REAL TIME ATTENDANCE AND ENGAGEMENT DETECTION SYSTEM

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Keywords

Computer Vision, Deep Learning, Facial Recognition, Engagement Detection, Real-time Analytics, Emotion Recognition, Smart Education.

Introduction

The Real-Time Attendance and Engagement Detection System is an AI-powered application designed to automate classroom monitoring and improve the teaching–learning experience. The project uses computer vision, face recognition, and behavioral analysis to track student presence and measure their engagement levels without any manual effort. The system captures live video through a classroom camera and detects the faces of students in real time. Using advanced machine learning models, it recognizes each student by matching their face with a pre-registered database. Once identified, the system automatically marks attendance and updates the records instantly. This eliminates traditional roll calls, reduces chances of proxy attendance, and provides accurate, time-stamped data.

Objectives

Primary Aims

1. To increase accuracy, transparency, and efficiency in attendance and engagement tracking.
2. To provide real-time insights that help educators/organizations improve performance.

Goals

1. To eliminate manual errors and proxy attendance using secure AI authentication.
2. To deliver a smart dashboard with continuous analytics for monitoring presence and attention levels.

Methodology

1. **Data Acquisition:**
    1. Install cameras/hardware.
    2. Enroll users by collecting facial data and storing unique identifiers (IDs and face embeddings).
2. **Model Training:**
    1. Train a **Face Detection Model** (to locate faces).
    2. Train a **Facial Recognition Model** (to identify individuals).
    3. Train an **Engagement Model** (to classify attention/drowsiness based on facial landmarks).
3. **Real-Time Execution:**
    1. Capture live video frames.
    2. Use the models to detect and identify faces in real-time.
    3. Log precise entry/exit timestamps for attendance and analyze engagement metrics (like EAR/gaze).
4. **Reporting and Optimization:**
    1. Store data securely and update a live dashboard for monitoring.
    2. Continuously test and tune models for high accuracy and low latency

Results and Conclusion

A machine learning methods were used to evaluate the student's observable actions in the classroom teaching system. The evaluation was created right after the live feed review. Several models have been produced. Such models were tested using map to decide which model is appropriate for object detection. The map (mean average accuracy) is a common measure used to determine the precision of the artifacts being observed. Tests indicate that this method offers reasonable pace of identification and positive outcomes for the detecting student faces dependent on observable student actions in classroom instruction. The suggested approach is often versatile and responsive to different situations, since more students would be interested in greater room sizes, utilizing a higher form of camera with certain enhancements such as IP camera for continuously capturing images of the students, detect the faces in images and compare the detected faces with the database. It may be used such as greater input picture measurements, anchor box dimensions ideal for different situations and further training details.

The Facial recognition database can be improved by adding more images and variable poses of the students to make recognition full proof. The Web based architecture can be utilized further by maintaining the databases on a remote server and the application will be accessible via the Internet.

Project Outcome and Industry Relevance

The project is highly relevant to the industry, society, and institutions. It addresses the growing need for affordable, portable, and real-time monitoring systems. In the Corporate industry, it provides accurate, real-time data for payroll and HR planning, eliminating manual errors and time theft. For society, it supports elderly care, rural healthcare, and personal health tracking without needing constant hospital visits. Institutions, tracking engagement in real-time allows educators to identify students who are struggling or distracted, enabling early intervention and personalized support. Overall, its affecting administration, human performance, and resource management across various sectors.

Working Model vs. Simulation/Study

1. **Real vs Virtual:** Working model is real-time; simulation/study is theoretical or virtual
2. **Input Type:** Working model uses live camera input; simulation uses datasets or recorded data
3. **Tools Used:** Working model uses tools like OpenCV for real-time processing; simulation focuses on algorithm design
4. **Hardware Requirement:** Working model needs hardware setup; simulation does not require physical devices
5. **Accuracy:** Working model provides practical and realistic results; simulation gives approximate results
6. **Complexity:** Working model is more complex to build and test; simulation is easier to develop
7. **Application:** Working model is used for real-world deployment; simulation is mainly for research and analysis

Project Outcomes and Learnings

1. Learned fundamentals of Computer Vision for face detection and recognition
2. Gained hands-on experience using OpenCV for real-time image processing
3. Understood basic concepts of machine learning and facial recognition algorithms
4. Explored engagement analysis using Affective Computing
5. Developed a system for automated attendance marking with improved accuracy
6. Built skills in handling real-time data, databases, and system integration
7. Created a scalable solution that can be extended to classrooms, offices, and other domains

References

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Future Scope

1. Improve accuracy using advanced AI frameworks like TensorFlow and PyTorch
2. Implement multimodal engagement detection (face, voice, gestures)
3. Integrate with Learning Management Systems (LMS) and online meeting platforms
4. Deploy on mobile devices and edge hardware for faster processing
5. Enhance privacy using encryption and on-device processing techniques
6. Use predictive analytics to track performance and engagement trends
7. Develop emotion-aware systems based on Affective Computing
8. Expand applications to corporate, healthcare, and security sectors