

Facial Recognition Based Student Analysis System Using CNN

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ABSTRACT—Our student analysis monitoring system uses the CNN with multiple face detection and facial recognition to automatically mark attendance each day. Simultaneous face detection guarantees precise and efficient data collection. Absentees are instantly notified by SMS to the class advisor and parents and also attendance records are safely kept in Firebase. This method facilitates communication between parents, teachers and students, streamlines the attendance process and promotes student monitoring and accountability. But ethical issues with monitoring and privacy need to be addressed and appropriate laws need to be put in place for responsible use. In the end, all stakeholders benefit from this system's time savings, decreased error rate and improved educational experience.

Keywords—CNN, Facial recognition, SMS, Attendance, Firebase.

I. INTRODUCTION

In the fast-evolving landscape of education, technology has emerged as a powerful, transforming traditional teaching and learning methodologies[6]. One of the most significant applications of technology in the educational sector is the development of advanced systems aimed at enhancing the overall experience for both students and educators. This research paper delves into a cutting-edge innovation known as “Facial Recognition-Based Student Analysis System Using CNN.”

This system represents a fusion of artificial intelligence, computer vision and educational management designed to revolutionize the way we monitor student attendance and engagement. With the proliferation of facial recognition technology, this system automates the process of marking attendance, making it not only efficient but also highly accurate. The use of facial recognition technology ensures that each student's presence is captured in real time and absentees are promptly notified through SMS to both the class adviser and parents.

Beyond streamlining the attendance process, this system offers a bridge for effective communication between students, teachers and parents, fostering a more informed and collaborative educational ecosystem. The data collected is securely stored in Firebase, ensuring accessibility and reliability.

While the benefits of such a system are evident, it is crucial to address the ethical and privacy concerns that inevitably arise with the implementation of monitoring technologies. This research paper will delve into the ethical considerations and the legal framework necessary for the responsible use of such a system in educational settings.

In summary, the "Face AI - Facial Recognition-Based Student Analysis System" holds the promise of revolutionizing the educational landscape by saving time, reducing error rates and ultimately enhancing the educational experience for all stakeholders. This paper aims to explore the intricacies of this innovation, from its technical underpinnings to its broader societal implications[4].

II. LITERATURE REVIEW

A) FINGERPRINT RECOGNITION SYSTEM

In[1], enrollment and authentication are two vital stages in a fingerprint-based attendance system. The user's biometric information, specifically their fingerprints, are taken upon registration and minutiae data—individual fingerprint traits—are retrieved and saved in a database alongside the user's ID. The goal of this enrollment module, which is normally run by an administrator, is to admit users by establishing through templates for each person that act as identity references. The user's biometric data is once more taken throughout the authentication procedure and the features that are extracted are compared to pre-existing templates in the database. After a successful match, the user's ID is marked with the attendance, indicating their presence.

Vulnerabilities in security:

Spoofing attacks, in which a person impersonates someone else using a phony fingerprint, can occur on fingerprint scanners. There are several ways to accomplish this, including using a high-resolution fingerprint scan or making a latex mould of a fingerprint.

Problems with accuracy:

When fingers are damp, unclean, or broken, fingerprint scanners may not always identify them accurately. False denials may result from this, preventing an authorised user from gaining access to the system.

Cost:

The acquisition and upkeep of fingerprint-based attendance systems can be costly. Adoption may be hampered for small enterprises and organizations by this.

Not suitable in all settings:

Certain environments might not be appropriate for fingerprint scanners. For instance, they could not function effectively in places that are extremely dusty or unclean or in conditions with high temperatures.

B) RFID

Radio Frequency Identification, or RFID, is a wireless technology that can be used to track, identify and manage people, animals and other objects. In[2], it is made up of RFID tags and RFID readers. RFID tags have a microchip and an antenna, while RFID readers emit radio waves and process data that has been received. A tag activates and transmits its specific identification information to the reader when it comes within range of an RFID reader. Applications in inventory management, retail, access control, transportation, logistics, animal tracking, healthcare, passport systems and waste management are made possible thanks to the processing and transmission of this data to a central database or system. RFID improves tracking, security and operational effectiveness in a variety of sectors.

III. PROPOSED SYSTEM

A. SYSTEM OVERVIEW :

The main objective of the proposed system is to identify and recognize students' faces from a video stream for analysing the attendance. This is achieved by comparing the detected faces with those already stored faces in the system and this system has the capability to automatically detect and recognize the individuals in time from the video stream.

At first the system captures students facial data and later associates them with their labels creating a dataset. To recognize faces a CNN model is utilized. While the Histogram of Oriented Gradient (HOG) method can also be employed for face detection it is less accurate compared to CNN. The captured face is positioned directly towards the camera for detection. The dataset is then trained for steps. Next the system connects to a video source strategically placed within the classroom for convenience. It analyses the video stream. Identifies faces of students in the class. These detected faces are then compared against those stored in the trained dataset

marking it as a recognition stage. The data of the students who have been recognized is stored in a sheet , where their attendance is recorded.

