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Dynamic Feature based Computational model of Sentiment Analysis to Improve Teaching Learning System

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ABSTRACT: Sentiment Analysis is a very attractive research area of data mining in recent years. There are many applications, in which user reviews and comments are collected to evaluate and improve the system. Web based interface is now a very easy platform to collect online reviews and opinions about anything. But the accuracy of computational analysis of the reviews is needed to improve right now. The main objective of the research is to present the overall detailed review of teaching learning system based on student feedback. Different techniques exist to evaluate teaching leaning systems currently in many institutes and universities. The applicability of sentiment analysis and opinion mining is shown in the paper for the evaluation of teaching learning process. The proposed computational model of sentiment analysis is an automated system to analyze the textual feedback of faculty submitted by students. This model is accurate, flexible and versatile than traditional feedback analysis systems where the student has to give an evolution score on some predefine aspects decided by management. The proposed model allows students to their aspects to evaluate teaching learning system and illustrates the advantage of the model in teaching learning system to enhance its quality.

Keywords: Sentiment analysis, teaching learning evaluation, emotion detection, and text based sentiment analysis.

I. INTRODUCTION

Sentiment Analysis (SA) is the process of computational analysis of user's feedback or comments to classify them into either one of the sentimental sentence as positive, negative, neutral or one of the emotions like happiness, sadness, angriness to identify actual feelings of the user about the particular subject, event or entity [1]. Nowadays sentiment analysis started to plays a very important role to analyze any system via the user's feedback and ensure the quality and performance of the system [2]. Sentiment analysis is basically a subfield of natural language processing to analyze and evaluate the textual data with combination of machine learning, computational linguistics and Data Mining techniques. Sentiment analysis deals with opinions, emotions, and beliefs expressed in a written text using language evaluation techniques [3]. The polarity score of the textual data is also useful to analyze the textual content and classify them into sentimental and emotional category. If the semantic meaning of a text is clear then the hidden sentimental and emotional context may be uncovered for the concerned system. Text analysis based on the user's feedback analysis comes in the category of sentiment analysis [4]. Many service providers have an feedback system based on customers for sharing their reviews to understand the satisfactory level toward the services and understand the actual demand of users to improve the system.

In this paper, a computational model has been proposed that focused on the role of sentiment analysis in the field of educational system to improve the teaching-learning process of the system. In the teaching-learning process [5], the first task is to collect student's feedback, review and comments about the respective teachers and generate the summery of all the collected data to analyze it for improving the teaching learning process via data visualization [6]. In the proposed system, text based feedback and comments are collected using web interfaces as shown in Fig. 1.

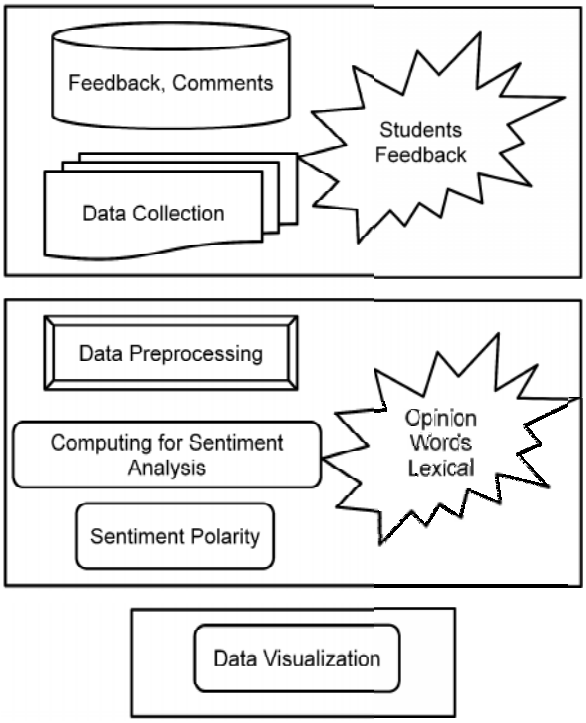

Fig. 1. Feedback Collection for Sentiment Analysis.

