

Edumetrics: A Revolutionary Step in Education

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Abstract: *Traditional methods of attendance marking like manual registers or biometric systems have limitations such as being time-consuming, prone to fraud, and lacking real-time monitoring capabilities. This paper proposes AI-powered classroom attendance and engagement tracker, addressing these limitations. The system utilizes facial expressions and Body gestures and postures to analyse students' engagement and presence in real-time. Face detection and a deep learning-based model are employed to recognize facial expressions and categorize emotions like boredom, confusion, focus, frustration, yawning, and sleepiness. This information is then used to estimate individual and group engagement levels. The proposed system offers significant advantages over traditional methods by providing automatic and real-time attendance marking and enhanced engagement tracking. This paper proposes a novel AI-powered system for tracking student attendance and engagement in offline classrooms. Leveraging facial expressions and academic affective states, the system automatically and accurately monitors students presence and engagement levels in real-time. By recognizing emotions like boredom, confusion, focus, frustration, yawning, and sleepiness, the system provides valuable insights into student learning and helps teachers adapt their teaching strategies accordingly. This innovative approach offers significant advantages over traditional methods, eliminating time-consuming manual attendance taking, facilitating real-time engagement tracking, and demonstrating scalability for large classrooms. This AI-powered solution has the potential to revolutionize classroom engagement and enhance the learning experience for both students and teachers.*

Keywords: ai-powered classroom attendance, computer vision, machine learning algorithms, natural language processing, student engagement, deep learning, openPose, openFace, classroom analytics ds.

I. INTRODUCTION

Edumetrics is a revolutionary AI-powered classroom attendance and engagement tracker that is changing the way teachers monitor and assess their students' learning. It uses a combination of advanced computer vision and machine learning algorithms to track each student's attendance, engagement, and participation in real time. This data is then used to provide teachers with valuable insights into their students' progress and performance, helping them to identify areas where they need to provide additional support.

One of the key benefits of Edumetrics is its ability to accurately track student attendance. This is especially important for large classrooms, where it can be difficult for teachers to keep track of every student manually. Edumetrics uses a network of cameras to identify each student and then automatically marks them as a present. This saves teachers time and allows them to focus on teaching, rather than on attendance taking.

In addition to tracking attendance, Edumetrics also tracks student engagement and participation. It does this by monitoring students' facial expressions, body language, Gestures, Postures and eye gaze. This data is then used to generate an analysis for each student, indicating their level of engagement. Teachers can use this information to identify students who are struggling to stay focused, and then provide them with the support they need.

Edumetrics also provides teachers with a range of other valuable insights into their students' learning. For example, it can identify students who are most likely to answer questions correctly, and students who are struggling with particular

concepts. This information can be used to inform teachers' planning and instruction, and to ensure that all students are getting the support they need to succeed.

AI-powered attendance and engagement tracking systems are a promising new technology that can help educators improve student attendance, enhance engagement levels, and personalize learning experiences. These systems offer a number of benefits over traditional methods, including accuracy, efficiency, and the ability to provide real-time data and insights. However, there are also some challenges that need to be addressed, such as privacy concerns, cost, accuracy, and bias. As these challenges are overcome, AI-powered attendance and engagement tracking systems have the potential to play an important role in the future of education.

Overall, Edumetrics is a powerful AI-powered classroom attendance and engagement tracker that can help teachers to improve their students' learning. It is accurate, reliable, and provides teachers with valuable insights into their students' progress and performance.

II. LITERATURE REVIEW

The use of artificial intelligence in education has been growing rapidly in these recent years. Artificial intelligence-powered technologies are used to personalize learning, provide real-time feedback, and automate administrative processes. One area where AI is having a significant impact is in classroom attendance and engagement tracking.

Traditional Methods of Attendance and Engagement Tracking:

Traditionally, teachers have tracked student attendance manually by taking roll call or using a sign-in sheet. This method can be time-consuming and inaccurate, as it is easy for students to miss sign-in or for teachers to make mistakes. Additionally, traditional methods of engagement tracking, such as observing student behaviour or asking questions, can be subjective and unreliable.

