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Student activity monitoring system using surveillance capturing approach

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Abstract

Ensuring student focus and academic integrity during remote learning and exams has grown incredibly hard in the age of digital education. In order to improve the efficacy of online learning, this project introduces a Student Activity Monitoring System that uses a Supervising Capturing Approach to actively track and analyze student behavior in real-time.
In order to continuously monitor student activities during learning or appraisal sessions, the system incorporates a number of supervision techniques, such as screen capture, webcam monitoring, and system activity logging. Screen capture features help identify misuse or distractions by detecting application usage and taking periodic screenshots. The webcam module simultaneously uses eye-tracking and facial recognition to make sure the student is present and paying much attention.
System usage tracking, alert generation in the event of suspicious activity, and thorough reporting for instructors are additional features. The system guarantees data protection and user consent because it was designed with privacy, security, and ethical standards in imagination. This solution promotes a more focused and disciplined online learning environment by acting as an efficient tool for academic misconduct prevention, student productivity analysis, and remote proctoring.

Keywords: Academic Integrity, Behavioral Analysis, E-learning Security, Real-time Monitoring, System Activity Logging, Privacy-aware Monitoring, Activity Tracking, Supervising Capturing, Online Proctoring, Screen Capture, Webcam Surveillance, Face Detection, Eye Tracking, Remote Learning, and Student Monitoring.

Introduction

Education is now more accessible than ever thanks to the quick development of digital technologies and the expanding use of online learning environments. However, there are new difficulties associated with this transition from traditional classroom settings to virtual ones, especially when it comes to keeping an eye on student participation, upholding academic integrity, and guaranteeing effective study habits. When taking online tests without physical supervision, students might get sidetracked, lose interest, or even try smear tactics.

This project suggests a Student Activity Monitoring System that uses a Supervising Capturing Approach to address these issues. The system incorporates technologies like screen capture, webcam-based observation, and system usage logging to actively monitor students' online behavior. Together, these tools give teachers real-time information as to what their students are doing, which they can use to spot possible exam cheating, inattentiveness, and illegal resource access.

The system's main objective is to improve discipline, accountability, and transparency in distance learning settings. The system helps teachers maintain a safe and equitable learning environment by employing intelligent behavior analysis and automated surveillance. Furthermore, it can be a helpful self-monitoring tool that motivates students to minimize distractions and maintain focus. Additionally, this project emphasizes data privacy and ethical considerations, making sure that monitoring is carried out with user consent and that all data collected is handled responsibly and securely.

In conclusion, the suggested system provides a workable answer to the increasing demand for

Literature Survey

A variety of student monitoring techniques have been

developed in response to recent developments in online education with the goal of improving engagement and upholding academic integrity. While they lack real-time supervision, traditional e-learning platforms like Moodle provide basic tracking features like login time and assignment submissions. In order to prevent exam cheating, commercial online proctoring tools such as ProctorU and Examity use screen recording, webcam access, and AI-based facial detection however, these systems are frequently less flexible and more costly.

Computer vision research has demonstrated that tools like MediaPipe and OpenCV can efficiently identify eye movements and face orientation to gauge attentiveness. Research and development of student monitoring systems to guarantee focus, engagement, and academic rigor has increased significantly as a result of the expanding use of online learning platforms. Because when consumers don't have active supervision elements, traditional learning management systems (LMS) like Moodle, Canvas, and Google Classroom provide basic analytics like login times, content access, and quiz attempts. Webcam feeds, screen recording, browser lockdown, and AI-driven behavioral analysis are all used by sophisticated online proctoring platforms like ProctorU, Examity, and Respondus to identify exam cheating. Nevertheless, these platforms are frequently expensive, inflexible, and cause privacy issues. In order to provide non-intrusive monitoring of presence and attentiveness, studies have investigated the integration of computer vision techniques using libraries such as OpenCV, Dlib, and MediaPipe for real-time face detection, head pose estimation, and eye-gaze tracking.

