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Towards Effective Collaborative Learning: A Machine Learning Solution for Identifying and Assisting Inactive Students

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ABSTRACT

Learning plays an important role in everyone's life. In schools there are various methods used to teach students new skills, and how well students perform is crucial. And in the learning process, one effective method is collaborative learning, where students work together in groups to achieve common goals. In schools it may possible that there may be multiple groups performing collaborative learning activity and, in few groups, in some cases it is observed that the few students never talk in group and for such a kind of student continuous monitoring is required and it seems to be a difficult task for the teacher to predict whether the concept is understood to the student or not.

This research aims to address this issue by designing a machine learning-based model. The model helps to monitor individual students in collaborative learning groups, which will help to focus on inactive students.

Proposed system would help teachers to work on individual students' performance in each group. Ultimately, this work contributes to making collaborative learning more effective and inclusive by ensuring that every student's progress has monitored and supported for learning performances of individual student of group activities.

Keywords : Machine Learning, Collaborative Learning, Performance Monitor

I. INTRODUCTION

Collaborative learning, where students work in small groups to achieve academic goals. It involves students of different abilities working together towards a shared objective, taking responsibility for their own and their peers' learning. Success of one student contributes to the success of others in the group [1].

Collaborative learning in small groups offers numerous benefits, including celebrating diversity as students engage with a variety of perspectives and cultural backgrounds, acknowledging individual differences that contribute to comprehensive outcomes, fostering interpersonal development, particularly beneficial for students with social challenges, promoting active participation and critical thinking, and providing more opportunities for personal feedback, enhancing learning through extensive student interactions, a contrast to limited exchanges in large-group instruction [2].

Small-group learning in a collaborative environment offers several advantages. Each group member has the chance to actively participate and contribute, enhancing learning outcomes. Students benefit from engaging in the thought processes of their peers and observing their teammates' perspectives. Collaborative learning motivates students to improve their communication skills. Every student in the group contributes to solving the problem in order to complete the task.

It may also be possible that few students are inactive and may not feel comfortable in group learning. In such cases it will be very hard to judge the understanding level of the learner.

The proposed system provides a solution for evaluating student performance using machine learning techniques. It assists in categorizing a student's understanding level by analysing their emotional expressions, such as happiness or sadness. Typically, students exhibit these emotions when they either grasp or struggle with the concepts being taught. Continued assessment strengthens students' commitment to learning, by checking the continuous performance of students, teachers can motivate students to take responsibility for their participation in team work and to help them understand the concept in a collaborative environment. Performance of the student can be evaluated by machine learning techniques.

Proposed system takes input as a dataset and by applying the machine learning techniques, performance of the student can be categorised and with the help of performance categories student performance can be evaluated.

II. Literature Review

Anuradha A. Gokhale explored the concept of collaborative learning, where students work together in small groups towards a common academic goal, promoting critical thinking through active idea exchange. The study emphasizes the importance of collaborative learning in fostering critical thinking and suggests implications for instructional practices and future research areas, including group composition, structure, and teacher intervention in collaborative learning processes [1].

Ritu Chandra explored collaborative learning (CL) as a student-centered approach where groups work together to achieve academic goals. It emphasizes the benefits of CL, including deeper learning, higher-level thinking, and improved interpersonal skills [2].

Vivek Anand et al. discussed a web-based system for predicting students' academic results based on criteria like attendance, illness, and prior academic performance. This comprehensive approach offers a robust framework for predicting student outcomes and enhancing educational support [3].

Sunita B. Aher et. al conducted an in-depth analysis of classification algorithms in the context of course recommendation for students. It systematically evaluates various algorithms, including ADTree, Simple Cart, J48, ZeroR, and Naive Bayes, assessing their performance in correctly categorizing student preferences regarding specific courses. The study employs a dataset extracted from a college's Moodle platform and finds that ADTree emerges as the top-performing algorithm, boasting the highest accuracy in classifying student preferences. As a result, ADTree is selected as the preferred algorithm for the Course Recommender System [4].

The paper titled "A Comparative Study of Classification Algorithms for Spam Email Data Analysis" addresses the growing problem of spam emails and evaluates four classification algorithms (ID3, J48, Simple CART, and ADTree) using a spam email dataset within the WEKA environment. The experimental results demonstrate that J48 yields the highest classification accuracy among the four algorithms, emphasizing its effectiveness in spam

email classification. The paper concludes that J48 is the preferred choice for this task and suggests future research avenues to explore algorithm performance under different attribute configurations [5].

Tejashree U. Sawant et. al discussed on Educational Data Mining (EDM) with an emphasis on predicting student performance in higher education. The introduction highlights the significance of EDM in improving educational outcomes by predicting and addressing student performance issues. The paper employs decision tree algorithms predicts student performance with good accuracy [6].

