AI-Enabled Feedback Management For Enhancing Education

1st Mrs. Radha P. Sali, 2nd Sahil K. Patil, 3rd Jayesh S. Bacchav, 4th Harshal S. Patil, 5th Siddesh S. Boraste
[1]Asst. Professor, [2]UG Student, [3]UG Student, [4]UG Student, [5]UG Student
[1,2,3,4,5]Artificial Intelligence and Data Science Department,
[1,2,3,4,5]MET Institute of Engineering, BKC, Nashik, India

Abstract - In today's educational landscape, institutions increasingly recognize the value of student feedback for enhancing learning experiences. However, traditional methods like manual reviews and basic statistics often fail to capture the complex and complicated patterns within this feedback. Our project proposes a novel approach using Long Short-Term Memory (LSTM) algorithms to analyze student feedback and predict sentiment more effectively. LSTM's strength in handling sequential data enables us to uncover deeper insights into student experiences and trends. This innovative method aims to transform feedback analysis into a comprehensive, data-driven evaluation tool, ultimately improving educational practices. Additionally, we will implement a Generative Pre-trained Transformer (GPT) model to provide dynamic, tailored suggestions for student growth. By combining advanced machine learning techniques, our system not only analyses feedback but also offers actionable recommendations, fostering a more supportive and effective learning environment. This holistic approach aims to enhance both student outcomes and institutional practices.

Index Terms - Feedback analysis, sentiment analysis, LSTM algorithm, GPT model.

I. INTRODUCTION

Many colleges and institutes rely on student feedback for betterment and improvement of overall education curriculum improvement and student growth. With the advancement in machine learning, supervised learning algorithms are at forefront for sentiment analysis and opinion mining [1]. Supervised algorithms such as Naïve-Bayes classifier, Support vector Machine Classifier can be proved useful for prediction of the student feedback [2]. There is more emphasis on the thought that feedback of student regarding open-ended questions are unique but not that useful in quality improving as they are unused due to the use of traditional methods, where focus is on close-ended questions. The gap mentioned above can be overcome with the help of modern algorithms and models [3]. Usage of supervised learning algorithms for sentiment analysis have made a significant impact for various fields where sentiment behind feedback is valuable to overcome the deficiencies including library systems where students gather for gaining knowledge with the help of books. In order to properly understand the context and predict sentiment properly of qualitative data, we will be using the LSTM algorithm in our project. The LSTM (long-short term memory) is known for its processing of sequential data and time-dependent data. In addition, our project will also focus on providing dynamic suggestions based on the feedback and its sentiment. This can help the institutes, universities to gain actionable insights which can be implemented for better performance.

II. LITERATURE SURVEY

[1] **Using Sentiment Analysis to Evaluate Qualitative Students' Responses, Delali Kwasi Dake, Esther Gyimah, Education and Information Technologies, Volume 28, Issue 4, 2022.**

The paper explored using machine learning (ML) to analyses qualitative student feedback from open-ended questionnaires. The primary goal was to categorize feedback into excellent, good, and poor sentiments. The study used 280 feedback instances from Level 100 students at the University of Education, Winneba, Ghana, collected via Google Forms. Data preprocessing removed missing values, and 232 instances were used for model construction. Four algorithms: Random Forest, J48 Decision Tree, Naive Bayes, and Support Vector Machine (SVM) were employed. The SVM algorithm achieved the highest accuracy of 63.79% using 10-fold cross-validation. After training, the SVM model accurately predicted 92% of new test data. This showed that SVM can be effectively used to classify student feedback. The study highlighted the potential of sentiment analysis for enhancing teaching and learning and also provides a basis for SMART campus architectures.[1]

[2] **Machine Learning based Student Performance Prediction using Feedback Method, Ms. G. Swathi, Mr. V. Ravikanth, Journal of Emerging Technologies and Innovative Research, Volume 10, Issue 7, 2023.**

The paper explored using machine learning (ML) and opinion mining to analyze student feedback for predicting teacher performance. Student feedback data was collected and pre-processed, and predictive models like Naive Bayes, KNN, and SVM were trained. The system used AI and human language processing tools to determine the sentiment and polarity of student input based on teaching and learning parameters. The system also allowed students to submit feedback, which administrators can view. The study compared algorithms like SVM, Naive Bayes, KNN, and found that the Naive Bayes Classifier performed best. The system addressed the limitations of manual analysis systems which are time-consuming and have low accuracy. Future enhancements included using clustering and adding new hyperparameters to increase model accuracy.[2]

