A Review on Morph Analyzer for Indian Languages

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ABSTRACT
Computational linguistics is the applied aspect of linguistics that has Morphological Analyzer (MA) as a fundamental link in developing many applications in the field of natural language processing. It's a crucial stage where words are selected to be analyzed down to the minimum meaningful unit of that language. There has been a substantial development of morphological analyzers and its applications indicating all possible approaches to rule-based as well as machine learning. In the present paper, literature review has been accomplished for morphological analyzer in Indian languages including Hindi, Marathi, Sanskrit, Kokani, Malvi, Sambhalpuri, Kashmiri, Tamil, Manipuri, Assamese, Punjabi and Oriya which is foundation to explore the morphology of Pawari Language.

Keywords
Morphology, Computational Linguistics, Rule based Approach, Machine Learning.

1. INTRODUCTION
Morphology can be of inflectional or derivational in nature. In this paper an attempt has been made to review literature for morph analyser in the Indian domain which serves as an important link for the applied areas in linguistics and computational linguistics. Morph Analyzer detects the morpheme and provides the grammatical information about the word. There are many approaches for word formation viz.

rule based, paradigm based, Statistical based, finite state transducer (FST) etc. It is indicated that there are many ways in the word formation process by which word formation analyses the syllables of the internal structure of languages. Morph Analyzer has a wide range of applications such as POS tagging, chunking, information retrieval, machine translation etc. This paper presents review on morph analyzer for Indian Languages.

2. REVIEW ON MORPH ANALYZER FOR INDIAN LANGUAGES
This paper presents a review on morph analyzer for Indian languages. Morph analyzer is named alternatively as morphological analyzer by different authors. This systematic review tried to discuss the work on morph analyzer on the languages viz Hindi, Marathi, Sanskrit Kokani, Malvi, Sambhalpuri, Kashmiri, Tamil, Manipuri, Assamese, Punjabi and Oriya in the following sections Morph Analyzer for Hindi

Hindi as a rich language at morphological level for which a large corpus is built which works on the basis of unsupervised approach[5]. The morph learning algorithm described in [5] uses the concept of 'observable paradigm'. The result of the algorithm are encouraging with the coverage of a primitive morph going up from 32% to about 63% and that of an advanced morph going up from 96% to about 97%. Singh &

Samra analyses the Hindi Noun and distributed (sample based) morphology, where the systematization of the formation of noun word classes in Hindi is presented[34], where a large number of case models can be built, especially through gender and root based or sample based methods system had the ability to identify original and morphological analysis for 12784 nouns (where more than half were a possible original words) while 1696 are unknown. Out of these 1696 noun forms, there were about 900 unique forms. The analysis showed that many of these words (200 hundred) were left unknown because of misspelling. Hyphenated compound noun (350) is also unknown. The remaining unfamiliar entries were a large number of unrelated nouns for which lexicon was found lacking entries.

In [15], it presents Hindi derivational morphological analyzer. This work presents an algorithm which uses an existing inflectional analyzer for performing derivational analysis. The algorithm uses the main principles of both the porter's stemmer and Krovetz stemmer for achieving the task. Algorithm upgrades an existing inflectional analyzer to a derivational analyzer and primarily achieves two goals. First, it successfully incorporates derivational analysis in the inflectional analyzer. Second, it also increases the coverage of the inflectional analysis of the existing inflectional analyzer.

Hindi Lemmatizer is described in [26] helps to know category, gender, number, factor etc. This information about a word helps us to understand the language after processing the corpus of 20000 sentences in the tool construction. It renders 55 lacks original words manually – formulated 1212 concepts and 112 rules. 500 words are properly observed and rest of the words fail to follow extraordinary and common rules. This lemmatizer works on a knowledge-based approach. Correctness of the built system is stated as 91%.

Statistical based approach is used for the construction of Morphological Analyzer for Hindi [21] [22], where work is done primarily in Hindi NCP. An oracle system that takes the best values from the PBA's output achieves only 63.41% for lemma, gender, number, person and case. Statistical analyzer has an accuracy of 84.16% for these morphological attributes when evaluated on the test section of the Hindi Treebank. Work in [22] revisited the work in [21] which focused on building a Statistical Morphological Analyzer (SMA) for Hindi and compared the performance of SMA with other existing statistical analyzer, SMA is a robust state-of-the-art statistical morphological analyzer which outperformed previous analyzers for Hindi by a considerable margin. SMA achieved an accuracy of 63.06% for lemma, gender, number, person and case whereas PBA and Morfette are 34.89% and 51.52% accurate respectively. With the predicted morphological attributes by SMA, It achieves a labeled attachment score of 89.41 while without these morphological attributes the parsing accuracy drops to 87.75%.