Dr. K. Karthikeyan et. al discussed Educational Data Mining (EDM) to enhance predictions of student academic performance. EDM is instrumental in improving teaching and learning through the analysis of student data, and the paper aims to create a Student Performance Prediction System (SPPS) using advanced feature selection and ensemble classification methods, including clustering-based Enhanced SVM classifiers. It highlights the importance of predicting student performance to enhance course effectiveness [7].

Dr. Anjali B Raut et. al explores the application of classification techniques in educational data mining to predict student performance. The work proposed methodology employs decision tree algorithms and Generalized Sequential Pattern mining for prediction. This work discussed on the application of the C4.5 decision tree algorithm to forecast a student's performance in a specific subject. By examining test result components, this approach offers valuable insights for enhancing educational outcomes [8].

The paper discusses using technology to analyze handwriting for personality traits, aiming to complement manual graphologist analysis. The work proposed approach involves creating a training dataset and used K-Nearest Neighbors (K-NN). This system can assist graphologists and HR in decision-making [9].

III. System Architecture

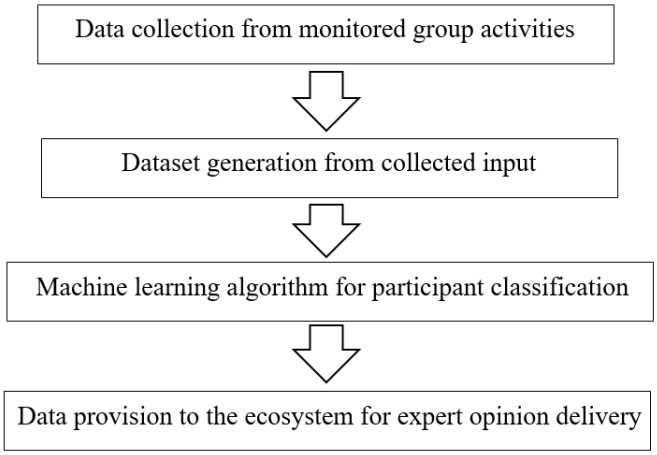

Fig. 1: Process Flow of System Architecture

Steps in designing the system architecture

Data Collection from Monitored Group Activities:

In this step, the system gathers data from monitored group activities. These activities can include various actions, events, or behaviours of participants that are being observed and recorded.

Dataset Generation from Collected Input:

After collecting the data, the system processes and structures it into a coherent dataset. This dataset serves as the foundation for subsequent analysis and machine learning tasks.

Machine Learning Algorithm for Participant Classification:

Once the dataset is prepared, the system employs a machine learning algorithm. This algorithm's primary objective is to classify participants into different categories, such as "active" and "inactive," based on the patterns and information extracted from the dataset. This classification is a critical component of the system's functionality.

Data Provision to the Ecosystem for Expert Opinion Delivery:

After categorizing the participants, the system provides this categorized data to an ecosystem. This ecosystem could include various components, such as user interfaces or communication channels. The purpose of this provision is to enable the ecosystem to deliver expert opinions and motivational content to those participants who have been identified as "inactive." This process aims to boost the engagement and participation of these individuals.

IV. Implications

In all types of collaborative learning models in the school, the proposed model is useful to identify passive students in a group and after identifying the passive student, teachers can motivate such students to actively participate in the collaborative learning.

Consider Scenario of Analyzing Student Involvement in classroom

In this scenario, we are simulating the analysis of student involvement in a classroom. To demonstrate the scenario, we have considered data of some sample values on two key metrics for each student

Attendance Percentage: This represents the percentage of classes attended by each student. It provides an insight into how regularly students attend their classes.

Participation Score: This score quantifies the level of active participation of students in classroom activities. It can include participation in discussions, asking questions, or involvement in group projects.

Analysis Steps:

Data Collection: We have considered dataset of 30 students, each assigned a unique StudentID. We randomly simulate values for Attendance Percentage and Participation Score for each student.

Machine Learning Classification: We classify students into two groups, "active" and "inactive," based on their Participation Score. Students with a Participation Score of 50 or higher are considered "active," while those with a lower score are categorized as "inactive." We use a simple threshold-based classification for this.