[3] **Sentiment Analysis of Students' Feedback on Institutional Facilities Using Text-Based Classification and Natural Language Processing (NLP), Fareed Kaleem Khaiser, Amna Saad Cordelia Mason, International Journal of Language & Communication Disorders, Volume 10, 2023.**

This paper used sentiment analysis of student feedback on library facilities, using Natural Language Processing (NLP) and machine learning. The study aimed to classify student feedback as positive, negative, or neutral to gauge satisfaction with library resources. Data was collected from a North Indian institution, focusing on library facilities, including books, audio/video CDs, staff services and computers. The study uses text-based classification methods with Naive Bayes Multinomial and Support Vector Machine algorithms. Preprocessing techniques such as tokenization, lemmatization, and stemming were applied. TF-IDF was used for feature extraction. The results showed that 70% of feedback was positive, 13% neutral, and 17% negative. The Naive Bayes algorithm achieved 92% accuracy, while SVM achieved 88% for positive prediction. The study suggested that libraries should enhance resources, including e-resources. Sentiment analysis helps institutions process feedback and make informed decisions.[3]

[4] **Sentiment analysis and opinion mining on educational data: A survey, Thanveer Shaika, Xiaohui Taoa, Christopher Dannb, Haoran Xiec, Yan Lia, Linda Galligan, Natural Language Processing Journal, 2023.**

This paper reviewed sentiment analysis and opinion mining in education, detailing how Natural Language Processing (NLP) techniques can interpret student feedback for improved practices. It explored different analysis levels including document, sentence, entity, and aspect-based analysis, the latter providing the most detailed insights. Sentiment annotation techniques such as lexicon-based and corpus-based approaches were also reviewed, alongside the use of AI methodologies like machine learning, deep learning, and transformers. The role of AI in processing large volumes of feedback was emphasized. The impact on education included enhancing pedagogy, decision-making, and evaluation. The challenges such as multi-polarity, polysemous words, negation handling, and opinion spam were discussed, and future directions included education-based annotation and knowledge bases. The paper emphasized that combining sentiment analysis with NLP and AI is crucial for educational institutions to make well-informed decisions based on student feedback in both online and offline education.[4]

[5] **Sentiment Analysis of Customer Feedback and Reviews for Airline Services using Language Representation Model, Aksh Patel, Parita Oza, Smita Agrawal, International Conference on Machine Learning and Data Science, 2023.**

This paper focused on sentiment analysis of customer feedback for airline services, highlighting its importance for service improvement in the competitive airline industry. The study utilized machine learning (ML) techniques to classify customer reviews as positive, negative, or neutral. Traditional ML algorithms, such as Naive Bayes, Support Vector Machine (SVM), and Decision Tree (DT), were applied, with Random Forest showing the best performance among these. However, BERT, a transformer-based model pre-trained on tasks like masked language modelling and sentence prediction, was also evaluated. The BERT model outperformed the other ML techniques, achieving 83% accuracy compared to Random Forest's 77%. This enhanced performance was attributed to BERT's bidirectional context understanding, which allows it to better grasp the nuances of customer reviews. The study used a dataset of airline reviews from Kaggle.[5]

[6] **Improvised Ensemble Model for Fast Prediction of DoS/DDoS Attacks in Various Networks, Mr. Santosh Gore, T. Prabhakara Rao, Y. Nagalakshmi, Mrs. Radha Pranav Sali, Dr Prem Knowles, Nalini S Jagtap, Dr K Gurnadha Gupta, 1st International Conference on Cognitive Computing and Engineering Education (ICCCEE), 2023.**

This paper investigated the use of machine learning (ML) to detect DoS/DDoS attacks in distributed systems, such as the internet and social media networks, which are increasingly vulnerable to such threats. The study used an ensemble model, which combines multiple ML techniques, to classify network traffic as either normal or malicious. In this approach, a hybrid model is trained using algorithms like Linear SVC, Naive Bayes, and Random Forest. The study employed two methodologies: the first using a generated dataset and the second using the NSL-KDD dataset. The ensemble model achieved a 99% accuracy in detecting DoS/DDoS attacks. The findings indicated that the hybrid model provides the highest accuracy in both methodologies. Tools such as Wireshark and the WinPcap Tool were used to capture streaming network packet traffic, which was then used to create a dataset for the study. The authors proposed that future work will explore the use of deep learning (DL) algorithms to enhance detection capabilities by learning complex patterns in network traffic.[6]