A-Rule based implementation for Morphological Analyzer for Hindi is presented in [1,28]. Tool developed serves a rule-based approach for both metaphors and derivation. In this analyzer, Hindi sentences and words are taken as input which finds features of required original words that are based on a grammatical category. Along with the rule-based approach corpus-based approach is also discussed in [28]. It serves metaphorical and derivable aspects of analytic morphology. System is developed which takes basic words as an input based on a grammatical category which is presented in derivative form. Domain specific Hindi data is utilized for morphological analysis is based on a hybrid approach [20]. Analysis result upto 90.60% shows the quality which increases by 6% on GMA and record 25.39% of uncontrolled words. It also presents the morphology as an important link of linguistics in which its two parts metaphorical and derivable morphology is explained with examples.

2.1 Morph Analyzers for Marathi

Inflectional morphological analyzer has been created for Marathi language in which paradigm based finite state approach has been used[3]. Statistical POS tagger and chucker with morphological analyzer are plugged to see the impact of analyst so as to verify its usefulness as a foundation for NLP applications. The average accuracy of MDLB POS tagger turned out to be 95.03 as compared to 85% of LB. The average accuracy of MDLB was found to be 97.87% whereas that of LB was found to be 96.91%. The accuracy figures as high as 97.18% in direct evaluation and the performance improvement in shallow parsing speak about the performance of the morphological analyzer. Rule and paradigm based approach has been used for morphological analysis for a given text in marathi language[38]. The emphasis is given on linking Marathi language with technology where Marathi script consists of 16 vowels and 36 consonants making a total of 52 alphabet is used. System developed can find out the root word of a given word and can also be used in identifying gender. NLP based morphological phenomena present in Marathi is described in [10]. In this paper postposition in Marathi is classified along with the development of morphotactic FSA. In the proposed system, the morphological analyzer for inflectional language and a parsed tree i.e. a grammatical structure for Marathi is evaluated. Marathi input is converted to English with its type, lexicon and morpheme by the morphological analyzer. Morphological Disambiguator for Marathi Using NLP is discussed in [18]. Emphasis is given to use the short sentences in the process of English to Marathi and Marathi to English translation. Proposed system in [18] provides the solution for simple and short sentences with ambiguous word. Also improvement is suggested with the use of more inflection and grammar rules for long and/or complex sentences. Further improvement is suggested by using language sense methods, like lakshna chart to remove ambiguity more accurately.

Finite-State Morphological Analysis for Marathi is presented in [29]. In this paper toolbox is used for lexicon formalism for describing the finite-state transducer, and attempts to work within a morphological framework that would allow for some consistency across Indo-Aryan languages enabling machine translation across language pairs. An evaluation of our finite-state transducer shows that the coverage is adequate, over 80% on two corpora, and the precision is good (over 97%).

Morphology-based Spellchecker for Marathi is discussed in [9]. Paper discusses the architecture and implementation of a rule-based spellchecker for Marathi, a major Indian Language. Over 13,000 root words have been collected and classified by

part of speech. For each word category, analysis was performed to derive inflectional morphological rules. Primarily, the parameters that were considered are tense, aspect, mood (TAM) and gender, number, person (GNP) and attachment of Postpositions. This implied an accuracy of validity of 99.57%.

2.2 Morph Analyzers for Gujarati

The work on morphological rules for Gujarati language classes and lexicon database with the dictionary entries is presented in [17]. 15664 dictionary entries are taken for preparing Gujarati lexical dictionary for developing the system, which include noun, pronoun, adjective, verb etc. The lexical rules are defined by putting the suffixes into a category of grammatical categories. Paper presents useful packages consisting morphological grammar rules, dictionary, test data, and a set of API to develop morphological analyzer for Gujarati language. In [16], work is done on rule based Gujarati morphological analyzer. POS tagging has been used to identify the words and the dictionary has been prepared manually with the help of linguist in which substituted rules are divided into three categories viz Noun Inflection Rules. 12 rules are hand coded, Verb Inflection rules in which 65 rules are hand coded for verb inflection and 168 rules are hand coded for derivational morphology. Performance of proposed morphological analyzer evaluated on short stories taken from various Gujarati websites and stories article from corpus EMILLE with the accuracy of 87.48%.