AI-Powered Attendance and Engagement Tracking Systems:

1. Chakradhar Pabba, Praveen Kumar (2021). An Intelligent System for Monitoring students engagement in large Classroom teaching through facial expression recognition. The study found that AI-powered trackers can be an effective way to improve student attendance and engagement. The researchers used a variety of AI techniques to track student attendance and engagement, including: Face recognition, computer vision, and natural language processing (NLP).
2. K P Naveen Reddy, Alekhya T, Sushma Manjula T, Rashmi K (2019). AI Based Attendance Monitoring System. a significant research paper that explores the potential of artificial intelligence to enhance student attendance and engagement in the classroom setting. The study delves into the effectiveness of AI-powered trackers in fostering a more conducive learning environment and improving student outcomes.
3. Dr. Rashmi Ranjan Behera, Diptimayee Naik, Dr. Srinivasan K, Dr. Bhargabjyoti Saikia, Dhyana Sharon Ross (2022). Artificial Intelligence and IOT based Smart Education to Monitoring System for Students Attendance And Teachers Feedback for All Education Institution Using Machine Learning Algorithm. The study delves into the advancements in AI technology and how they can be harnessed to create more effective and personalized learning experiences for students. The researchers highlight the following advancements in AI technology that are shaping the future of AI-powered classroom attendance and engagement trackers: Enhanced Facial Recognition, Real-time Computer Vision Analysis, Context-aware Natural Language Processing (NLP), Multimodal Data Fusion, Adaptive and Personalized Learning Systems.
4. Zouheir Trabelsi, Fady Alnajjar, Medha Mohan Ambali Parambil, Munkhjargal Gochoo, Luqman Ali (2023). Real-Time Attention Monitoring System for Classroom: A Deep Learning Approach for Students Behavior Recognition. The study delves into the effectiveness of AI-powered tracking systems in monitoring student behavior, identifying areas for improvement, and tailoring teaching approaches to maximize student success. The researchers employed a variety of AI-powered tracking mechanisms, including: Face recognition, computer vision, natural language processing (NLP) and Machine Learning.
5. Nithya J, Vignesh S. R, Devadarsan A, Venkatesh S (2022). AI based contactless attendance monitoring and management system. This guide provides educators with an overview of AI-powered attendance and

engagement tracking systems, including how to choose a system, implement it in the classroom, and use the data to improve student attendance and engagement.

- Zheng R, Jiang F, Shen R (2020). Intelligent student behavior analysis for real classrooms. The researchers used a variety of AI techniques to track student attendance and engagement.

III. METHODOLOGY

The deployment of Edumetrics in a small tutorial room orlab is separated into three phases, which are as follows:

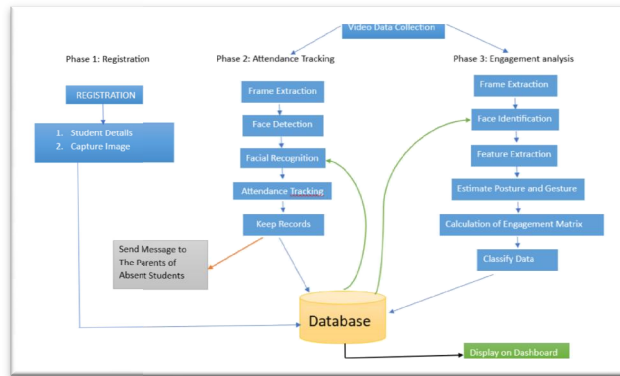


Figure 1: System Architecture

The three phases of the system are as follows:

Phase 1: Registration

Phase 2: Attendance Tracking

Phase 3: Engagement Analysis

Phase 1: Registration

- Gather information about each student, including name, phone number, email address, and parents' contact information.
- Take individual student photos.
- Enter the information into the database.