The collected data is preprocessed and then analyzed to evaluate sentiment polarity. The proposed system uses the feature selection module to classify the feedback into different category using feature score as discussed later. A students' sentiment, which is hidden in their feedback or comments about teaching learning, is the outcome of the proposed system that tells about the satisfaction level of the teaching learning system. Various researchers have worked in the field of sentiment analysis. In section II, we present the summary of relevant recent work published by different authors. Section III explains the existing system and its drawbacks. In sections IV and V, we elaborate on the proposed computational model with its architecture. Section VI presents our experimental result analysis and discussion. Section VII concludes the paper and focus on future work.

II. LITERATURE SURVEY

Many articles have been presented till now in the area of sentiment analysis for feedback analysis. Some of the relevant research articles have been discussed in the literature survey of this paper.

III. EXISTING SYSTEM AND PROBLEM DEFINITION

Nowadays, most of the institutes and universities have a student review system to evaluate the teaching learning process [13]. According to the current system, the student needs to evaluate each faculty based on predefined objectives and submit them to the management unit [14]. The student has been asked to evaluate faculty using some predefined questions decided by the experienced professors or management persons. Students need to write down the grade point from 1 to 5 for all listed questions as given in Table 2 and submit back to the evaluator. The evaluators collect the review document from all the students of a respective course [15]. The mark of all questions given by the student is evaluated as shown in Table 3 and the overall average score is calculated. The average feedback score of the faculty is calculated as shown in Table 4 to understand the quality of teaching learning process.

The evaluation process is continued for all the faculty members of the institute or university and Fig. 2 represents a comparative feedback score of the corresponding faculty of a particular course.

Table 1: Literature Survey of Sentiment Analysis.

Author	Input	Output	Advantages	Disadvantages
Hudson *et al.,* [7], in 2008	Boolean response of student using electronic circuits.	Student behavioral analysis improves student confidence and comfort levels	Analog circuits are successfully used in a combination for behavioral and analytical analyses	System only work when the students having good analytical power.
Gurupur *et al.,* [8], in 2015	A student concept dataset on any topic.	Using a concept map system evaluate students solution using sentiment score.	Useful to the instructor to identify student ability to induce a understanding of the topic and improve their teaching method.	Limited in concept map and chart to predict and show directional based knowledge.
Poria *et al.*, [9], in 2015	A customer alphanumeric review dataset.	Using sentiment flow based linguistic algorithm shown little improvement found.	It increases the effective sentiments of different sentences using Sentic Pattern Rules and CI classifier rules.	Should be work on Sentic Pattern rules to train the system to work on realistic sentence.
Lan *et al.*, [10], in 2017	A real world educational dataset.	Non-linear student response based on BLAh model using Boolean logic.	Improvement over traditional sentiment analysis model by Boolean logic functions for best in-class prediction performance.	Sparsity constraints and restrictions of Boolean logic functions
Sedera *et al.*, [11], in 2017	A user experience dataset.	Model based on expectation confirmation Theory.	It reduces the computational complexity with improved result using confirmation theory of service.	The research is limited to single dimension dataset.
Kusen & Strembeck [12], in 2018	Dataset consisting of twitter post and comments.	Shows that emotional texts are re-texted, replies and likes.	The work has a great discussion on all the aspect on the multidimensional texts using social media dataset.	Should be free from text API for data collection and abstraction.

Table 2: Student Feedback Form of Existing System.