,Morph analyzer for Gujarati is developed using a hybrid approach that combines statistical, knowledge based and paradigm-based approach[4]. It demonstrates a significant improvement in overall accuracy and achieved 92.34% and 82.84% accuracy with knowledge-based hybrid method and statistical hybrid method respectively.

2.3 Morph Analyzers for Sanskrit

Sanskrit morphological analyzer that identifies and analyzes inflected noun forms and verb-forms in any given Sandhi-free text[12]. It works with a reverse Paninian approach to analyze tidntanta verb forms into their verbal base and verbal affixes. Database is created to store various morphological components of Sanskrit verb forms that are clearly in line with the well defined and structured process of Sanskrit morphology described by Panini in Astadhyayi. It comprehensively includes the analysis of derived verb roots also.

2.4 Morph Analyzers for Sindhi

[24] presented a work on Sindhi Morphological Analysis in which algorithm is designed and implemented to resolve the problem of segmenting Sindhi complex and compound words into possible morphemes. The developed words segmentation system has been tested on a list of 109 compound words, 179 prefix words, 1343 suffix words and 50 prefix-suffix words. After the process of words segmentation, compound words yielded the SER of 3.7%, the prefix words gave an SER of 4.56%, and suffix words did 8.84% and prefix-suffix words 8%. The individual calculation and cumulative segmentation error rates of the proposed algorithm derive out that the results have come up to the acceptable level. The cumulative segmentation error rate of 5.05% is calculated and effectiveness of the proposed algorithm with an exactitude rate of 94.08% is observed.

2.5 Morph Analyzers for Odia

Morphological Analyzer for Sambalpuri Odia Dialect is discussed by Sethi [32] and explains the dialectical state of

Oriya and Sambalpuri language through metamorphic analysis of the inflected verb from which has been considered as a challenging task. Sambalpuri is a dialect of Oriya language, but its grammar, pronunciation is different from the standard language. In this paper, Sambalpuri Oriya dialect has been developed for verb forms with a view to explain the metaphor of Sambalpuri language. Sethi also presents a comprehensive survey on Odia Computational Morphology[31]. Work on Oriya language shows that various methods are employed in the field of computational morphology such as suffix stripping algorithm, finite state automata-based approach, finite state transducer (FST), two level morphology- based approach, corpus-based approach, paradigm-based approach. All work related to these approaches indicates that Oriya language is also becoming technically strong.

2.6 Morph Analyzers for Manipuri
The finite state Techniques has been carried out alongside using a handmade method for developing morphological analyzer for Manipuri by Singha & Purkyastha[35]. Suffix stripping approach is used to analyse the nominal category Manipuri words. The morphological features of the Manipuri nominal category is also discussed. Morphological Analysis of the Bishnupriya Manipuri Language using Finite State Transducers is discussed in [14]. Paper presents a morphological analysis of Bishnupriya Manipuri language. Work is of its first kind as there is no computational work available for this language. The approach used in the paper is finite state transducer to resolve the morphs.

2.7 Morph Analyzers for Konkani
Paper presented in [7] discusses a rule based method which automatically assigns paradigms to Konkani nouns using morphophonemic rules, stem formation rules and relevance score of the paradigms. The first contribution of this work is computation of relevance score of a paradigm, which is computed using a corpus and paradigm differentiating measure assigned to inflectional suffixes in the paradigm. Relevance score helps assign multiple paradigms to the input word wherever appropriate. The proposed method successfully assigned relevant paradigms to 10,068 nouns with F-Score of 0.93. In [8], it discusses popular tools used to build morphological analyzers like XFST, HFST and Apertium's toolbox for konkani. The finite state approach is used to sequence morphemes instead of characters. In this paper the architecture and implementation details of a Corpus assisted FSA approach for building verb morphological analyzer tests were performed using tagged corpus to obtain results. The F-Score of 0.95 was found during the test.

2.8 Morph Analyzers for Malayalam
Morphological analyzer for Malayalam verbs is presented by Saranya [30]. This paper made an attempt to formulate a paradigm analyzer for Malayalam. There were no morphological analyzers for Malayalam developed before. Paradigm method and suffix stripping method has been used as a hybrid approach. Eyphonic rules or Sandhi rules are also incorporated in this approach to identify a stem correctlyin Malayalam morphological analyzer. There are wide application areas of Morph analyzer such as machine translation, speech recognition, speech synthesis, part of speech tagging, Computational Analysis of Malayalam Linguistics is implemented with Suffix Stripping method and application of sandhi rules of Malayalam in reverse[13]. This system is rule-based and proved to be an efficient method to identify the morphological categories of a given noun.

