying the grammatical context a word belongs to. In English, regular verbs have a ground form with a limited set of modifications, however, irregular verbs do not follow these modification rules, and greatly increase the complexity of a language. The information gathered at the morphological stage prepares the data for the syntactical stage which looks more directly at the target language's grammatical structure.

C. Syntax:

Syntax involves applying the rules of the target language's grammar, its task is to determine the role of each word in a sentence and organize this data into a structure that is more easily manipulated for further analysis. Semantics are the examination of the meaning of words and sentences.

a. Grammar:

In English, a statement consists of a noun phrase, a verb phrase, and in some cases, a prepositional phrase. A noun phrase represents a

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subject that can be summarized or identified by a noun. This phrase may have articles and adjectives and/or an embedded verb phrase as well as the noun itself. A verb phrase represents an action and may include an imbedded noun phrase along with the verb. A prepositional phrase describes a noun or verb in the sentence. The majority of natural languages are made up of a number of parts of speech mainly: verbs, nouns, adjectives, adverbs, conjunctions, pronouns and articles.

b. Parsing:

Parsing is the process of converting a sentence into a tree that represents the sentence's syntactic structure. The statement: "The green book is sitting on the desk" consists of the noun phrase: "The green book" and the verb phrase: "is sitting on the desk." The sentence tree would start at the sentence level and break it down into the noun and verb phrase. It would then label the articles, the adjectives and the nouns. Parsing determines whether a sentence is valid in relation to the language's grammar rules.

D. Semantics:

It builds up a representation of the objects and actions that a sentence is describing and includes the details provided by adjectives, adverbs and propositions. This process gathers information vital to the pragmatic analysis in order to determine which meaning was intended by the user. D. Pragmatics: Pragmatics is "the analysis of the real meaning of an utterance in a human language, by disambiguating and contextualizing the utterance". This is accomplished by identifying ambiguities encountered by the system and resolving them using one or more types of disambiguation techniques.

a. Ambiguity:

Ambiguity is explained as "the statement that is interpreted in more than one way or have more than one meainng.

Types of Ambiguity:

Syntactic Ambiguity is present when more than one parse of a sentence exists. "He lifted the branch with the red leaf." The verb phrase may contain "with the red leaf" as part of the imbedded noun phrase describing the branch or "with the red leaf" may be interpreted as a prepositional phrase describing the action instead of the branch, implying that he used the red leaf to lift the branch.

Semantic Ambiguity is existent when more than one possible meaning exists for a sentence as in "He lifted the branch with the red leaf." It may mean that the person in question used a red leaf to lift the branch or that he lifted a branch that had a red leaf on it.

Referential Ambiguity is the result of referring to something without explicitly naming it by using words like "it", 'he" and "they." These words require the target to be looked up and may be impossible to resolve such as in the sentence: "The interface sent the peripheral device data which caused it to break", it could mean the peripheral device, the data, or the interface. Local Ambiguity occurs when a part of a sentence is unclear but is resolved when the sentence as a whole is examined. The sentence: "this hall is colder than the room," exemplifies local ambiguity as the phrase: "is colder than" is indefinite until "the room" is defined. Technical Notes and Letters should not exceed 2,000 words.

4. NATURAL LANGUAGE PROCESSING (NLP) METHODS AND APPROACHES

A. Natural Language Processing for Speech Synthesis*:*

TTS synthesis makes use of NLP techniques extensively since text data is first input into the system and thus it must be processed in the first place. [1] Describes the different high level modules involved in this sequential process: Text Normalization Adapts the input text so as to be synthesized.

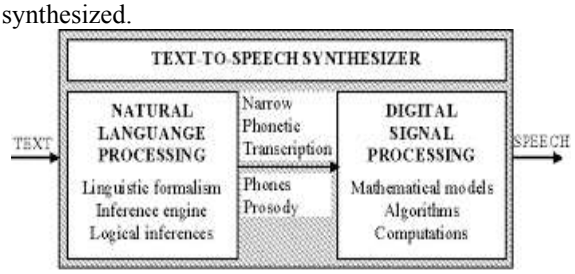

Fig.2. General Diagram for Text to Speech System.

The sentence segmentation can be achieved though dealing with punctuation marks with a simple decision tree. But more confusing situations require more complex methods. Some examples of these difficulties are the period marking, the disambiguation between the capital letters in proper names and the beginning of sentences, the abbreviations, etc. The tokenization separates the units that build up a piece of text. It normally splits the text of the sentences at white spaces and punctuation marks. This process is successfully accomplished with a parser. Finally, nonstandard words such as certain abbreviations (Mr., Dr., etc.), date constructs, phone numbers, acronyms or email and URL addresses need to be expanded into more tokens (units) in order to be synthesized correctly. Rules and dictionaries are of use to deal with non-standard words. Part-of-Speech Tagging assigns a word-class to each token. Thus this process consecutes the Text Normalization. Part-of-Speech taggers have to deal with unknown words (Out-Of Vocabulary problem) and words with ambiguous POS tags (same structure in the sentence) such as nouns, verbs and adjectives. As an example, the use a participle as an adjective for a noun in "broken glass".

