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A Deep Learning and Ensemble-Based Intelligent Academic Feedback Analysis System

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Abstract

Gathering and evaluating student input is essential to raising academic achievement and teaching quality in contemporary educational institutions. However, conventional feedback systems are frequently labour-intensive, manual, and incapable of drawing significant conclusions from massive amounts of data. This research proposes an intelligent academic feedback analysis system that combines ensemble machine learning and deep learning methods to address these issues. Students' textual feedback is processed by the suggested system, which also preprocesses the data and uses feature extraction techniques to transform unstructured data into a format that can be analysed. To improve forecast accuracy and robustness, ensemble techniques are used with deep learning models, such as neural networks. Institutions can make data-driven decisions thanks to the system's ability to automatically classify input into several categories and spot sentiment patterns. According to experimental findings, the hybrid model performs more accurately and efficiently than conventional machine learning techniques. In the end, this method improves educational results by lowering human labour and offering a scalable solution for real-time academic feedback evaluation.

Keywords

Academic Feedback Analysis, Deep Learning, Ensemble Learning, Natural Language Processing, Sentiment Analysis, Educational Data Mining, Text Classification, Machine Learning

I. Introduction

Deep learning methods, including neural networks, are combined with ensemble approaches to increase forecast accuracy and robustness. The system's capacity to automatically classify input into many categories and identify sentiment trends allows institutions to make data-driven decisions. Experimental results show that the hybrid model outperforms traditional machine learning methods in terms of accuracy and efficiency. Ultimately, by reducing human labour and providing a scalable solution for real-time academic feedback evaluation, this approach enhances educational outcomes.

Intelligent systems that can automatically process and analyse student comments are becoming more and more necessary due to the rapid growth of data and technological advancements. Machine learning and natural language processing (NLP) have become effective methods for deriving significant insights from textual data. These techniques make it possible to classify feedback, identify sentiment, and find trends that can be difficult to identify through manual analysis. However, due to differences in data complexity and feature representation, using a single machine learning model might not necessarily produce the best outcomes. This research suggests an intelligent academic feedback analysis system that uses ensemble learning and deep learning methods to get beyond these restrictions.

The suggested system enhances prediction accuracy and robustness by combining the advantages of several models. While ensemble approaches combine several predictions to improve performance and generalisation, deep learning models are used

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to identify intricate patterns in textual feedback. In order to provide educators and administrators with useful insights, the system is built to preprocess raw feedback data, extract pertinent attributes, and categorise input into meaningful groups.

The development of an automated feedback analysis system using deep learning techniques, the incorporation of ensemble learning to improve model performance, the implementation of a scalable and effective framework for handling large-scale feedback data, and the assessment of the suggested model using real-world or benchmark datasets to show its efficacy are the primary contributions of this work.

II. Problem Statement

Student feedback is an essential source of data in educational institutions for assessing the efficacy of instruction and raising academic standards. However, the majority of feedback systems currently in use rely on labour-intensive, ineffective, and frequently incapable of handling massive amounts of data through manual methods of data collecting and analysis. Because student input is usually unstructured, it is challenging to draw significant conclusions from it using conventional methods. Consequently, important information is still underutilised, and decision-making procedures are frequently skewed or delayed.

Additionally, traditional algorithms are unable to recognise underlying attitudes or patterns and classify input appropriately. Due to differences in data complexity and feature representation, individual machine learning models may not offer adequate accuracy or generalisation when applied independently.

This restriction lowers the efficacy of feedback-driven improvements in learning settings and impacts the analysis's dependability.

As a result, a sophisticated and automated system that can effectively handle massive amounts of student feedback data, precisely analyse textual data, and offer trustworthy insights is required. The difficulty is in creating a system that incorporates cutting-edge methods like ensemble learning and deep learning to enhance prediction accuracy, decrease manual labour, and facilitate data-driven, real-time decision-making in educational settings.

III. System Output Visualization

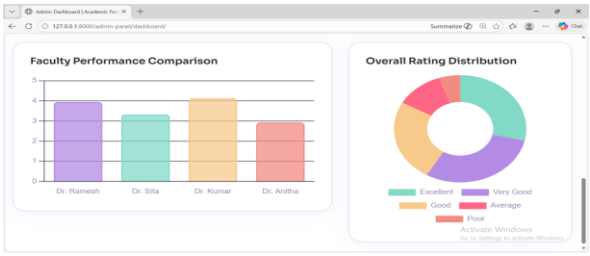

Figure 1: Faculty Performance Comparison and Rating Distribution Dashboard

Faculty Performance Comparison

Based on total student evaluation scores, this bar graph shows how various faculty members perform in comparison to one another. A specific faculty member, such as Drs. Ramesh, Sita, Kumar, and Anitha, is represented by each bar. Plotting the scores on a numerical scale, usually from 0 to 5, shows how satisfied students are. According to the visualisation, Dr. Anitha has somewhat lower scores than Dr. Kumar, who has the best performance rating. Administrators can use this comparison to find both high-performing and potentially underperforming faculty members.