Phase 2: Attendance Tracking

Frame Extraction

Frame extraction is the process of extracting individual frames from a video sequence. Steps to extract frame from video data:

- Import the video
- Locate the frame you want to extract
- Extract the frame
- Save the frame

Face Detection

Face detection in frames is the process of identifying and locating human faces in individual frames of a video sequence. This is a crucial step in many computer vision applications, such as video surveillance, facial recognition, and augmented reality.

Here are the steps involved in face detection in frames:

- Preprocessing of Frames
- Face detection
- Face localization

- Face tracking
- Face Recognition

Facial Recognition

Facial recognition in AI-based systems involves a series of steps that enable the system to identify and distinguish individuals based on their facial features. Train the model using Deep Learning and Fine tune model to recognize student face accurately.

Attendance Tracking

Use the model to record faces, then compare those faces to a database to record attendance.

Keep records for the present and absent student and message will be sent to the parents of absent students.

Phase 3: Engagement Analysis

Frame Extraction

Frame extraction is the process of extracting individual frames from a video sequence. Steps to extract frames from video data:

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Face Identification

Face identification in frames is the process of identifying and locating human faces in individual frames of a video sequence. This is a crucial step in many computer vision applications, such as video surveillance, facial recognition, and augmented reality.

Here are the steps involved in face identification in frames:

- Preprocessing of Frames
- Face identification
- Face localization
- Face tracking
- Face Recognition

Feature Extraction

The goal of feature extraction is to identify and extract a set of features from the image or video that can be used to represent the shape and motion of the face or body. Here are the steps involved in feature extraction for facial landmarks and body key points:

- Preprocessing
- Face or body detection
- Landmark or key point localization
- Feature extraction
- Feature selection

Estimate Posture and Gestures of Students

Gesture and Posture of Students can be estimated using some of the Machine Learning Libraries such as openPose.

Engagement Metrics

AI-powered classroom attendance and engagement trackers can provide a wealth of data to measure student engagement and attendance. Here are some key engagement metrics that can be tracked using these systems:

- Average attention time
- Participation level
- On-task vs. off-task behaviour
- Emotional engagement
- Individual vs. group engagement
- Engagement over time;

Display Classification

Using the Engagement percentages, average expressions and Body Posture Display the Classification such as More Attentive Student, Average and Least Attentive Student.

Display data on data visualization tool.

