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Abstract: *This visionary project strives to bring about a paradigm shift in classroom management by pioneering a facial recognition-based attendance system. This innovative and cutting-edge solution is poised to not only optimize educational efficiency but also elevate the role of educators by automating the mundane task of attendance taking. By alleviating teachers of this administrative chore, they can channel their valuable time and resources towards the fundamental pursuit of education - moulding the next generation. The system harnesses the power of state-of-the-art facial recognition technology to seamlessly integrate and simplify administrative operations, thus revolutionizing the landscape of classroom management. With unwavering commitment, the ultimate aspiration of this endeavour is to enhance the educational journey for educators and students alike, fostering a more dynamic, productive, and immersive learning environment.*

I. INTRODUCTION

A. Introduction

In the dynamic landscape of education, where adaptation and innovation are key, our project introduces a groundbreaking initiative that seeks to revolutionize classroom management. We embark on a journey to implement a facial recognition-based attendance system that promises to redefine not just how we manage classrooms, but also how we empower and support educators. The aim is to significantly reduce administrative burdens and pave the way for a more efficient and forward-thinking educational environment.

Traditionally, teachers have had to grapple with the time-consuming and often tedious task of taking attendance, diverting their valuable time and energy away from their primary mission: guiding and shaping the next generation.

This project acknowledges the pressing need to liberate educators from this administrative burden, allowing them to focus on their core objective of imparting knowledge and wisdom. By automating attendance procedures, we aim to provide teachers with more opportunities to nurture and educate students, ultimately contributing to a richer educational experience.

At the heart of this initiative is the integration of state-of-the-art facial recognition technology. This technology promises to streamline administrative processes, thereby enhancing the overall efficiency of classroom management. The potential impact of such innovation is profound, as it not only optimizes attendance-taking but also opens the door to a myriad of possibilities for future advancements in educational technology.

B. Existing Work

In the context of attendance management, various traditional methods have been employed, ranging from manual roll call to barcode scanning and RFID-based systems. While these methods have served their purpose, they come with inherent limitations, such as time inefficiency, manual errors, and logistical challenges. This project aims to address these issues by introducing an automated and technologically advanced attendance system, which not only reduces the administrative burden on teachers but also enhances the accuracy of attendance records.

C. Motivation

The motivation behind this project arises from the pressing need for a modern and efficient attendance system that aligns with the advancements in technology. Traditional methods of taking attendance often consume valuable class time, resulting in disruptions to the learning process. Additionally, the potential for inaccuracies in manual record-keeping necessitates a more precise and automated solution. The motivation is to create a system that benefits both educators and students, offering a convenient and reliable way to manage attendance, which, in turn, can enhance the overall learning experience.

D. Objectives

The primary objectives of this project are to:

- 1) Develop a user-friendly attendance system that leverages face recognition technology.
- 2) Utilize a teacher's mobile hotspot to create a dedicated server for real-time attendance recording.

- 3) Create a web-based platform accessible to students via mobile devices and laptops.
- 4) Implement Python machine learning models for accurate face recognition and attendance tracking.
- 5) Employ HTML, CSS, and Bootstrap for the frontend to ensure an intuitive user interface.
- 6) Utilize Flask to establish communication and data exchange between different components of the system.

E. Scope

The scope of this project encompasses the design and development of a comprehensive attendance management system that can be used in educational institutions of various sizes and types. It is tailored to work in real-time, ensuring quick and accurate attendance recording. The system is adaptable for use with any class size, and its web-based nature makes it accessible from various devices, offering flexibility to both educators and students.

F. Summary

In summary, this project introduces an innovative attendance system that leverages modern technology to address the shortcomings of traditional attendance management methods. It employs a teacher's mobile hotspot to create a dedicated server, allowing students to access the attendance system via a website on their mobile devices and laptops. Python machine learning models ensure accurate attendance tracking through face recognition, while HTML, CSS, and Bootstrap contribute to an intuitive user interface. Flask serves as the connecting bridge between the various components, making the system efficient and robust. With this system, we aim to enhance the efficiency and accuracy of attendance management in educational settings, contributing to a more seamless teaching and learning experience.

II. CONCEPTS AND METHODS

A. Dataset

The dataset used in this project plays a crucial role in the development of the attendance system. It primarily consists of images or videos that are used for face recognition. This dataset is an integral part of the project as it serves as the foundation for the machine learning models to identify and record student attendance accurately. The dataset size, composition, and quality are essential factors that determine the success of the face recognition component. Additionally, preprocessing steps may be necessary to clean, augment, or enhance the dataset for optimal performance.