Feedback Form [2018–2019]						
Department : _____Course Name: _____Current Semester : _____						
Subject Name : _____Faculty Name : _____						
PID	**Parameter**	**5**	**4**	**3**	**2**	**1**
P1.	Ability to explain the concepts and principle of subject taught					
P2.	Knowledge, expertise, and confidence of teacher in the teaching					
P3.	Ability to clear doubt in the classroom and outside.					
P4.	Ability to conclude concept with an example.					
P5.	Communication skill and clarity.					
P6.	Punctuality and regularity in class taking and time management with respect to syllabus coverage.					
P7.	Interaction and discussion with the student in the classroom.					
P8.	Attitude towards students and monitoring activities.					
P9.	Monitoring students and creating interest on subjects talk.					
P10.	Timely evaluation of internal assessment, showing the same to students and discussion thereon.					
The number of grading points represents the meaning of feedback as follows: 5 – Excellent 4 – Very Good 3 – Good 2 – Average 1 – Poor						

Table 3: Traditional way to evaluate the feedback of 20 students for the all 10 parameter.

Feedback Form Evaluation 2018 – 2019																				
Subject-1 (Cryptography) Department of Computer Science & Engineering [B.Tech. - 5th Semester] Faculty-1 (Yatendra Sahu)																				
Parameter	Student -1	Student -2	Student -3	Student -4	Student -5	Student -6	Student -7	Student -8	Student -9	Student -10	Student -11	Student -12	Student -13	Student -14	Student -15	Student -16	Student -17	Student -18	Student -19	Student -20
P1	4	5	3	2	1	3	5	2	3	3	4	5	4	4	5	4	3	4	5	5
P2	3	4	4	4	4	5	2	3	2	3	2	4	5	3	4	5	4	3	3	5
P3	4	5	4	4	3	5	3	4	2	2	4	4	5	4	5	3	5	4	5	5
P4	3	4	5	4	4	4	5	3	3	5	2	3	4	5	4	3	4	5	4	5
P5	2	3	4	5	3	3	4	3	3	2	3	4	3	4	4	4	3	3	2	3
P6	5	3	4	5	3	5	4	4	3	4	4	4	5	2	3	2	3	2	4	5
P7	4	4	3	4	3	4	5	3	3	4	3	3	2	3	4	3	4	5	4	5
P8	5	4	4	4	4	4	5	3	5	4	4	3	5	3	4	2	3	2	4	3
P9	4	5	3	3	4	3	4	3	3	2	3	4	3	4	4	4	3	3	2	3
P10	3	4	2	4	5	3	3	4	3	3	2	3	4	3	4	3	3	2	3	4
Total (out of 50)	37	41	36	39	34	39	40	32	30	32	31	37	40	35	41	33	35	33	36	43
Average	36.2/50 = 72.3 %																			

The overall feedback score of a faculty more than 90% is the example of excellent teaching learning achieved by the respective faculty [16]. The score below 70% is the example of poor teaching learning.

Table 4: All Faculty Review Results.

Subject	Faculty	Summery	Remark
Subject - 1	Faculty-1	72.3 %	Warning
Subject - 2	Faculty-2	67.3 %	Termination Notice
Subject - 3	Faculty-3	80.1 %	Increment only
Subject - 4	Faculty-4	90.5 %	Award & Increment
Subject - 5	Faculty-5	78.9 %	Warning
Subject - 6	Faculty-6	83.1 %	Increment only

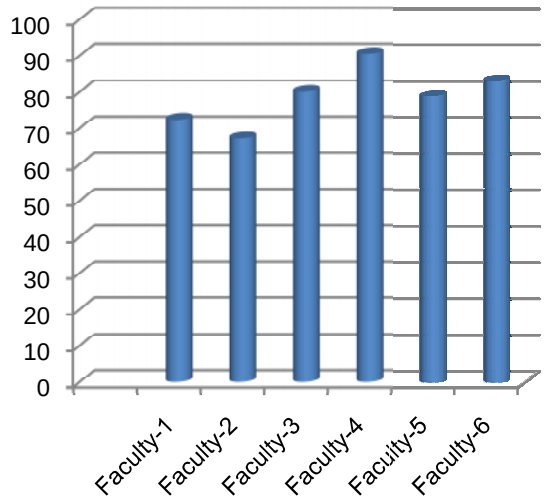

Fig. 2. Graph of Review Percentage.

