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Classification of Sentiment Analysis based on Adaptive Neuro Fuzzy Inference Model (ANFIS)

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Abstract: ***With the growing demand of Social media and its various networks and with the emergence of virtual nature of Online Shopping users are not easily able to determine whether the quality of the product or service is good or worse. For this work there is no such specific model existed that can find similar or dissimilar products from the people posting tweets in the form of post, messages or hashtags using similar sort of textual content. Also the companies are giving their Product reviews, which contain the direct / Indirect feedback from the customers. The companies are also getting feedback from the social media in the form of tweets / post / blogs from the twitter in the form of text for the same product. So, to find the sentiments of an individual based on the product recommendations the work had been proposed. The reviews from various intelligent algorithm for sentimental classification based on Adaptive Neuro-Fuzzy Inference System were studied. The research work is based on the comparison of the other traditional based Sentiment Analysis methodology with the ANFIS. Therefore, we are able to identify the best method to be used for the reviews identification in the best possible method.***

Keywords: Adaptive Neuro-fuzzy Inference system (ANFIS), Sentiments Analysis, Machine Learning algorithms, Natural Language Processing (NLP), Online Shopping.

I. INTRODUCTION

The sentiment analysis is one of the requirements in today's education sector specially the pandemic situation like Covid-19 when the students and learners are forcefully lived in a house and not communicated with their peer groups in a physical mode; we need to have a regular monitoring on such learners who might fall under depression category. An automated system with a prediction-based approach is very useful in such situations. The SA is also very useful in other sectors like E-commerce, product reviews, movie reviews etc. In case of product and the availability of E-Commerce, websites a person need a better review result before buying a product. Second case belongs to movie reviews and feature reviews, event reviews. However, the approach for product selection and movie selection may be same, the objective of these two selections are different.

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The product selections maybe our daily needs while movies/events may be for entertainment purposes. In this [1.1] author focused on the specific domain – movie review, in which the author had proposed multi-knowledge approach, integrating WordNet, using statistical analysis and the knowledge obtained from movie reviews. In these experimental results, the effectiveness of the proposed mining and summarization approach in movie review. We have identified some of the research gaps. They are summarized as below:

i. For feature extraction using bi-gram and n-gram text analysis adds to Computational Complexity
ii. No fine grained clustering sentiments classification, since the classification results have many overlaps
iii. Sarcasm and slang words are not accounted for the Sentiment classification

Major Objective of this paper are as follows:

1. As the text used for the blog or the post or tweets contains some fuzziness. This made the text unrealistic in the sense of Natural Language Processing (NLP). So, during identification of Sentiments this can be used in a more efficient and automatic manner.
2. Lexicons are extracted using TextBlob, which is one of the efficient for polarity of the dataset.
3. Proposed novel fuzzy-based rules forms the domain independent, which means that the rules can be further extended including any reviews consisting of textual data including Assignment in academics. These types of textual data general employs lexicon which somewhat contains fuzziness in the text.
4. Adaptive Neuro fuzzy Inference system (ANFIS) is employed in which the parameters antecedent and precedent are optimized by least-squares estimate and gradient descent algorithm using Tensorflow ANFIS.

This current paper proposes intelligent model for sentiment classification. The model proposes the methodology based on two stages. First supervised learning and second ANFIS using Tensorflow in python. In the first stage, the reviews are analyzed through a preprocessing method and classified among two categories, first Positive sentiments, and second negative sentiment. In each of the above classification the earlier performance was not significant therefore, the current work also introduces high positive, low positive sentiments high Negative (HN) sentiments. This will give a better picture to the customers. In the second stage, the current system uses ANFIS through TensorFlow which gives a fast processing with better accuracy. In ANFIS we drafted self-made rules for the membership functions.

We created a confusion matrix corresponding to all reviews for a particular product or movie. We have designed a framework and it's implemented in python as its supports deep learning packages. The dataset is trained according to above polarity computation and passed through the designed framework. The known results are validated under testing phase and it has been observed a significant improvement over the previous work with a better accuracy and prediction.