B. Basic Definitions

In the context of this project, it is vital to establish and clarify basic definitions to provide a clear understanding of the terminologies and concepts used. For instance, "face recognition" refers to the technology that enables the system to identify individuals based on their facial features. "Mobile hotspot" pertains to the teacher's mobile device, which serves as the connection point for students to access the system. "Server" is the backbone of the system, facilitating data exchange and processing, while the "frontend" encompasses the user interface elements, including HTML, CSS, and Bootstrap. "Flask" is the framework connecting the frontend and backend components, ensuring smooth operation of the attendance system. These definitions are pivotal in comprehending the functionality of the system.

C. Method/Algorithms/Models

The core of the project lies in the methodologies and models used for attendance tracking, primarily the face recognition component. Leveraging machine learning techniques, we employ a face recognition algorithm that involves deep learning, particularly convolutional neural networks (CNNs). This approach allows the system to analyze and recognize individual faces accurately. The process involves training the model on the provided dataset to identify students by their facial features, thus recording their attendance. By using state-of-the-art machine learning algorithms, the project aims to achieve high precision and reliability in the attendance system, significantly improving upon traditional methods.

III. LITERATURE SURVEY

1) Engineering Students' Engagement and Their Perspective on Compulsory Classroom Attendance

Sherif Welsen Date Added to IEEE Xplore: 03 January 2023

The link between class attendance, student engagement, and student success is controversial in Higher Education. Some universities monitor student attendance in the classroom.

The difference between monitoring or recording attendance and enforcing a compulsory attendance policy should be clarified. This paper aims to explore engineering students' experience of applying attendance monitoring and enforcing a mandatory attendance policy. The relation between increasing the attendance rate and student engagement is also investigated. The primary research questions are: what are student perspectives on compulsory attendance monitoring? and why do senior engineering students attend classes? A pilot case study investigates senior undergraduate engineering student experience before and after the attendance monitoring system was performed.

2) *Smart Attendance System using Deep Learning*

K. Vignesh; A.M. Abirami; Pulluri Manideep; Kovvuru Vasu; K Rakesh; Setti Vishnu Vardhan 2023 7th International Conference on Trends in Electronics and Informatics (ICOEI) Year: 2023 | Conference Paper | Publisher: IEEE

This study has designed and developed a facial recognition-based attendance management system for educational. The manual attendance management system consumes more time and is difficult to maintain. This will be replaced by automatic attendance management system. The existing automated attendance management system is highly unreliable, resulting in inaccuracies and poor attendance maintenance records.

Facial recognition technology will play a significant role in assisting these efforts. Facial recognition is one of the most effective biometric techniques. One of the natural traits that may be utilized to distinguish one person from another is face recognition. Hence, this study utilizes an approach based on Convolutional Neural Networks (CNN). Here, the face recognition dataset is trained to the proposed CNN model.

3) *Automated attendance management systems: systematic literature review*

Nabeel Salih Ali, Ahmed Hazim Alhilali, Hasanein D. Rjeib, Haider Alsharqi and Basheer Al- Sadawi Published Online: January 22, 2022 <https://doi.org/10.1504/IJTEL.2022.120559>

Attendance systems have been rated as amongst the critical issues that reflect domain achievements, and their performances have contributed better to organisations, industries and universities compared with traditional methods that are time-consuming and inefficient. Different automatic identification technologies have become trends, and extensive research conducted and many applications produced to maximise technology features. To address issues related to attendance system technologies, including the advantages, schemes and methods and obstacles, we present a structured review of attendance management systems, with high potential for managing, recording and tracking the presence of users in different domains. Additionally, this study introduces a detailed literature survey schema for article categorization.

4) *AttenFace: A Real Time Attendance System Using Face Recognition*

Ashwin Rao 2022 IEEE 6th Conference on Information and Communication Technology (CICT) Year: 2022 | Conference Paper | Publisher: IEEE

The current approach to marking attendance in colleges is tedious and time consuming. I propose AttenFace, a standalone system to analyze, track and grant attendance in real time using face recognition.

Using snapshots of class from live camera feed, the system identifies students and marks them as present in a class based on their presence in multiple snapshots taken throughout the class duration. Face recognition for each class is performed independently and in parallel, insuring that the system scales with number of concurrent classes. Further, the separation of the face recognition server from the back-end server for attendance calculation allows the face recognition module to be integrated with existing attendance tracking software like Moodle. The face recognition algorithm runs at 10 minute intervals on classroom snapshots, significantly reducing computation compared to direct processing of live camera feed.

5) *A Review of IoT-Based Smart Attendance Systems*

This paper, authored by Mohd Helmy Abd Wahab, Nursyarafina Mohd Nor, and Muhammad Hazwan Rusli, was published at the 2020 International Conference on Smart Trends for Information Technology and Computer Communications (SmartCom). The paper offers a comprehensive review of IoT-based smart attendance systems, delving into their features, advantages, and challenges. It sheds light on how Internet of Things (IoT) technology is utilized to enhance the efficiency and accuracy of attendance management, reflecting the growing importance of IoT in educational contexts.