[7] **Sentiment Analysis on Roman Urdu Students' Feedback Using Enhanced Word Embedding Technique, Noureen Sharin, Hazlin Huspi, Zafar Ali, Baghdad Science Journal, Volume 21, 2024.**

This paper reviewed the challenges of performing sentiment analysis on Roman Urdu, an informal version of Urdu written using the Roman script. Due to the lack of standardized spellings and the use of slang and informal expressions, traditional sentiment analysis models were not effective with this type of text. The paper proposed an enhanced word embedding technique that used methods like Word2Vec and GloVe, to better capture the unique nuances of Roman Urdu. The study used these enhanced embeddings in combination with deep learning models, such as CNN and LSTM, to categorize sentiments into positive, negative, and neutral classes. The researchers compared this enhanced approach against traditional machine learning models, like Naive Bayes and SVM. The results showed that the enhanced word embedding technique significantly improved accuracy, precision, and recall for sentiment classification in comparison to the traditional models. The model is based on a two-layer architecture using a Bi-LSTM layer for encoding, and enhanced word embeddings in the input layer. The experimental results indicate that the Bi-LSTM model combined with Word2Vec embeddings achieved an F1-score of 90% on the student feedback dataset.[7]

[8] **Attention-aware with stacked embedding for sentiment analysis of student feedback through deep learning techniques, Shanza Zafar Malik, Khalid Iqbal, Muhammad Sharif, Yaser Ali Shah, Amaad Khalil, M. Abeer Irfan and Joanna Rosak-Szyrocka, PeerJ Computer Science, 2024.**

This paper introduced a hybrid model for sentiment analysis of student feedback, aiming to classify it as positive, negative, or neutral. The model used multiple text embedding techniques like FastText, ELMo, and RoBERTA to capture contextual word meanings. A multi-head attention mechanism identified key text features, and deep learning models like Bi-LSTM, GRU, and Bi-GRU process the feedback. Preprocessing involved tokenization and lemmatization. The model uses a stacking metho to reassemble and select the best features from the three embedding techniques. Evaluated on a Vietnamese university dataset, the model achieves 95% accuracy and a 96% F1-score, outperforming existing techniques. The study noted the need for fine-tuning for different domains and addresses limitations like sarcasm and computational demands.[8]

[9] **Sentiment Analysis of Students Feedback Using Lexicon Based Method and Hybrid Machine Learning Method, Ms. Shital A. Patil, Dr. Krishnakant P. Adhiya, Dr. Girishkumar K. Patnaik, International Journal of Intelligent Systems And Applications In Engineering, 2023.**

The paper investigated sentiment analysis of student feedback using a hybrid approach that combined lexicon-based methods and machine learning. The study noted that traditional methods like rating scales often failed to capture the nuances of student emotions. Thid paper aimed to classify sentiments in student feedback as positive, negative, or neutral1. To address the challenges of unstructured data and varied language, the research employed techniques such as TF-IDF, N-grams, and lexicon-based features for extracting meaningful information from text. The study compared several classification algorithms, including Naïve Bayes, ANN, SVM, and a hybrid machine learning (HML) approach. The HML method combines the strengths of both ANN and SVM. The HML model with lexicon-based features achieved the highest accuracy, significantly surpassing other models. The hybrid approach's success comes from its ability to integrate the predictive power of machine learning with the context-awareness of lexicon-based analysis.[9]

[10] **Students feedback analysis model using deep learning-based method and linguistic knowledge for intelligent educational systems, Asad Abdi, Gayane Sedrakyan,· Bernard Veldkamp, Jos van Hillegersberg Stéphanie M. van den Berg, Soft Computing by Springer-Verlagn Volume 27 Issue 19, 2023.**

This paper introduced DTLP, a deep learning-based method for analysing student feedback, which addresses the limitations of earlier machine learning techniques like SVM and Naive Bayes. These earlier methods struggled with understanding context, handling negations, and accounting for variations in word meanings. The DTLP model used Convolutional Neural Networks (CNN), Bidirectional Long Short-Term Memory Networks (Bi-LSTM), and an attention mechanism to improve sentiment classification accuracy. The DTLP method employed a unified feature set that combined word embeddings, sentiment knowledge, and linguistic and statistical knowledge to capture nuances in feedback. This unified approach addressed challenges such as contextual polarity, sentence types, and word sense variations. The model is designed to learn from multiple resources within a sentence to create an enhanced vector representation. Additionally, DTLP uses multiple sentiment lexicons to increase word coverage. [10]