II. LITERATURE REVIEW

The author [0] reviewed the different movies on daily basis. They manually summarize the reviews. The work of the author is summarized as below:

(a) For the classification of the reviews from various movies from IMDB dataset is used by the author. The Machine Learning algorithms like Naïve Bayes with features set including the context unigrams and bigrams.
(b) Semantic similarity can be calculated using graph based ranking algorithm is proposed which produces a generic extractive summary from the movie reviews classification.
(c) In this the metrics used by the author like ROUGE-1 and ROUGE-2 had been used for comparing the summarising approach to the state-of-the-art approaches. These were the evaluation criteria used in the work.

The author depicted a framework with four phases:

(a) Pre-processing
(b) Extraction of Features
(c) Reviews Classification
(d) Reviews Summarization

This work can also be done with the help of Adaptive Neural Networks. The ANFIS can predict in a different way and can be useful in today's environment.

The collection of fuzzy rules for sentiment computing was proposed by the author [1.1]. This was used to categorise the review as either good or negative. In this case, the input sentiment is the confidence score from supervised Support Vector Machine (SVM) classification of text and speech signals. For identifying sentiment, the merging of fuzzy logic with auditory and linguistic information adds a variable to the fuzzy rules. The author's approach uses eight state-of-the-art techniques to create a new exemplar in multimodal sentiment analysis. In comparison to the state-of-the-art, their approach achieves 82.5 percent accuracy on benchmark datasets, which is greater in supervised machine learning.

A comparative analysis on Sentiment Analysis was conducted in the publication [2]. The author conducted an empirical investigation on previous 47 Sentiment Analysis studies and chose a suitable challenge. They then demonstrated the influence on the percentage of Sentiment Accuracy. The author made two comparisons: the first was between the Sentiment Analysis challenges and the sentiment review structure, which could have an impact on the sentiment outcomes. The second comparison looked at the impact of addressing the Sentiment problems on accuracy. Based on two comparisons across all forty-seven studies, this survey paper evaluated the importance and impacts of evaluation. The comparison's findings revealed that domain-dependence is an important aspect in recognising sentiment issues. In addition, the negation challenge grew in popularity across the board.

The author [3] used twitter dataset for classifying sentiments. They considered different types of facial expressions, generic objects places, weather, animals and birds also. This paper proposes a scheme wherein, knowledge gained from a language is passed on to a language with scarce amount of labels. After one of the classifications is being long short term memory where words with special functions (such as transition and negation) are shown and the difference of words with opposite emotions are exaggerated. The author also expressed extraction and classification method. One of the feature extractions is through Grey wolf optimization where contents on social media platforms are optimized. A suggestion came with combination of content based filtering and collaborative filtering. They considered the sentiment data set which contains a set of product in which various sentences were categorised as positive, negative and neutral class. The author worked with deep learning board optimization technique because of the feed-forward network that can used to extract logical properties of an emoji in a sentence unigrams, bigrams model based word vector representation is used for feature vector, and those feature vectors are considered for LSTM and CNN for training and learning. This paper [5] proposed a fuzzy rule based system for sentiment analysis. The author compared the performance of proposed approach with commonly used sentiment classifiers. The author proposed a fuzzy rule based system for sentiment classification. They identified key features with its significance in practical applications. The data is being trained with the use of fuzzy rule learning approach. Fuzzy logic is well capable of dealing with linguistic uncertainty. The results found are very good with a accuracy over 90% however, the use of ANFIS is another good approach in getting high accuracy.

In the paper [6] the author collected different texts for sentiment analysis. They analysed the text with fuzzy semantic similarity measures. The author developed a linear Dialogue system and designed a feature set. The author collected text from dialogue system for the design of FUSE for semantic similarity algorithm. The result is comparatively with low accuracy although it can be used for simple linear text.

III. COMPARATIVE STUDY AND OBSERVATION

In the work presented and compared among all the authors the performance of the Sentiment classification can be improved by applying fuzzy rules including Fuzzy Inference System (FIS) in integration with Adaptive Network based Fuzzy Inference System (ANFIS) [5] Jang 1993. Fuzzy If-Then rules and Fuzzy Inference systems along with neural networks back propagation algorithm the performance of the Sentiment Analysis can be improved. Also by applying Gradient descent at the consequent end, we may get the better results in accordance with the performance analysis. In most of the applications the adaptive capability of the ANFIS gives full control in identifying the sentiments from the reviews taken from Twitter or any specific product reviews. In most of the papers compared, the work had been done on the static dataset.