In the traditional system, students are asked to fill one form having some predefined questions for every teacher. But in this type of system, no person can evaluate any system in perfect manners. This is the main reason why online shopping website starts to get a review of the product via users in their comments and thoughts [17]. What is user thinking about the system is more important in the time of feedback.

It is observed by many of the researchers [16-20] that the user feels more comfortable to provide feedback on their sentence. Feedback is a private thought of someone that can be more accurate in their way free from all predefine aspects. The user's feedback must be available in a more elaborated form so an administrator may use to improve the quality of service according to users thinking rather than some predefined aspect decided by the experts or experienced professors based on their personal experience.

IV. PROPOSED COMPUTATIONAL MODEL

The proposed system collects feedback in the form of text which is free from all types of predefined aspects. After that received textual feedback, are passed into the FES unit to generate the feedback report of the particular faculty as given in Table 5.

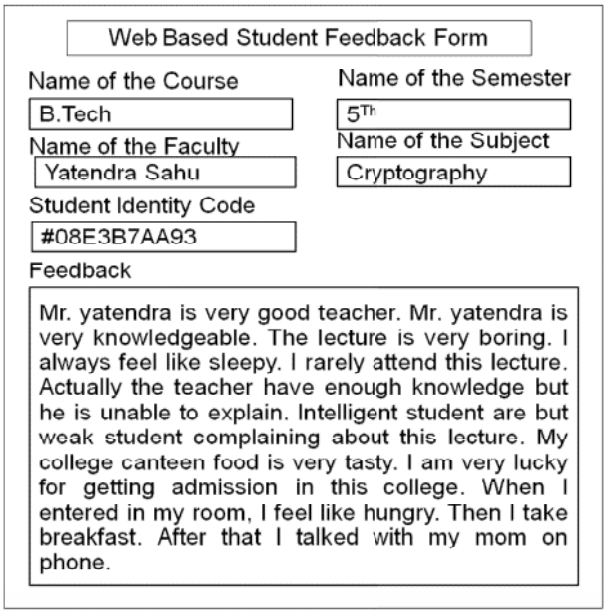

Fig. 3. Internet based online textual feedback form.

The feedback is firstly broken down into the number of sentences to analyze and evaluate them separately. Each sentence is then classified into the category of positive, negative or neutral as shown in Fig. 6. The classification of the sentences is based on sentiment polarity score generated during sentence evaluation. The polarity score of sentences indicates the satisfaction or dissatisfaction level of the student by teaching learning system. The computational process of analysis of feedback is explained in the next section.

Table 5: Internet based Feedback Sentences.

SID	Sentence	Sentiment
S1	Mr. yatendra is a very good teacher. He is very Knowledgeable.	Positive
S2	The lecture is very boring. I always feel sleepy. I rarely attend this lecture.	Negative
S3	Actually, the teacher has enough knowledge but he is unable to explain. Intelligent student are satisfied but weak student complaining about this lecture.	Positive
S4	My college canteen food is very tasty. I am very lucky for getting admission in this college.	Neutral
S5	When I entered my room, I feel like hungry. Then I take breakfast. After that, I talked with my mom on the phone.	Neutral

In the real world, many kinds of teachers are there. Some may have the good technical knowledge and some may not have. But every faculty has their social

behavior to impress students for having a positive and negative impact. If students are asked to evaluate faculty using a grade point of one to five or ten, more than 50% of students choose the grade based on the social behavior of a faculty.

Many times faculty having good technical knowledge with strict social behavior normally falls behind in this grading system. So the predefine aspect for evaluating faculty through student is not a trustworthy system.

V. SYSTEM ARCHITECTURE

The FEM works on the concept feature based evaluation of sentiment analysis and opinion mining of textual data. The textual data is evaluated either based on sentimental polarity or opinion based score. Three modules are used to constitute the FEM system namely the pre-processing module, feature extraction module, and classification module.