OPENCV

OpenCV(Open Source Computer Vision) Library, is a powerful open-source software library designed for computer vision and machine learning applications. It is extensively utilised in Python and other programming languages for a wide array of image and video analysis tasks. OpenCV, accessible through the cv2 package in Python, offers a rich collection of functions and modules for tasks such as image processing, manipulation, analysis, filtering and video processing. It provides tools for image manipulation, feature detection, object detection and machine learning integration, making it a versatile choice for various applications. Whether it's reading, displaying and saving images, detecting contours or objects or applying filters for image enhancements.OpenCV is a go-to resource for developers, researchers and engineers working in fields like computer vision, robotics, augmented reality and more. Its open-source nature and widespread adoption make it a valuable asset in the realm of computer vision and image analysis.



Fig.4.1 OpenCV

OpenCV is written in C++ and offers APIs for several programming languages, including Python, Java and MATLAB. It provides various modules for tasks such as image and video processing, feature detection, object detection, machine learning and more.

FACE RECOGNITION MODULE

The Face Recognition module is a sophisticated component of computer vision and artificial intelligence systems, designed for the precise identification and authentication of individuals based on their facial features. It utilises advanced algorithms, including deep learning techniques such as Convolutional Neural Networks (CNN), to detect and analyse key facial characteristics, such as the arrangement of eyes, nose and mouth. By comparing these features with reference images stored in a database, the module can accurately recognize and verify a person's identity.

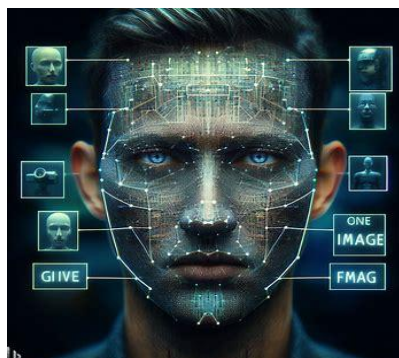


Fig.4.2 Face Recognition Module

This technology finds diverse applications in security, user authentication and attendance tracking systems, as well as in the automation of tasks like unlocking devices or granting access to secure areas. With its non-intrusive and hygienic nature, especially in a post-pandemic world, the Face Recognition module has gained prominence for its efficiency and precision, revolutionizing the way we interact with technology and secure sensitive information.

DATE TIME MODULE

The DateTime module is a crucial component in programming languages like Python that allows for the effective manipulation and management of date and time data. It provides a comprehensive set of functions and classes to work with dates, times, time zones and time intervals. With the DateTime module, developers can perform a wide array of operations, such as creating and formatting dates, performing arithmetic operations on dates and times and parsing dates from different formats. It also handles time zone conversions and supports localization, ensuring that date and time representations are accurate across different regions. This module is indispensable in various applications, including scheduling tasks, handling time-sensitive data and tracking events, as it provides a standardised and reliable way to work with temporal data, ensuring precision and consistency in managing time-related information. The DateTime module, which is often found in programming languages like Python.

FIREBASE ADMIN

The Firebase Admin module is a critical component in the management and interaction with Firebase, a versatile cloud-based platform for web and mobile application development. It plays a pivotal role in handling server-side tasks and privileged operations within Firebase projects. This module offers a range of features, including authentication management, realtime database control, integration with Cloud Firestore, and secure cloud storage operations. It enables administrators to create and manage user accounts, define roles and permissions, and maintain synchronised data across clients in real-time. With the Firebase Admin module, developers can efficiently manage user-generated content and enforce stringent security rules and access controls for databases and storage. Its practical use cases span from user management to content moderation, making it an indispensable tool for streamlined, secure, and efficient Firebase project administration.

The Firebase Admin module empowers developers and administrators to maintain data integrity, ensure user authentication, and implement effective access control in their Firebase applications.

TELEGRAM BOT

A Telegram bot is a computer program that operates within the Telegram messaging platform, enabling automated interactions with users through chat. These bots are developed using the Telegram Bot API and can perform a wide range of tasks, from providing information, conducting surveys, offering customer support, to automating various functions. Telegram bots can be created by developers or organisations, and they function as virtual assistants that respond to user messages and commands. They can offer real-time updates, deliver customised content, and engage in one-on-one or group conversations, making them versatile for both personal and business applications. Telegram's bot platform supports the integration of rich media, interactive buttons, and even custom keyboards to enhance user experiences. Additionally, Telegram's security and encryption features ensure the privacy of interactions, making it a preferred platform for bot development in various domains, from news and entertainment to e-commerce and productivity tools. Telegram bots have become increasingly popular due to their user-friendly interfaces and versatile capabilities, fostering seamless, automated interactions within the Telegram messaging ecosystem.