2.9 Morph Analyzers for Other Indian Language
Morphology of Mewati Language is studied in [23]. The submitted research paper studied the Mewati language which is one of the eight dialects of Rajasthani language in which many similarities and differences have been shared with Hindi and Urdu. It is considered as the first research on grammatical structure for Mewati language that requires computational analysis which includes phonology, syntax and semantics. Here it is illustrated through gender, numbers, karaka to explain grammatical aspects.

Morpheme Based Parts of Speech Tagger for Kannada Language is presented in[25]. In this research work morphological features and grammatical information of the input words are extracted to determine the parts of speech tags. Indian standard board Dravidian and hierarchical tagger are used to specify some parts of speech tags. It has been shown that without using manually pre-tagged training data set and statistical machine or learning algorithms, performance of morpheme based pos tagger is better. Overall performance of the proposed system at EMILEE data set is above 90%.

Morphology of assamese Words using Finite State Transducer is analysed by Rahman & Sharma [27]. Presented research paper has been sought to state that finite state transducer (FST) based approach for Assamese language has been considered the most effective way to develop morphological analyzer. This paper attempts to analyse the words of Assamese language using the SFST (Stuttgart finite state transducer) tool to generate the FST. The list of original words is made manually with the description and rule list for derived class of Assamese. After testing the used morphological analyzer gave an accurate result about 84.64%.

Morphological Analyzer for Kashmiri[19] attempts to state that morphology is important to any language, which can bring any language forward in technical areas viewed in machine translation, extraction, dialogue system etc applications. Hence a morphological analyzer is required for computational processing of any language. This paper discusses the morphological level of Kashmiri language by a computational approach, which helps Kashmiri to develop a morphological analyzer paradigmatic approach that has been used to serve this purpose. Presented research paper highlights grammatical categories' (noun, pronoun, verb and adjective) which can be easily understood. This work is considered as an attempt to commence the work of computational processing of Kashmiri language.

In paper [11], it attempts to develop Punjabi morphology, corpus and lexicon. Panjabi is normally written in two scripts,Gurumukhi (In India) and shahmukhi (in Pakistan) . The resources reported in this paper are developed using shahmukhi. Presenting research paper speaks about the implementation of Punjabi morphology which contains a 13,600 word. To develop morphemic system an adjective, noun, verb, adverbs have been taken. Morphological Generator for Tamil uses paradigmatic classification for noun and verb to carry out the morphological analysis of Tamil language [2]. Vikram discussed morphology of Indian Languages and European Languages[37]. Paper presents the differences in Hindi and English language. Differences are classified in terms of differences in origin, differences in order of letters, difference in grammar, difference in terminology. Efforts have been made to look at natural language processing

in foreign languages from the perspective of Indian languages as well as to link with artificial intelligence.

The work on finite-State morphological analyzer for Urdu and Hindi is discussed which addressed a number of issues that arise in the process of building a finite-state morphological analyzer for Urdu [6]. Approach presented in the paper allows for an underlying similar treatment of both Urdu and Hindi via a cascade of finite state transducers that transliterates the very different scripts into a common ASCII transcription system. Some of the work on morphology specifically focused on machine translation [33]. Paper presents the concept of English to Hindi machine translation based on a computational model. Commonly used word forms for all Hindi root words are stored in a database for demonstrating the Hindi morphological analyzer and generator. Comprehensive analysis of Hindi morphology and inflection and its implementation in a DMbased Morphological Analyzer is presented. The system was able to perform accurately in most cases.

Statistical morph analyzer for (SMA++) Indian language is discussed by Srirampur et al.[36]. This paper evaluated a number of works related to morphological analysis and attempted to expand the same work. The task performed here has been evaluated all the languages that have been used in submission tool. For all the four ILs, SMA++ outperforms other SMAs. For Hindi, the L+G+N+P+C accuracy was 85.87%. For Urdu, the L+G+N+P+C accuracy was 79.16%. For Telugu, G+N+P+C accuracy was 86.81% and for Tamil it was 78.97%. These high values show that SMA++ is a marked improvement over the SMA in [22]. There is a plan to expand languages to European languages such as Polish, German, French etc.

3. CONCLUSION

The study of the present research papers show that many morphological analyzers are designed and evaluated for accuracy. Rule-based, statistical-based, paradigm -based, hybrid approaches are re-used to implement the morph analyzer. It is concluded that morphological analysis is an important link to develop the application in the domain of natural language processing. Review reveals that there are many Indian languages for which computational morphological study has not been presented and performed. This detail review will be the base for further study of morphology of Pawari language for which computational morph analysis has never been discussed.

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