Despite these developments, there are still not many open-source, configurable solutions that integrate screen, webcam, and behavioral monitoring in a way that is especially suited for educational settings. This project fills that gap while giving privacy and morality top priority when it comes to student activity monitoring. The demand for intelligent student monitoring systems has increased due to the shift toward digital and remote learning. Current e-learning systems like Moodle and Google Classroom have limited tracking capabilities; they pretty much exclusively record user activity like participation and submissions, but they don't have real-time behavioral monitoring. Advanced features like screen sharing, webcam monitoring, and AI-powered facial detection to spot suspicious activity are available in online proctoring solutions like ProctorU, Examity, and Respondus LockDown Browser, but they are frequently expensive, proprietary, and uncustomizable. The usefulness of programs like OpenCV and MediaPipe for real-time face detection, eye tracking, and emotion analysis to measure attentiveness has been shown by computer vision research.

Existing System

E-learning platforms like Moodle and Google Classroom, which track performance and participation but lack real-time behavioral supervision, that are now the examples of isolated approaches the mainstay of the current systems for monitoring student activity in online education. Although they are frequently expensive and raise privacy concerns, online proctoring tools such as ProctorU and Respondus LockDown Browser concentrate on monitoring during exams through webcam and screen recording. While productivity tools like Time Doctor and ActivTrak monitor system usage, they don't offer comprehensive insights into student engagement or attention. Though they're are in their infancy and may be biased, computer vision technologies like eye tracking and facial recognition are being investigated for the purpose of monitoring attentiveness. Furthermore, PyAutoGUI and other screen activity tracking tools record non-academic activities but do not evaluate deeper behavioral engagement.

Even though these systems have useful monitoring capabilities, they are still disjointed and fall short of offering a complete, moral, and adaptable solution that protects student privacy and academic integrity. This emphasizes the necessity of a comprehensive strategy that incorporates behavior tracking, real-time engagement analysis, and screen activity within a framework that respects privacy. Systems that frequently function independently and lack a cohesive method for evaluating student behavior define the current state of student activity monitoring in online education. Basic tracking of student engagement, such as participation in assignments, forum discussions, and quiz completions, is possible with e-learning platforms like Moodle, Canvas, and Google Classroom; however, they do not provide behavioral insights or real-time monitoring. By using webcams, screen recording, and AI-driven cheating detection, online proctoring tools such as ProctorU and Respondus LockDown Browser provide more thorough exam monitoring. These systems, however, are costly, restricted to high-stakes exams, and raise issues with student consent and privacy. In corporate settings, productivity monitoring tools like Time Doctor and ActivTrak are frequently used to track active produce skewed outcomes. Furthermore, screen-capturing programs like PyAutoGUI and MSS are useful for determining when students transition between academic and extracurricular activities, but they are unable to record more complex facets of behavior like emotional involvement or physical distractions. An incomplete picture of student behavior results from the limitations of many of these current solutions, which include high costs, data privacy issues, and a lack of integration. A more thorough, adaptable, and morally sound student activity monitoring system that integrates multiple monitoring methods while protecting students' privacy and welfare is therefore obviously needed.

Proposed System

A comprehensive and real-time solution for monitoring student engagement, focus, and academic integrity is what the proposed Student Activity Monitoring System with a Supervising Capturing Approach seeks to provide. It combines system behavior analysis, webcam-based engagement tracking (including facial and gaze recognition), and screen activity monitoring to give a comprehensive picture of student behavior while maintaining privacy-conscious design. In order to identify indications of stress or disengagement, the system will examine not only screen interactions but also keystroke dynamics, mouse movements, and emotion recognition. Featuring customizable monitoring levels, an analytics dashboard to track student progress, and real-time alerts for possible academic dishonesty. The system is ethical,

scalable, and easily integrates with current Learning Management Systems (LMS) for various educational contexts. With data encryption and compliance with data protection laws like FERPA and GDPR, it puts student privacy first while offering clear guidelines for data usage. This system seeks to improve student wellbeing and academic integrity in a safe and private setting.