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We have improved on the work including the real time data analytics of the Twitter dataset. The generalization capability of the sentiment classification is increased based on the Adaptive Neuro Fuzzy Inference system. By using linguistic hedges, we are able to update on impreciseness and vagueness can be reduced with the help of backpropagation algorithm used in Neural Networks. With the use of linguistic hedges with Adjectives (nouns) or adverbs (verb) like very, low, slight, more or less, fairly, slightly almost, barely, mostly, roughly, approximately and many more can be used for defining the rules for Fuzzy Inference System.

Paper	Attributes	Algorithm work	Output - Accuracy	Conclusion
Movie Review Summarization Using Supervised Learning and Graph-based Ranking Algorithm [0] Khan 2020	Considered Edges of the graph as semantically similarity weight	The author had considered the algorithm using Naïve Bayes, which considers both as feature set unigrams and bigrams.	Author used paired-sample T-test to compare the means of two results that represent the same test group and obtained low significance values of 0.039, 0.030, and 0.029 for average precision, recall, and F-measure. Typically, the low significance values are obtained for the T-test conducted which is less than 0.05, meaning that they are less significant.	The performance of the classifier was further improved with the weighted IDF when the frequency of features (unigrams and bigrams), but the results were not presented.
Inferring Sentiments from Supervised Classification of Text and Speech cues using Fuzzy Rules [1.1] Vashishtha 2021	Used set of fuzzy (FIS) rules to label the review into, positive and negative sentiments of the reviews. The confidence score from supervised Support Vector Machine (SVM) with the classification of text and speech cues is considered as the input variable for the fuzzy rules. This fusion of acoustic using fuzzy logic and the linguistic features for classifying sentiment. This contributes different variable forming various the fuzzy rules.	Used Supervised algorithm SVM for Input to the FIS rules. Fuzzy approach has been compared with other ML algorithms for multimodal sentiment analysis	As proposed by the Author, experiments on benchmark datasets yield 82.5 % accuracy. The experiments on benchmark datasets yield 82.5 % accuracy for our approach which is higher in contrast to the state-of-the-art. contrast to the state-of-the-art.	By incorporating fuzzy inferencing (FIS) rules with linguistic and acoustic behavior, the system deals well with vagueness and ambiguity related to text and speech.
A survey on sentiment Analysis [2] Hussein 2018	Comparative study on Sentiment Analysis is being done.	The challenge remains in the negation in all types of reviews done.		Comparisons done among Sentiment Analysis is based on domain-dependent.
Optimization based fuzzy deep learning for Classification for Sentiment Analysis [3] Uma 2020	Used linguistic hedges to compute the sentiment score using fuzzy functions.	Features are extracted based on Grey Wolf Optimization. Fuzzy-Long short Term memory (F-LSTM) classification of data under social reviews in Twitter	Aspect level Sentiment classification is used to predict among food, room and service. Fuzzy Accuracy – 90.3, LSTM – 92.6 and F-LSTM – 95.7 as predicted by the author	Unigrams and bigrams model are represented as word vectors which are fed into CNN and LSTM to get better performance.
Fuzzy Approach for Sentiment Classification [5] Jefferson 2017	Rules are defined for the Sentiment Score. Author had considered the fuzzy score Rule 1: $f_{Good}(3) = 0.25$, $f_{High}(5) = 0.75$	Author had used Tsukamoto fuzzy rule (FIS) systems for classification of sentiments.	Calculated Degree value for Class, Negative, Degree value for Class, Positive. Considered dual output as positive and negative. Intensities are considered as Positive, Negative, Somewhat Positive, Positive and somewhat Negative, Somewhat Positive, Positive and somewhat Negative and Neutral.	The fuzzy approach allows the definition of different degrees of sentiment without the need to use a larger number of classes.
Interpreting human response in dialogue system [6] Adel 2020	Semantic similarity measure is considered for the work.	Author had considered CAFÉ feedback dialogue questions, which are being mapped to fuzzy score.	Results from 32 participants were considered by the author, and showed that fuzzy measures improved within the dialogue system by 21.88 percent and had compared the results with the crisp measure known as STASIS, providing a natural and fluid dialogue exchange. The results according t the author had showed that the average TP of FUSE is 87.85% which is an improvement of 21.88% when compared with STASIS rule firing rating (65.97%).	Author compared semantic similarity of user utterances and rules with FUSE and STASIS to determine which rule to apply.