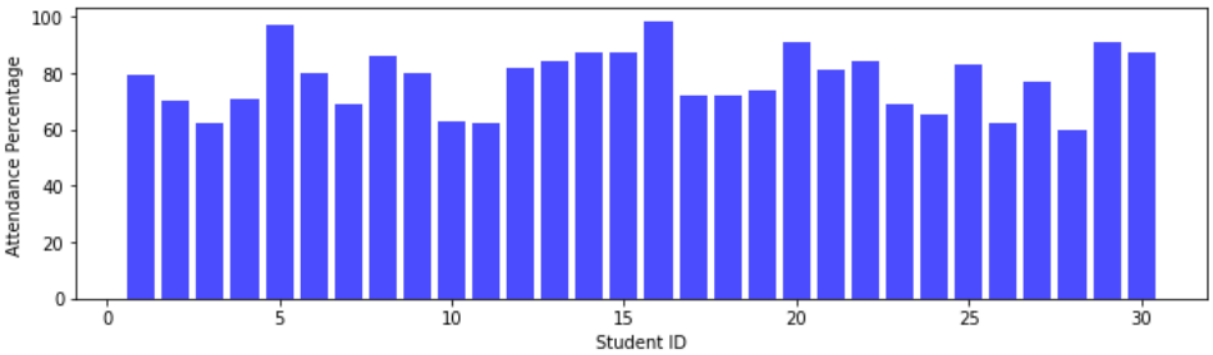

Fig. 2: Attendance Percentage of Students

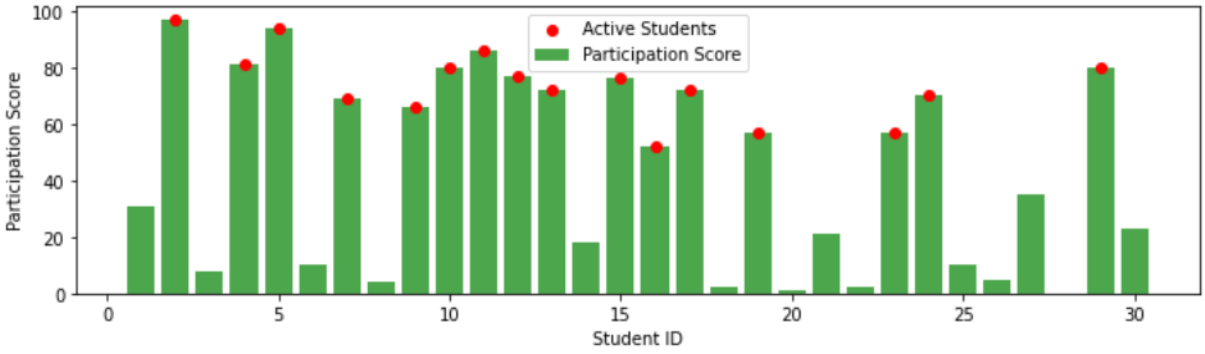

Fig. 3: Participation Score of Students

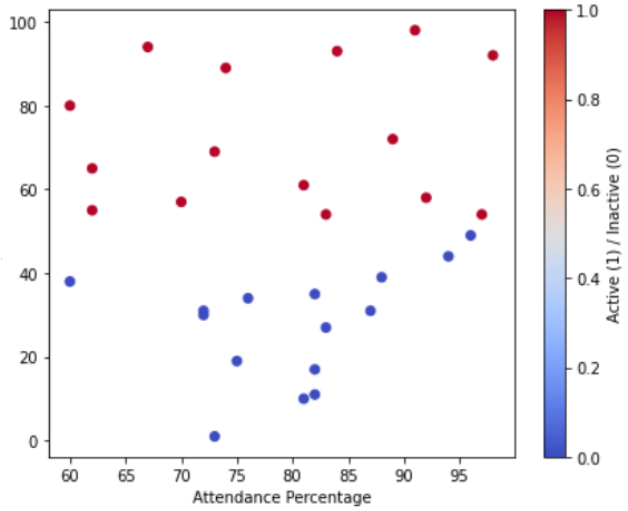

Fig. 4: Participation Score vs. Attendance Percentage

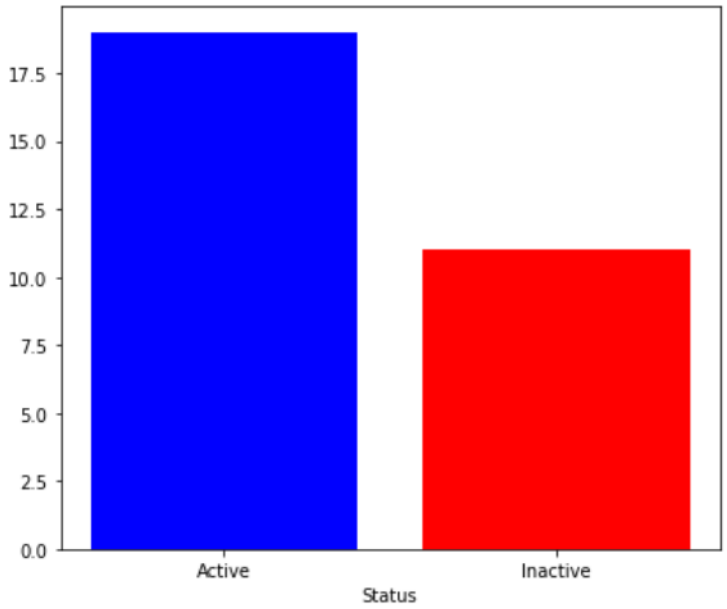

Fig. 5: Number of Active and Inactive Students

V. Conclusions and Future Work

The proposed system can help to improve the performance of students in collaborative learning and it will be helpful to teachers to achieve all the goals of the teaching learning process. The proposed methodology works on the dataset which is generated from various input sources of collaborative learning, in future work we will try to identify the different parameters as an input such as audio, video and movements of body parts, so that the system will be helpful for all types of teaching learning processes.

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