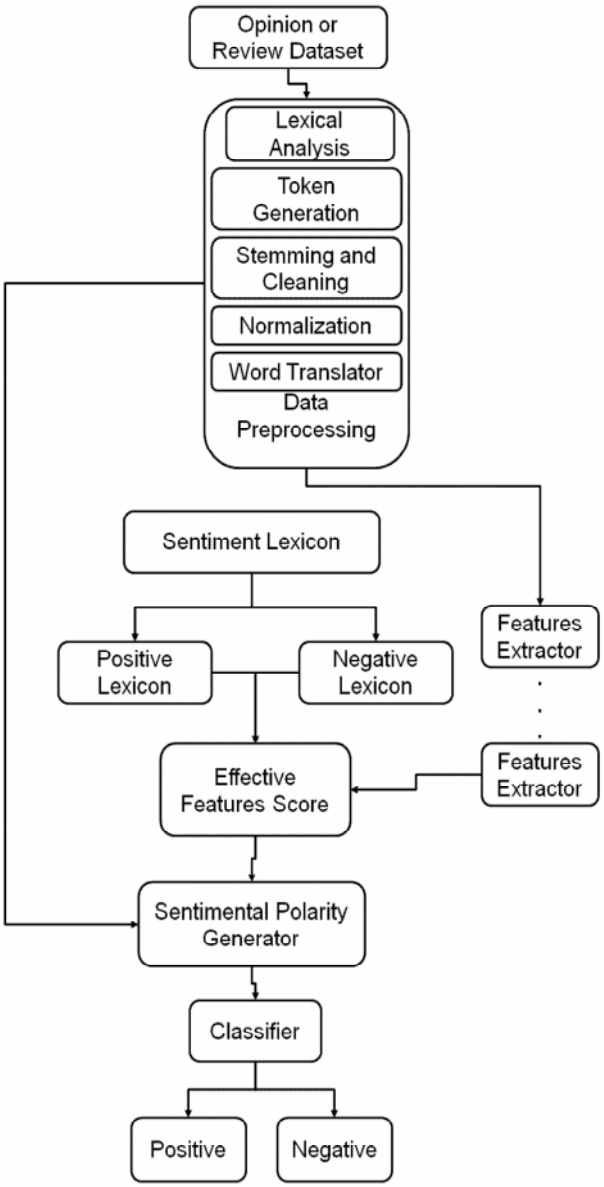

Fig. 4. Computational Model of Sentiment Analysis.

A. Pre-processing

This module simply prepares the submitted feedback data for further proposing. All steps are implemented using python based NLTK. Main steps include lexical analysis, removing unwanted symbols, removing hyperlinks, removing irrelevant text, clearing and stemming, normalization, word correction, and translation [22-26]. Misspelled words are corrected and the word translator converts other languages into the respective language. Abbreviations are normalized using a dictionary.

B. Feature Extraction Module

The module takes the preprocessed form of feedback as input and identifies the relevant feature available in all the feedback to generate an effective score for all the identified features using sentiment lexicon as discussed in [22]. The feature score is the basis of sentiment analysis in this model which is evaluated using the equations explained in below. The overall structure of this model work as follows.

$$FS(f,t) = \frac{P*(+1) + N*(-1) + \log\left(\frac{P+1}{N+1}\right)*neut}{P + N + \log\left(\frac{P+1}{N+1}\right)*neut} \quad (1)$$

where FS(f,t) generates a total feature score of a particular feature available in all feedback for teacher t. P, N, and Neut. are the total number of occurrences of positive negative and neutral.