Neuro-fuzzy network incorporating multiple lexicons for social sentiment analysis [7] Vashishtha 2021	Author had considered the features (Multiple Lexicons) by using VADER, AFINN and SentiWordNet. Novel set of 64 rules for the sugeno-type FIS are considered.	Fuzzy based Sentiment Analysis is being applied with the help of Adaptive Neuro Fuzzy Inference System (ANFIS) model. Dataset from 10 different sources are considered among them Airline, Twitter and Reddit are considered.	Single Lexicon based 9 Fuzzy rules are defined as well as for Multiple Lexicon based 64 fuzzy rules are being defined by the author.	Membership functions applied includes are Triangular, Gaussian and Generalized Bell are considered by the author to improve the performance of the results.

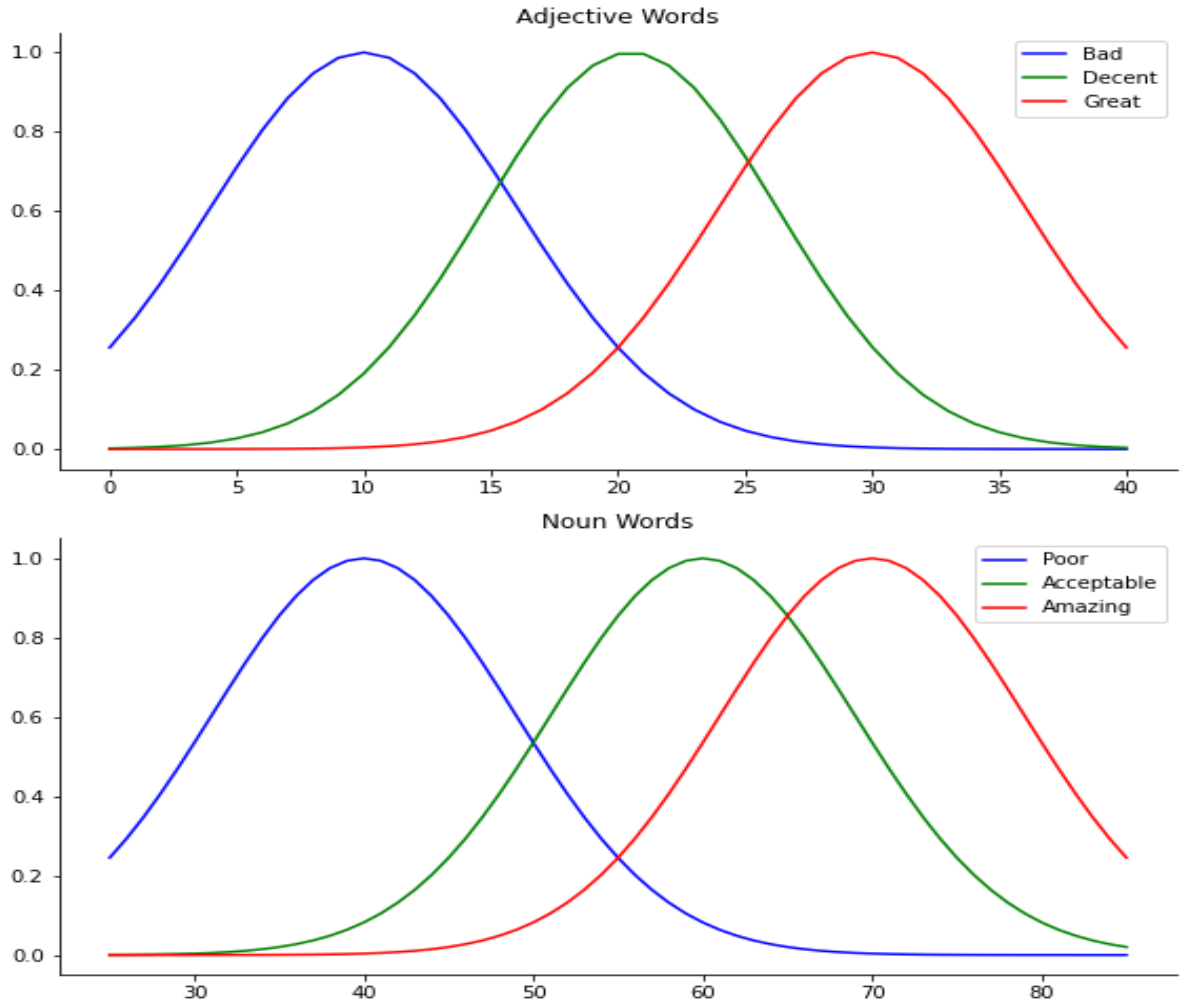

Fig. 1 Gaussian Membership function used for Feature Identification Adjective

In the given figure the adjective bad, descent and great are considered as label to plot the Gaussian membership function.

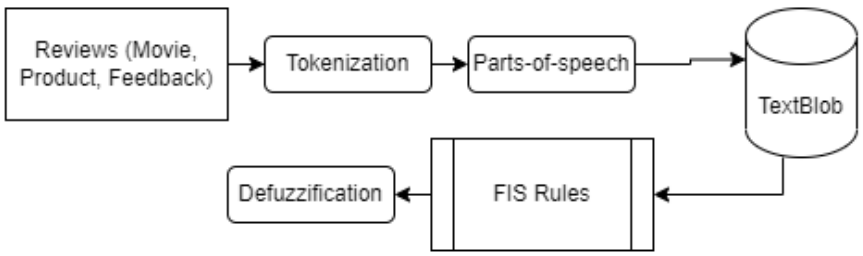

fig 2: Methodology followed for movie reviews

IV. POLARITY CALCULATION FOR THE IDENTIFICATION OF THE SENTIMENTS

Processing (NLP). The sentiments can be better understood from corporate surveys, e-commerce reviews, producer reviews to Movie reviews like imdb and Netflix. To identify the opinion imbibed into the text or reviews and to analyze the text is called sentiments. To quantify a sentiment, the value of polarity like positive, neutral or negative is used. The sign of polarity score identifies the overall sentiment in a review in the form of positive, neutral or negative. Generally, there are two approaches to Sentiment Analysis:

1. Supervised Machine Learning including deep learning approaches
2. Unsupervised lexicon-based approaches

With the lexicon based approaches we have several methods proposed by various scientist, that presented below:

1. AFINN lexicon – Polarity words of more than 3300, this is used to calculate the sentiments.
2. SentimentWordNet – It assigns to each synset of Wordnet 3 sentiment scores.
3. Bing Liu lexicon – This also includes the aspect based sentiment.
4. MPQA subjectivity lexicon – Subjectivity of the text can be used from these lexicons.
5. VADER Lexicon – Valence Aware Dictionary and sEntiment Reasoner - works better in the case of slang and emoji's
6. TextBlob lexicon – Subjectivity score can be identified by using TextBlob.

V. CONCLUSION AND PROPOSAL

We can conclude from the reviews that by comparing the state-of-the art algorithm used in machine learning we can improve the performance in Classifying the Sentiments by applying the Fuzzy rules (FIS) Fuzzy Inference system. We have used Linear Regression for the movie reviews and validated the results. The results interpreted based on the Linear regression applied for the movie reviews dataset considering the polarity. The reviewed papers are the research work on the analysis of movie reviews data. Finally, the results are calculated using training and validating the data for general purpose. These dataset applied for fuzzification to get the better accuracy. Finally, we can plot the error plot to calculate cost in Training Loss with the learning rate and Training loss in validation phase

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