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Grapheme-to-Phoneme Conversion assigns the correct phonetic set to the token stream. It must be stated that this is a continuous language dependent process since the phonetic transcriptions of the token boundaries are influenced by the transcriptions of the neighboring token boundaries. Thus, accounting for the influence of morphology and syllable structure can improve performance of Grapheme-to-Phoneme conversion [5].

B. Natural Language Processing for Speech Recognition:

Automatic Speech Recognition systems make use of NLP techniques in a fairly restricted way: they are based on grammars. This paper refers to a grammar as a set of rules that determine the structure of texts written in a given language by defining its morphology and syntax. ASR takes for granted that the incoming speech utterances must be produced according to this predetermined set of rules established by the grammar of a language, as it happens for a formal language. In that case, Context-Free Grammars (CFG) play an important role since they are well capable of representing the syntax of that language while being efficient at the analysis (parsing) of the sentences. For this reason/restriction, such language cannot be considered natural. ASR systems assume though that a large enough grammar rule set enable any (strictly formal) language to be taken for natural. NLP techniques are of use in ASR when modeling the language or domain of interaction in question.

Through the production of an accurate set of rules for the grammar, the structures for the language are defined. These rules can either be 1) hand-crafted or 2) derived from the statistical analyses performed on a labelled corpus of data. The former implies a great deal of hard-work since this process is neither simple nor brief because it has to represent the whole set of grammatical rules for the application. Since hand-crafted grammars depend solely on linguistics for a particular language and application they have little interest in machine learning research in general. Thus, the literature is extensive on the data driven approaches (N-gram statistics, word lattices, etc.). Aiming at a flexible enough grammar to generalize the most typical sentences for an application, [2] and [3] end up building N-gram language models.

1. DISTRIBUTIONAL APPROACHES

Distributional approaches include the large-scale statistical tactics of machine learning and deep learning. These methods typically turn content into word vectors for mathematical analysis and perform quite well at tasks such as part-of-speech tagging (is this a noun or a verb?), dependency parsing (does this part of a sentence modify another part?), and semantic relatedness (are these different words used in similar ways?). These NLP tasks don't rely on understanding the meaning of words, but rather on the relationship between words themselves.

2. FRAME-BASED APPROACH

"A frame is a data-structure for representing a stereotyped situation," explains Marvin Minsky in his seminal 1974 paper called "A Framework for Representing Knowledge." Think of frames as a canonical representation for which specifics can be interchanged.

Liang provides the example of a commercial transaction as a frame. In such situations, you typically have a seller, a buyers, goods being exchanged, and an exchange price.

3.MODEL-THEORETICAL APPROACH

The third category of semantic analysis falls under the model-theoretical approach. To understand this approach, we'll introduce two important linguistic concepts: "model theory" and "compositionality".

Model theory refers to the idea that sentences refer to the world, as in the case with grounded language (i.e. the block is blue). In compositionality, meanings of the parts of a sentence can be combined to deduce the whole meaning. Liang compares this approach to turning language into computer programs. To determine the answer to the query "what is the largest city in Europe by population", you first have to identify the concepts of "city" and "Europe" and funnel down your search space to cities contained in Europe. Then you would need to sort the population numbers for each city you've shortlisted so far and return the maximum of this value.

4. INTERACTIVE LEARNING

Paul Grice, a British philosopher of language, described language as a cooperative game between speaker and listener. Liang is inclined to agree. He believes that a viable approach to tackling both breadth and depth in language learning is to employ dynamic, interactive environments where humans teach computers gradually. In such approaches, the pragmatic needs of language inform the development.

To test this theory, Liang developed SHRDLRN as a modern-day version of winograd's SHRDLU. In this interactive language game, a human must instruct a computer to move blocks from a starting orientation to an end orientation. The challenge is that the computer starts with no concept of language. Step by step, the human says a sentence and then visually indicates to the computer what the result of the execution should look like.

5. CONCLUSION

NLP is a relatively recent area of research and application, as compared to other information technology approaches, there have been sufficient

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successes to date that suggest that NLP-based information access technologies will continue to be a major area of research and development in information systems now and far into the future. The state-of the-art Natural Language Processing techniques applied to speech technologies, specifically to Text-To-Speech synthesis and Automatic Speech Recognition. In 3TTS. The importance of NLP in processing the input text to be synthesized is reflected. The naturalness of the speech utterances produced by the signal-processing modules are tightly bound to the performance of the previous text-processing modules. In ASR the use of NLP particularly is complementary [6].

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