III. PROPOSED SYSTEM

In our proposed system, feedback data will first be collected from students in textual format, capturing their thoughts and opinions on various aspects of their learning experience. But before the student who wants to submit feedback will have to check whether he is eligible to submit feedback on various criteria such as marks, attendance. This will ensure that proper feedback is received. This feedback will be processed using an LSTM (Long Short-Term Memory) algorithm, a type of recurrent neural network (RNN) well-suited for handling sequential data like text. The feedback will be classified into three categories based on sentiment: positive**,** negative**,** and neutral**.** Once the feedback is classified, it will serve as input for the next step in the process: suggestion generation**.** The feedback's sentiment and content will guide the system in generating dynamic and appropriate suggestions for faculty members. These suggestions will be designed to help faculty address any identified issues or to enhance areas of success. The suggestion generation will be provided by a Generative Pre-trained Transformer (GPT) model, specifically fine-tuned for this purpose. The GPT model will be trained on a comprehensive dataset that includes historical student feedback and corresponding suggestions.

To ensure that suggestions are actionable and tracked effectively, the system will include a notification and tracking system. After suggestions are provided, the faculty will be responsible for updating the implementation status of each suggestion in the system. The implementation status will reflect whether the teacher has made changes based on the suggestions or if any actions remain pending. This step ensures accountability and allows the system to monitor the progress of the improvements being made.

Once the system verifies that a suggestion has been marked as implemented, it will trigger a notification to the student who originally provided the feedback, asking them to re-submit feedback. This follow-up feedback will allow the system to evaluate whether the changes made by the teacher based on the original suggestions have had a positive impact on the student's learning experience.

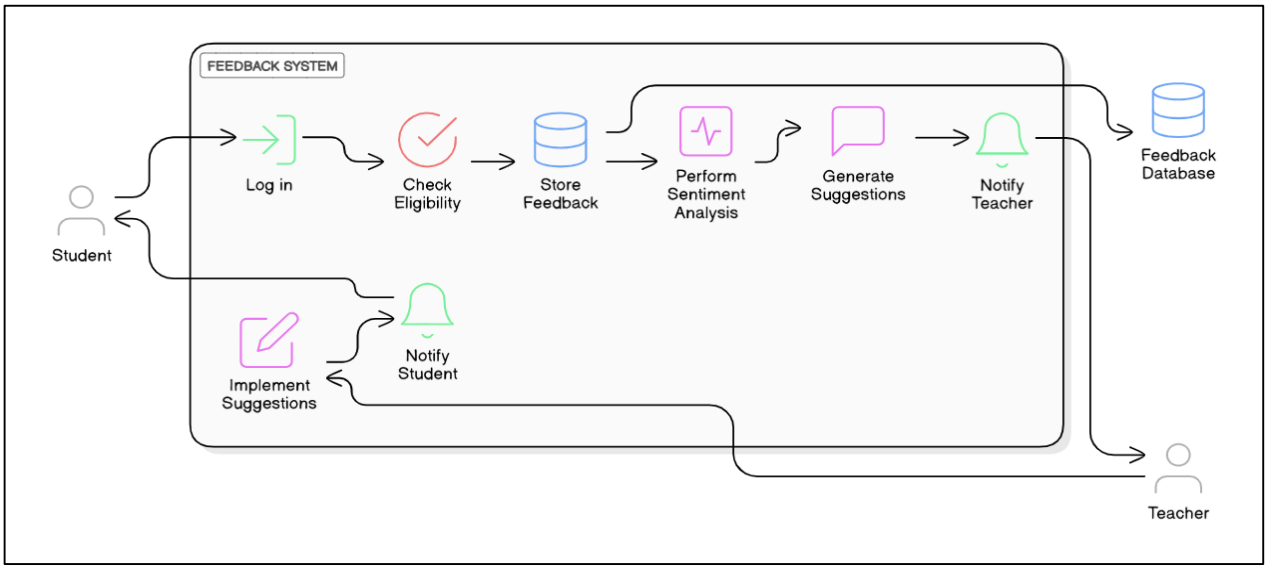

Figure 1. System Architecture

IV. REFERENCES

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