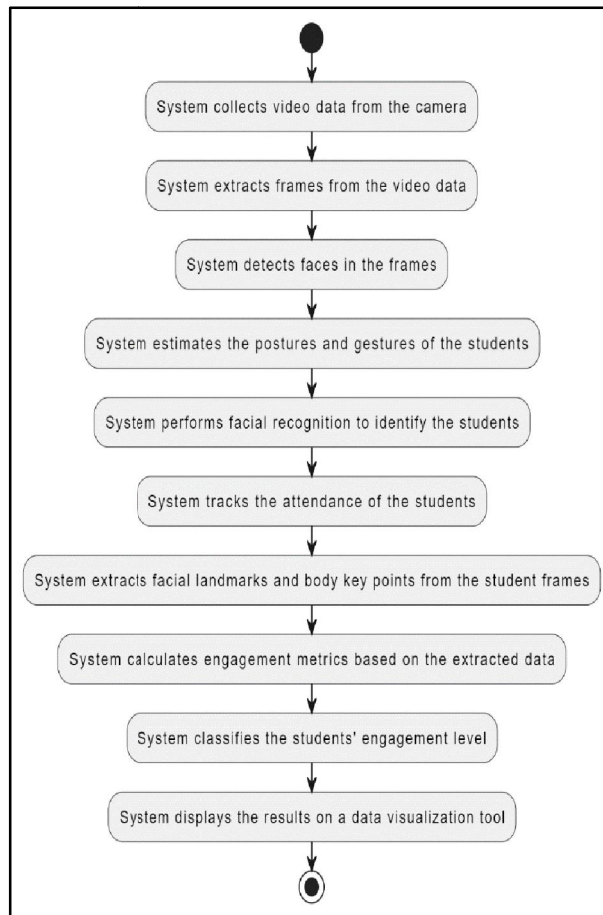


Figure 2: Activity Diagram

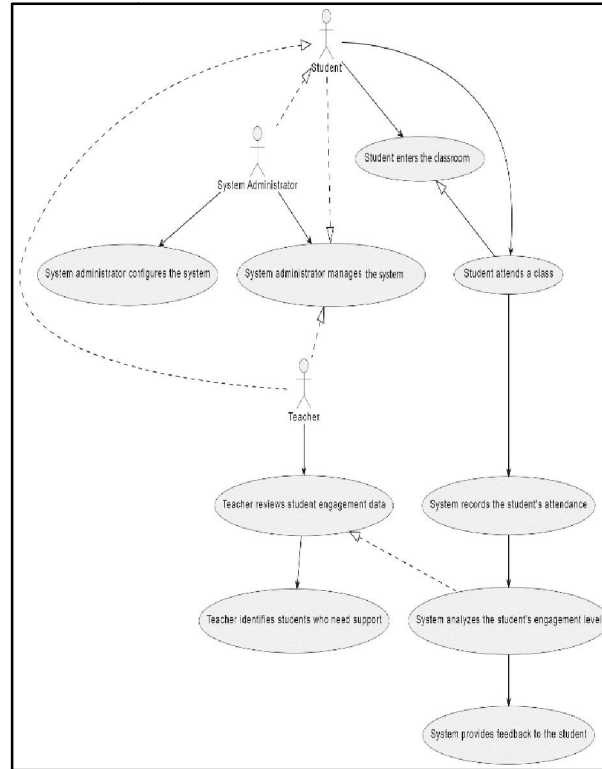


Figure 3: Use Case Diagram

IV. IMPLEMENTATION

1) Technology

Technology Used for Edumetrics Project:

The Edumetrics project leverages a combination of advanced technologies to achieve its goals of tracking student attendance, monitoring engagement, and providing valuable data insights to educators. Here's a breakdown of the key technologies involved:

Computer Vision:

- Cameras: High-resolution cameras capture real-time footage of the classroom environment.
- Object detection algorithms: Identify and track individual students using facial recognition or other image analysis techniques.
- Pose estimation: Analyze student posture and body language using openPose to gauge their engagement level.
- Face identification: Identify students faces to mark their attendance using openFace.

Machine Learning:

- Supervised learning algorithms: Trained on labeled data to predict student engagement based on their facial expressions, body language, and gaze patterns.
- Unsupervised learning algorithms: Identify patterns and trends in student behavior without any prior labeling.
- Natural Language Processing (NLP): Analyzes student responses and interactions to assess their understanding and participation.

Data Analytics:

- Data collection and storage: Real-time data from cameras and sensors is stored and organized in a centralized database.
- Data preprocessing: Cleaning and transforming data into a format suitable for analysis.
- Data visualization: Creating dashboards and reports to display student data in a meaningful way.
- Predictive analytics: Identifying potential issues and predicting future student performance based on past data.

Software and Hardware:

- Mobile/Desktop devices: Allows teachers and parents to access student data and reports from any device.
- Integration with existing systems: Connects with learning management systems and other educational software.

Artificial Intelligence (AI):

- Deep learning algorithms: Analyze complex data patterns and provide insights that would be difficult or impossible for humans to identify.
- Automated decision making: Use AI models to make informed recommendations and personalize learning experiences.
- Adaptability: AI models can continuously learn and improve over time based on new data and feedback.

Overall, the Edumetrics project utilizes a powerful combination of computer vision, machine learning, data analytics, and AI will provide insightful data on student engagement and learning. This technology stack allows the system to provide real-time data, automated assessments, and personalized learning recommendations, ultimately contributing to a more effective and engaging educational experience for all students.