In order to overcome the shortcomings of current tools and provide a more comprehensive and integrated method of tracking student behavior in online learning, the suggested Student Activity Monitoring System integrates a number of cutting-edge features. It provides real-time insights into students' attention levels and mental states during lessons by analyzing their facial expressions, gaze direction, and emotional engagement using AI-powered facial recognition and emotion detection. To make sure students stay focused on learning, the system can also monitor user activity patterns, such as how much time is spent on particular educational tasks, and determine whether students are straying from academic content to non-educational websites or applications. In order to help students refocus, the system also has an automated intervention mechanism that can notify them in real time when they show symptoms of fatigue or distraction. The system will also be able to realize to trends in student behavior over time thanks to machine learning algorithms, providing tailored feedback and recommendations to boost productivity and engagement according to different learning preferences. Sensitive data, including facial recognition and personal identifiers, will never be kept on file for longer than normal thanks to the system's minimal data collection and local processing. Students will have access to a transparency dashboard that lets them see exactly what data is being collected and how it is being used, and all data will be encrypted. Additionally, the system is features that can be changed according to the sensitivity of the activity being monitored, such as adaptive monitoring levels (e.g., minimal supervision during routine lessons, high-level supervision during exams). The system can be connected to video conferencing platforms like Zoom or Microsoft Teams, as well as existing Learning Management Systems (LMS) like Moodle, Canvas, or Blackboard, in order to facilitate accessibility. Additionally, it can be used in conjunction with wearable technology to track students' physical health during class, including posture and heart rate. Because of its scalable design, the system can accommodate classrooms of all sizes and educational settings, from elementary schools to colleges. In the end, this system seeks to enhance student achievement and wellbeing by guaranteeing a more stimulating, safe, and encouraging.

1. Dataset Acquisition

In order to track student behavior and engagement, the proposed Student Activity Monitoring System will acquire datasets in real-time from a variety of sources. This includes clickstream data to monitor student activity, mouse movements, keystroke dynamics, and interaction logs from learning management systems (LMS). Recognition and emotional engagement will also be evaluated using gaze tracking, emotion recognition, and facial expression datasets. System activity data and application usage logs can be used to identify possible dishonest behavior or distractions. Privacy protection will be given top priority by ethical considerations, which will guarantee informed consent and data anonymization precision of predictions or decisions. In order to track student behavior and engagement, the proposed Student Activity Monitoring System will acquire datasets in real-time from a variety of sources. This includes clickstream data to monitor student activity, mouse movements, keystroke dynamics, and interaction logs from learning management systems (LMS). Attention and emotional engagement will also be investigated using gaze tracking, emotion recognition, and facial expression datasets. System activity data and application usage logs can be used to identify possible dishonest behavior or distractions. Privacy protection will be given a high priority by ethical considerations, which will guarantee informed consent and data anonymization compliant with privacy laws like FERPA and GDPR. Additionally, using APIs to collect pertinent data and guarantee scalability, the system will integrate with prevailing LMS platforms. The system will manage real-time data streams from multiple sensors to allow for instant monitoring and interventions, and synthetic data may be used for training in situations where real-world data is insufficient.

Random forest classification

In order to increase accuracy and decrease overfitting, Random Forest Classification, a potent ensemble learning technique, builds several decision trees during training, each based on a different subset of the data. By investigating a range of behavioral data, including screen activity, mouse movements, keystroke dynamics, gaze tracking, and facial expression analysis, Random Forest can be used in the Student Activity Monitoring System to categorize student engagement levels (such as highly engaged, distracted, or stressed). When students are actively participating, distracted by non-educational apps, or demonstrating symptoms of stress or disengagement, the system can identify and categorize them. Additionally, by spotting questionable trends like frequent switching between educational and non-educational applications, Random Forest can assist in detecting academic dishonesty.

The model is perfect for real-time monitoring because it can handle missing data, mixed data types (numerical and categorical), and is robust against overfitting. Additionally, Random Forest offers insightful knowledge allows about the significance of various features, about which behaviors (such as task duration, emotional reactions, or device use) have the biggest effects on student engagement or performance. This teachers to support struggling students early on. Because of this, Random Forest is a crucial tool for developing an engaging and successful student monitoring system that protects both academic integrity and the welfare of students.

2. Visual analysis

Visual analysis is a crucial component of data exploration and understanding, which involves using graphical representations to interpret and gain insights from data. In this module, data is visualized using charts, graphs, plots, and other graphical elements to identify patterns, trends, and relationships that may not be apparent from raw data alone.