C. Classification Module

This module classifies the feedback into positive negative or neutral based on the effective feature score.

effective_feature_score() =

$$EFS(t) = \frac{\sum_{F\ Feature\ Aspects} FS(f,t) * w(f,t)}{\text{total number of feedbacks for teacher t}} \quad (2)$$

$$w(f,t) = \frac{\text{number of feedback holding feature f}}{\text{total number of feedbacks for teacher t}} \quad (3)$$

With the help of the above equation, feature score is evaluated which help to generate the polarity of the sentence. On the basis of polarity, feedbacks are classified into different category of sentiments.

VI. RESULT AND DISCUSSION

For sentiment analysis, the computational model outperforms on a dataset retrieved from twitter API. The dataset is a collection of Twitter posts and comments done by students as feedback on their respective faculties. The data is in the form of comma-separated sentences enclosed in a double quote and each tweet having tweet_id as a unique identifier. Dataset is a mixture of words, emoticons, URLs, references to people. Words and emoticons are useful in sentiment analysis but URLs, references, a mixture of misspelled words, extra punctuations need to be preprocessed [24]. After preprocessing the training and testing dataset have been prepared with 3500 and 1500 sentence respectively. The proposed system is very helpful in student feedback kind of dataset because the feature score generator has also included covering all kind of sentences. Feature analyses enhance and improve the quality of the system.

Table 6: Statistics of preprocessed dataset.

	Total	Unique	Average	Max	P	N
Feedback	5000	—	-	—	—	—
Mentions	2447	—	0.4593	12	-	—
Emoticons	42	—	0.0079	11	41	36
URLs	238	—	0.0461	6	—	—
Unigrams	61430	1958	13.013	37	—	—
Bigrams	56430	17163	10.89	—	—	—

The experiments show the performance of the proposed model with a comparison of existing techniques. The main parameter used in the experiment is Accuracy based on precision and recall. Precision and recall are the main standards of data gathering evaluation. The proposed method has been applied to the data retrieved through the Twitter API.

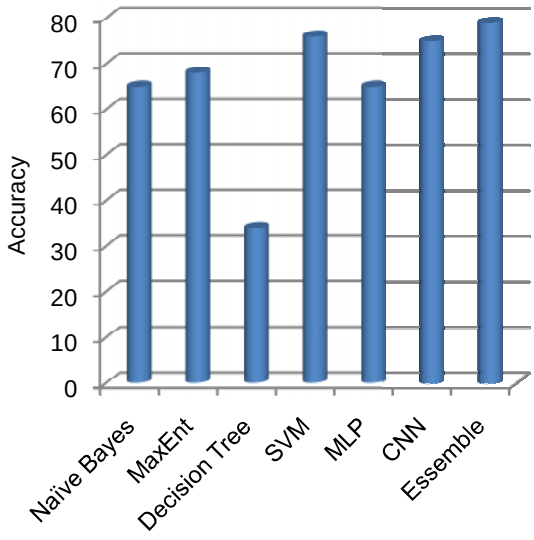

Fig. 5: Comparison of various methods.

All classifiers and the proposed system are implemented using Python and the ensemble method presents a better result with the highest accuracy of 79% as compared to all other pre-existing techniques.

VII. CONCLUSION

The proposed a computational model of sentiment analysis is an automated system to analyze the textual feedback of faculty submitted by students. Many approaches analyze sentiments but hardly any work accomplished on word student's feedback based analysis. Data gathered by a student's feedback posts on the Twitter posts are enormous, noisy, unstructured, and dynamic in nature, and thus novel challenges arise. This model is more accurate, flexible and versatile than traditional feedback analysis systems where the student has to give an evolution score on some predefine aspects decided by management. This model shows a better solution with 79% of the accuracy that needs to enhance in our future work.

VIII. FUTUTRE SCOPE

The proposed model has some limitations as its efficiency and suitability depend on the quality of the data gathered from student feedback system. In future, some module will be developed to transform normal feedback into quality data to improve the system performance.

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Conflict of Interest. There is no conflict of research in this research article. The manuscript has not been submitted to, nor is under review in another journal or other publishing venue.

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