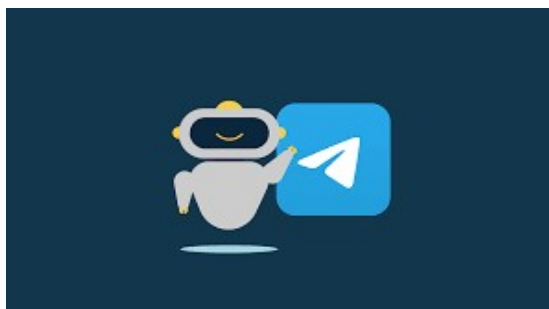


Fig.4.5 Telegram Bot

B)METHODOLOGY :

In[5],the system's components can be divided into five major phases. These are the following:

- Dataset Collection
- Dataset Training
- Face Detection and Recognition
- Analysis using logic
- Analysis marking

1) Dataset Collection :



The process of gathering a structured or unstructured set of data from different sources and domains is known as dataset collection. Datasets can contain text, photos, audio and other kinds of information and they are usually arranged into files or tables. The size, complexity and purpose of datasets can differ greatly and they serve as the fundamental units for testing theories, developing, training machine learning models and making data-driven decisions. Dataset collection is an essential part of face recognition-based student attendance monitoring systems. Every student in the class must have their facial images collected in order to build a reliable and strong face recognition model. A wide variety of student identities, including people of different ages, genders and ethnicities should be represented in these pictures. The dataset should be extensive and representative capturing the looks and facial expressions of students in a variety of backgrounds, lighting scenarios and viewpoints. The machine learning model will be trained using the gathered photos as the base and allowing it to identify every student individually. The dataset should be updated on a regular basis to add new students and to make an modifications for the appearance of current students. Therefore, gathering datasets is more essential to developing a dependable face recognition-based student attendance tracking system.

2) Dataset Training :



The student attendance tracking system that uses Convolutional Neural Networks (CNNs) for multiple face detection per frame by using the gathered dataset. After obtaining a large dataset that includes every student's face image in the class, the process begins with data preprocessing. To improve dataset diversity, images are resized, standardised to use augmentation techniques. The bounding box annotation of every facial image indicates the exact locations of faces that have been detected. Based on the needs of multi-face detection, an appropriate CNN architecture, such as SSD, YOLO or Faster R-CNN is selected.

The model gains the ability to distinguish unique facial features, patterns and traits that set one face apart from another during the training phase, which is essential. Through this procedure, the model is prepared to handle the dataset's wide range of facial appearances, orientations and lighting conditions. Following that, the model's performance is validated and any necessary adjustments are made through validation and fine-tuning. Subsequently, the trained CNN is used for inference, utilising bounding boxes to detect multiple faces in real-time frames. The identified faces are linked to student identities, making it easier to log attendance for each frame. The model offers a precise and effective solution for managing attendance by continuously monitoring frames for real-time student presence tracking. Face Detection and Recognition

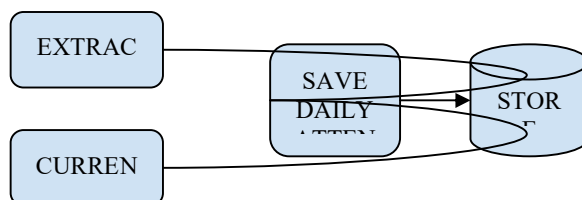


3) Analysis using Logic

Through the utilisation of facial recognition technology, the system proficiently recognises students upon their arrival and departure from educational facilities, guaranteeing precise attendance records. Students are quickly recorded as present when their faces are identified and absentees are carefully recorded when their faces are not recognised. This sensible structure offers a robust security layer in addition to streamlining the attendance recording procedure. Additionally, the subheading describes how the system's proactive approach goes beyond tracking attendance; in the event of a student's absence, it promptly notifies parents and class advisors, promoting increased parental involvement and student wellbeing. It highlights how the system is revolutionising security protocols and attendance tracking in the educational field and stresses the need for strong data protection and ethical considerations within the project's framework.

4) Analysis marking :

The analysis and marking process involve capturing real-time facial images, detecting faces using algorithms like Haar cascades, aligning and preprocessing the detected faces for uniformity. These preprocessed images are then fed into a trained CNN model, which extracts high-level facial features through its convolutional layers. Techniques such as PCA or LDA are applied to reduce feature dimensionality, facilitating efficient comparison. By employing distance metrics like Euclidean distance, the encoded features of the detected face are compared with stored features in the system's database. If the similarity score surpasses a predetermined threshold, the individual is recognized and attendance is marked with relevant data logged for future reference. This seamless process ensures accurate and rapid attendance management, demonstrating the system's efficacy in real-time applications.