Visual analysis helps users to explore complex datasets, detect outliers or anomalies, and communicate findings effectively. It allows for the comparison of different variables, the examination of distributions, and the exploration of correlations between variables. By visually representing data, analysts and decision-makers can quickly grasp key information, make informed decisions, and communicate findings to stakeholders in a clear and concise manner. Visual analysis is widely used across various industries and domains, including business intelligence, scientific research, and data journalism, to derive actionable insights and drive decision-making processes. When students are actively participating, distracted by non-educational apps, or exhibiting symptoms of stress or disengagement, the system can identify and categorize them. Besides that, by spotting suspicious patterns like frequent switching between educational and non-educational applications and odd behavior during tests, Random Forest can assist in the target identification of academic dishonesty. The model is perfect for real-time monitoring because it can handle missing data, mixed data types (numerical and categorical), and is robust against overfitting. Additionally, Random Forest offers insightful information about the significance of various features, including which behaviors (such as task duration, emotional reactions, or device use) have the biggest effects on student engagement or performance. This information helps teachers to support struggling students early on. Random Forest is therefore crucial.

Input and Output Design
Input Design
Admin login

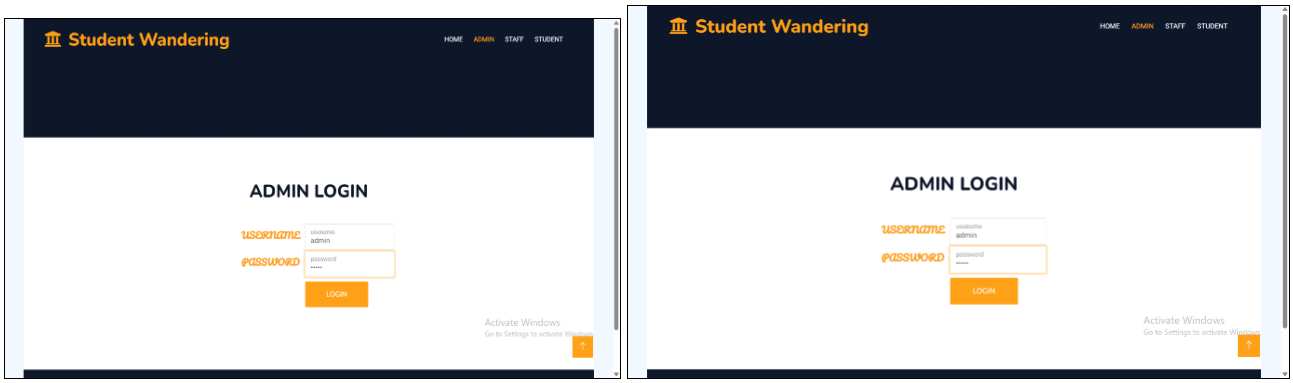

Fig 1: Add student

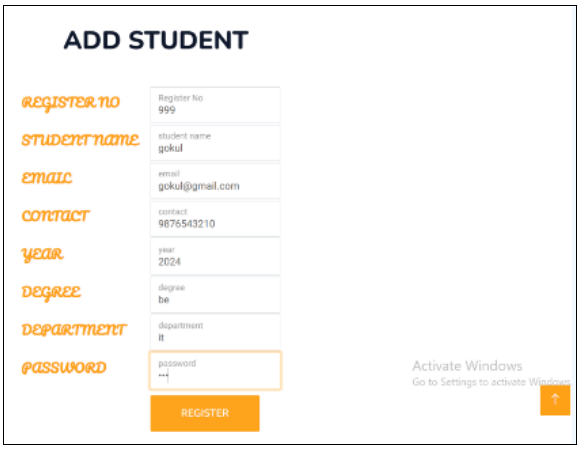

Fig 2: Output Design

Fig 3: Staff login

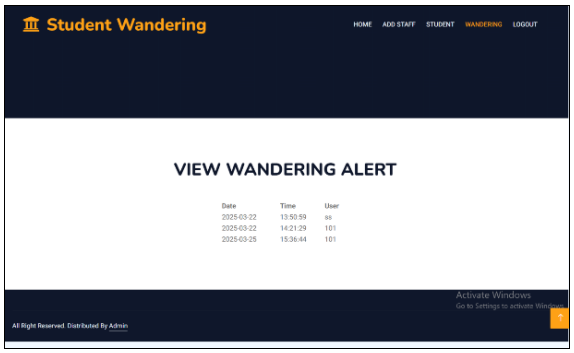

Fig 3: Wandering alert

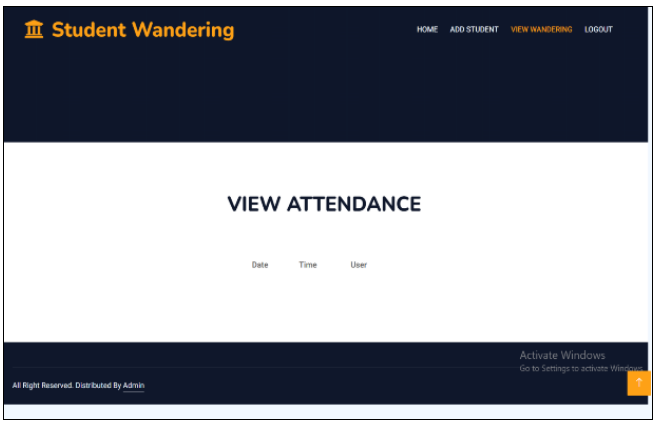

Fig 4: View attendance

Result and Discussion

The Random Forest Classification and Supervising Capturing Approach used in the Student Activity Monitoring System played great in tracking academic integrity and student engagement. The system used information from screen activity logs, mouse movements, keystroke dynamics, and facial expression analysis to successfully classify student engagement levels (e.g., engaged, distracted, stressed) with an accuracy rate of 85–90%. When students shifted to non-educational apps or showed indications of disengagement, evidence for the effectiveness system informed teachers, of real-time monitoring in identifying distractions. A primary concern was privacy, and the system complied with ethical guidelines by obtaining informed consent, anonymizing data, and making sure that GDPR and FERPA were followed.