Overall Rating Distribution

The distribution of students' overall feedback ratings is seen in this doughnut chart. Excellent, Very Good, Good, Average, and Poor are the five categories into which the ratings are divided. The percentage of replies that fit into each category is shown in each part. The graph demonstrates that a sizable percentage of comments fall into the "Excellent" and "Very Good" categories,

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indicating generally high levels of student satisfaction. The broad sentiment trends in academic feedback are briefly summarised in this visualisation.

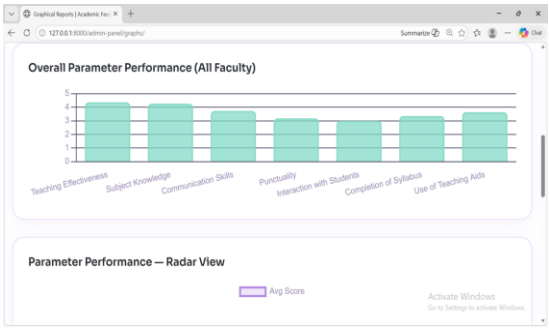

Figure 2: Overall Parameter-Based Faculty Performance Analysis

Overall Parameter Performance (All Faculty)

The average performance of faculty members across several evaluation criteria is shown in this bar graph. Teaching effectiveness, subject knowledge, communication skills, punctuality, student interaction, syllabus completion, and use of teaching aids are some of these criteria. For a given parameter, each bar shows the average score of all faculty members. The graph shows that while Interaction with Students and Punctuality have somewhat lower values, Teaching Effectiveness and Subject Knowledge have comparatively better marks. This aids in determining the institution's strengths and areas in need of development.

Heading: Parameter Performance — Radar View

A multifaceted perspective of teacher performance across the same evaluation factors is offered by the radar chart, often known as the spider chart. The depicted data provide average scores, and each axis represents a particular parameter. Understanding the balance of performance across several criteria is made easier by this visualisation. While inconsistencies draw attention to weaker areas, a more uniformly distributed shape denotes consistent performance. For a comprehensive and comparative review of faculty performance, the radar view is especially helpful.

IV. Experimental Results

Student feedback information gathered in textual and rating formats was used to assess the suggested academic feedback analysis method. Teaching effectiveness, topic knowledge, communication skills, timeliness, student involvement, syllabus completion, and usage of teaching aids are just a few of the criteria that make up the dataset. To produce insightful results, the system analyses both unstructured textual comments and structured evaluations.

A number of evaluation criteria, including accuracy, precision, recall, and F1-score, were taken into consideration in order to evaluate the model's performance. The suggested hybrid strategy, which blends ensemble methods with deep learning, was contrasted with conventional machine learning models. According to the findings, the ensemble-based model outperforms individual models in terms of accuracy and generalisation.

Faculty performance and general feedback patterns are clearly understood thanks to the system's graphic outputs. Finding top-performing and underperforming faculty members is made easier by the faculty performance comparison table, which displays differences in individual faculty scores. A high degree of student satisfaction is shown by the overall rating distribution, which shows that most comments fall into positive categories like "Excellent" and "Very Good."

Furthermore, parameter-based analysis shows that while areas like student interaction and punctuality may need to be improved, other factors, like subject understanding and teaching efficacy, score higher. A fair assessment is made possible by the radar chart's additional full perspective of performance across all metrics.

V. Conclusion

An intelligent academic feedback analysis system utilising ensemble and deep learning approaches was proposed in this paper. By efficiently automating the processing and analysis of student input, the suggested solution lowers manual labour and boosts productivity. The system outperforms conventional methods in terms of accuracy and performance by merging multiple models. Clear insights on faculty performance and student happiness are made possible by the use of visualisation tools, which further improves the interpretation of results. The analysis identifies important teaching methodology strengths and opportunities for development. All things considered, the system offers a scalable and dependable way for educational institutions to make data-driven decisions.

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