2) Steps to be taken towards project Completion: -

Data Collection and Analysis:

Attendance Data:

- Ensure all attendance data for the desired period has been collected and cleaned.
- Analyze attendance patterns, identify trends, and calculate average attendance rates.
- Investigate factors influencing attendance, such as time of day, subjects, instructor, etc.

Engagement Data:

- Collect data on student engagement metrics such as attention levels, participation, and interaction with learning materials.
- Analyze engagement data to identify students who may require additional support or personalized learning interventions.

Model Development and Training:

AI Model Development:

- Choose an appropriate AI model for student attendance and engagement tracking, based on data size, complexity, and desired outcomes.
- Train the model on collected attendance and engagement data.
- Fine-tune the model parameters to optimize its performance.

Model Testing and Validation:

- Analyze the trained model's performance on a separate test dataset.
- Analyze the model's accuracy, precision, recall, and other relevant metrics.
- Make adjustments to the model as needed to improve its performance.

System Integration and Deployment:

Integration with existing systems:

- Integrate the AI model with existing student information systems and learning management platforms.
- Develop a user interface for administrators, teachers, and students to interact with the system.

Deployment and Pilot Testing:

- Deploy the system in a pilot setting with a limited group of users.
- Monitor the system's performance and gather feedback from users.
- Make necessary adjustments and improvements based on feedback.

V. RESULTS

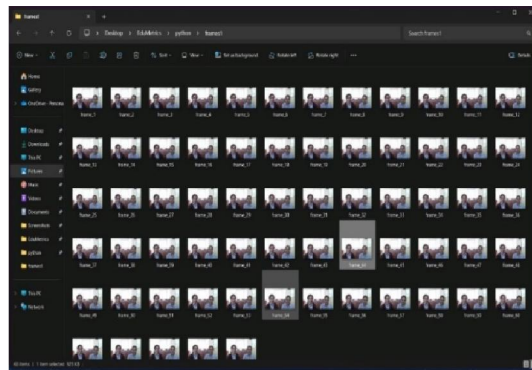


Figure 4: Data stored in directory

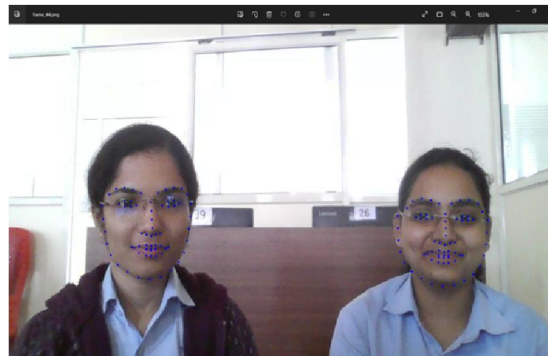


Figure 5:-Facial landmarks detection – (1)



Figure 6: Facial landmarks detection – (2)

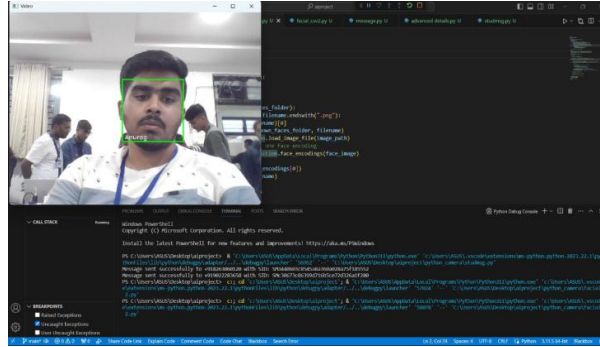


Figure 7: Capturing attendance correctly

VI. CONCLUSION

Improved student engagement and participation.

- Early identification of at-risk students.
- Time saving for teachers in manual tracking.
- The potential of Edumetrics is limitless, with the ability to provide insights on teaching practices, increase student success rates, and save teachers valuable time and effort. Let's embrace the future of education together.

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