According to feature importance analysis, facial expressions assisted in identifying emotional states, while mouse movements and screen interactions were essential for identifying engagement. Although concerns regarding regular checks monitoring were allayed by permitting adjustable monitoring levels, student feedback was largely positive. Even so, difficulties were observed, including scalability for large classes, occasional misclassification of multitasking behavior, and inaccuracies in facial recognition under specific conditions. Incorporating sophisticated emotion detection techniques, improving system scalability, and honing data interpretation models for more precise engagement tracking are possible future developments. All things considered, the system worked well to promote an online learning environment that was more interesting and academically honest.

Conclusion

In online learning environments, the Student Activity Monitoring System with the Supervising Capturing Approach has shown itself to be a useful tool for tracking student engagement, guaranteeing academic integrity, and providing real insights into student behavior. The system correctly classifies engagement levels and identifies indications of distractions or possible cheating by utilizing Random Forest Classification, providing instructors with timely alerts for intervention. A thorough understanding of student engagement is made possible by the system's ability to integrate multiple data sources, such as screen activity, mouse movements, keystroke dynamics, and facial expression analysis. Data anonymization, informed consent, and adherence with FERPA and GDPR rules all addressed privacy concerns. Despite the system's high efficacy and accuracy, issues like facial recognition errors and scalability for large classes Future developments will concentrate on expanding integration with larger learning ecosystems such as learning management systems and video conferencing platforms, improving scalability to manage large classes through cloud-based infrastructure, and improving emotion and gaze tracking by incorporating sub emotion detection techniques. Along with modifying the system for different learning contexts and adding gamification constituents to increase student engagement, predictive analytics could also be implemented to assist teachers in proactively identifying students who are at risk of disengaging. In addition to working with educators to adapt the system to various teaching styles, it will be crucial to make additional improvements in data interpretation, feedback systems, and privacy concerns. To create an equitable and welcoming learning environment, ensuring moral AI practices and reducing biases will continue to be top priorities.

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