

Advancing Student Engagement Detection in Online Learning Through a Bagging-Driven Deep Learning Ensemble Model

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Abstract: The move from regular classrooms to online learning has made it harder for teachers to see if students are paying attention in real time.

In a physical classroom, teachers can see students' faces and body language, but online learning platforms don't offer the same way to check if students are engaged. To fix this issue, this work introduces a new system that uses a special type of deep learning called a Bagging-driven Deep Learning ensemble. This system combines several different neural networks that are trained on different parts of the data, helping to make the model more accurate and stable. The system uses facial features, eye movements, and head position from video to determine whether a student is engaged. The results show that this method performs better than using a single neural network, making it more reliable for checking student behavior in online classes.

Keywords: Deep Learning, Bagging Ensemble, Student Engagement, E-learning, Computer Vision, Facial Expression Recognition

I. INTRODUCTION

The fast growth of online education has made it important for teachers to have tools that can help them understand how students are doing.

While online learning is flexible and accessible, it can be challenging to track student interaction, making it difficult for teachers to notice when students are losing focus. It's important for teachers to recognize when students aren't paying attention to keep learning effective.

Traditional ways of checking student engagement, like manually observing or just noting attendance, aren't good for large online classes.

So, researchers are looking into using Computer Vision and Deep Learning to automatically detect engagement. However, simple models like basic Convolutional Neural Networks (CNNs) might not work well because of issues like poor lighting, different angles of faces, and background noise that are common in home settings.

To solve these problems, this study introduces a new system that uses Bagging, which is a method of training several models on different data sets and combining their results to improve accuracy and stability.

The main contributions of this work are:

- A process to extract important facial features for checking engagement.
- A system that uses predictions from several different models.
- A comparison showing that this new method works better than using a single model.

II. NEED FOR SYSTEM

As online learning becomes more common, it's becoming harder for teachers to see if students are concentrating during online classes.

In a normal classroom, teachers use eye contact, body language, and other signs to judge if students are paying attention, but these clues aren't present in online learning.



This can lead to students getting distracted without the teacher noticing. To address this, there's a clear need for a system that can monitor student engagement by analyzing video footage from webcams. Such a system provides an objective way to track attention, helps teachers intervene quickly when needed, and makes online learning more effective and interactive.

III. SCOPE OF SYSTEM

This system is designed to check how attentive students are during online classes by looking at their facial expressions and eye movements using a webcam.

It helps teachers monitor engagement in real time and provides useful feedback that can improve the learning experience.

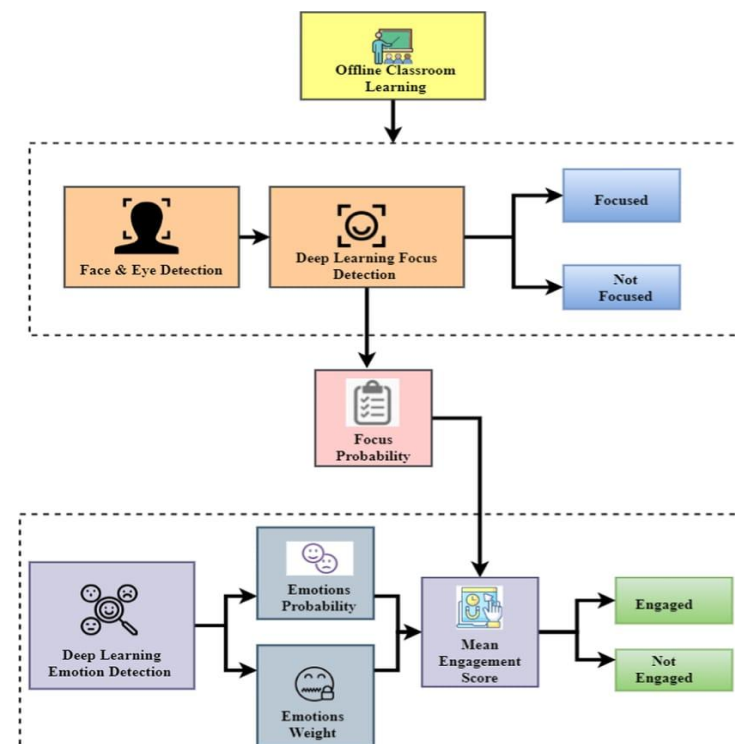
The goals of this system include:

- Detecting student engagement using facial features and eye gaze.
- Analyzing real-time video input from the webcam.
- Classifying students as either engaged or not engaged.
- Helping teachers monitor large online classes.
- Giving feedback to improve learning outcomes.
- Allowing for future features like emotion or fatigue detection.

IV. SCOPE OF INTERFACE

This study presents an automated system for detecting student engagement using a Bagging Deep Learning ensemble. By combining the results from several different models, the system is more accurate and reliable than using a single model.

The experimental results confirm that this method is effective for tracking attention in virtual classrooms. Future work will aim to make the model simpler for use on lightweight devices and include tools that allow for real-time feedback from teachers.



IV. CONCLUSION

This study presented an automated student engagement detection model based on a Bagging Deep Learning ensemble. By combining the outputs of multiple independently trained models, the system achieves greater robustness and accuracy than single CNN architectures. The experimental results confirm that ensemble learning offers a reliable method for monitoring attention levels in virtual classrooms. Future work will aim to reduce model complexity for deployment on lightweight devices and incorporate real-time instructor feedback tools.

REFERENCES

- [1] R. Mehta and P. Choudhary, "Intelligent monitoring systems for remote learning platforms," IEEE -Transactions on Learning Technologies, vol. 14, no. 3, pp. 210–219, 2021.
- [2] L. Breiman, "Bagging predictors," Machine Learning, vol. 24, no. 2, pp. 123–140, 1996.
- [3] S. Tanwar and V. Sharma, Deep Neural Networks for Vision-Based Recognition, 2nd ed., Singapore: Springer, 2020.
- [4] A. Kulkarni and R. Deshmukh, "Facial behavior analysis for student engagement assessment," in Proc. IEEE Int. Conf. on Artificial Intelligence and Image Processing, Pune, India, 2022, pp. 55–62.
- [5] N. Patel and G. Singh, "A survey on ensemble learning techniques for robust classification," International Journal of Computational Intelligence, vol. 18, no. 1, pp. 45–58, 2020.