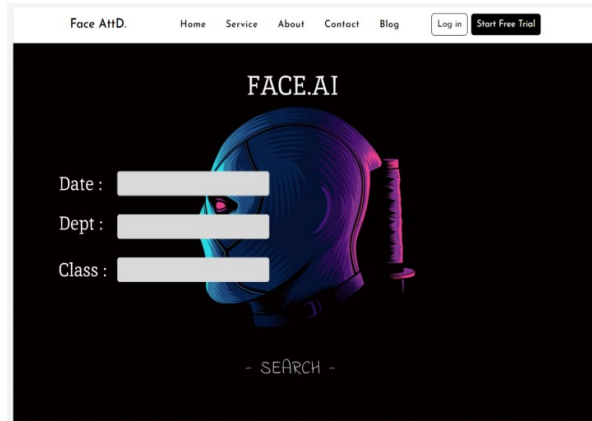


IV. RESULT AND DISCUSSION

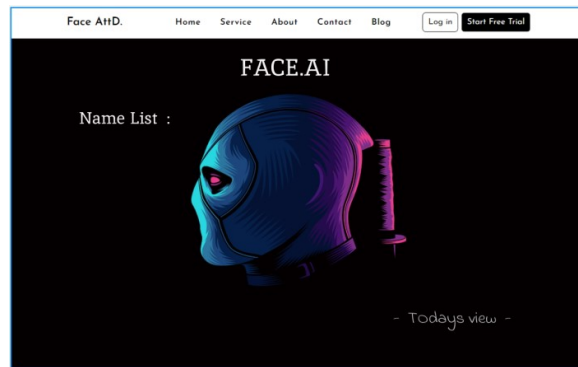
There are several strong advantages for educational institutions when a web-based interface is combined with a face recognition-based student attendance system. By instantly identifying students as they enter designated areas, this system enables real-time attendance tracking and significantly lowers the possibility of attendance fraud or mistakes. A web page makes the attendance data easily accessible, enabling authorized users such as teachers, administrators and students to view and interact with attendance records from any location with an internet connection. By streamlining attendance management, saving valuable class time and facilitating instant access to past attendance records, this web-based interface improves the effectiveness of educators.

Notifications that are sent automatically can notify accountable parties in a timely manner about anomalous attendance patterns or unwanted access. Students can also actively monitor their own attendance, which promotes accountability and transparency. For a more insightful and eye-catching display of attendance trends, the system can provide data visualization tools like graphs and charts. Comprehensive analysis of attendance data is made easier with the generation of custom reports based on specified parameters. Users can view attendance information on a variety of devices, including computers, tablets and smartphones thanks to the system's cross-platform accessibility. It can easily interface with current student management systems, minimizing redundant data entry and guaranteeing data consistency.

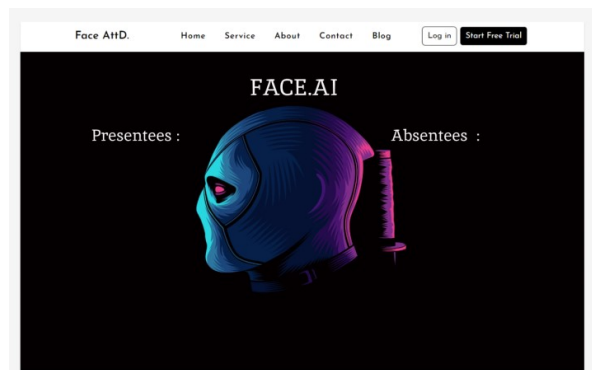
The system is scalable to support more students and locations as the institution expands. Facial recognition technology greatly reduces the chance of errors associated with manual methods of attendance tracking, making it much more accurate and efficient. The system reduces costs over time by expediting tasks related to attendance and administrative workload. For compliance and historical analysis purposes, attendance data is kept, backed up and stored securely. In conclusion, real-time tracking, data accessibility, efficiency and improved security are just a few of the ways that the combination of a web interface and a face recognition-based student attendance system revolutionizes attendance management, ultimately helping both teachers and students.



Requesting Class Details



Display the Student Details



Displaying the Present and Absent Details

This project implements an automated system for recording and categorising class attendance. Data entry for the implementation process is part of the people, training dataset, facial recognition and labelling Automatic attendance. The CNN model applied to this research even if a person is not looking directly into the camera, it can still identify and detect them based on the features of their face. By automatically recording and storing the attendance of the current students, the suggested system saves teachers time and hassle and has a maximum accuracy of roughly 92% in identifying and recognising the students in the class. The system needs to have a sufficient and reliable number of photos of every individual during the training phase in order to function

as efficiently as possible. In addition, all of the students must be clearly visible to the camera from its current position. Moreover, any company can use this system to automatically record staff attendance.

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