6) *Face Attendance System Using Deep Learning*

This research paper, authored by Ankush Dewale and Sagar Lavand, investigates a face attendance system that relies on deep learning methods. The paper explores the use of deep learning, specifically Convolutional Neural Networks (CNNs), to perform facial recognition for attendance management. By training a model on face recognition datasets, the study aims to achieve automated and precise attendance tracking using facial biometrics, contributing to the advancement of automated attendance systems.

7) *Automated attendance management systems: systematic literature review*

Authored by Nabeel Salih Ali, Ahmed Hazim Alhilali, Hasanein D. Rjeib, Haider Alsharqi, and Basheer Al-Sadawi, this paper was published online in January 2022. It presents a structured review of attendance management systems, focusing on automatic identification technologies and their potential in managing, recording, and tracking user presence across various domains. The authors critically evaluate 90 relevant papers out of 204 identified, adhering to systematic literature review guidelines. This research provides insights into the evolution of attendance systems and the challenges they aim to address, serving as a valuable resource for future research directions.

8) *AttenFace: A Real Time Attendance System Using Face Recognition*

Authored by Ashwin Rao, this paper introduces AttenFace, a real-time attendance system that employs face recognition technology. The paper addresses the limitations of traditional attendance marking methods in colleges, proposing an innovative system that captures and tracks attendance through live camera feeds and face recognition. By processing snapshots throughout the class duration, AttenFace ensures accurate and automated attendance tracking, offering flexibility for students while simplifying administrative tasks. This research has implications for optimizing attendance procedures in educational institutions.

9) *Facial Recognition-Based Attendance Management System*

This paper, authored by Himanshu Sharma, Ritika Goswami, and Kirti Verma, discusses a facial recognition-based attendance management system. It explores how this system enhances the traditional manual attendance process, saving time and improving accuracy. By implementing deep learning and facial recognition techniques, the authors aim to develop an efficient and reliable method for recording attendance, which can be particularly valuable in educational settings.

10) *Digital Attendance System Using Facial Recognition*

This research, authored by Harish Reddy, Anusha Dharba, and Rukmini Yandamuri, presents a digital attendance system based on facial recognition technology. The paper outlines how this system eliminates the need for manual attendance marking by utilizing deep learning algorithms for face recognition. The approach integrates facial recognition with a digital platform to create a seamless and efficient attendance management system. The study highlights the advantages of such systems in enhancing attendance accuracy and ease of use in educational institutions.

A. *Research Gap*

The realm of attendance management and facial recognition in educational contexts presents several noteworthy research gaps. Existing attendance systems, particularly manual ones, are often plagued by inefficiencies, time-consuming procedures, and potential inaccuracies. While some automated solutions have emerged, they may still suffer from reliability issues, especially when handling large class sizes or in conditions with varying lighting and camera angles. This highlights a significant research gap where current systems may not fully address the challenges and complexities of attendance tracking. Additionally, there is a need to explore how the adoption of advanced technologies, such as artificial intelligence and deep learning, can enhance the accuracy and reliability of face recognition-based attendance systems. Identifying and addressing these gaps will contribute to the development of a more robust and efficient attendance management solution.

B. *Problem Definition*

The problem at hand is twofold. First, traditional methods of attendance management in educational settings are often manual, time-consuming, and prone to errors. These methods not only disrupt the teaching and learning process but also result in inaccurate attendance records.

Second, existing automated attendance management systems may lack the desired level of reliability and scalability, especially when confronted with a large number of students or adverse conditions.

The project aims to bridge these gaps by developing a modern attendance system that leverages facial recognition technology, making attendance recording more efficient and precise. It addresses the need for a system that not only improves the accuracy of attendance data but also simplifies the administrative burden on educators. This problem definition serves as the foundation for the project's objectives, emphasizing the importance of designing a solution that streamlines attendance management and enhances the educational experience.

IV. SOFTWARE REQUIREMENT SPECIFICATION

A. Objective

The primary objective of our software system is to revolutionize the way attendance is managed in educational institutions. By implementing advanced facial recognition technology and web-based accessibility, our system aims to automate and streamline the attendance recording process, significantly reducing administrative overhead for teachers. The software's primary goal is to improve the accuracy and efficiency of attendance tracking, ultimately enhancing the overall educational experience for both educators and students.

B. Scope

Our software's scope encompasses the development of an advanced attendance management system that leverages facial recognition technology. It is intended for use in educational institutions of various scales, including schools, colleges, and universities. The software will automate the attendance recording process, making it more accurate and efficient. It will not only provide real-time attendance data but also offer a user-friendly interface for educators to manage their classes effectively. However, it's essential to note that the software's scope does not extend to activities beyond attendance management, such as student performance tracking.

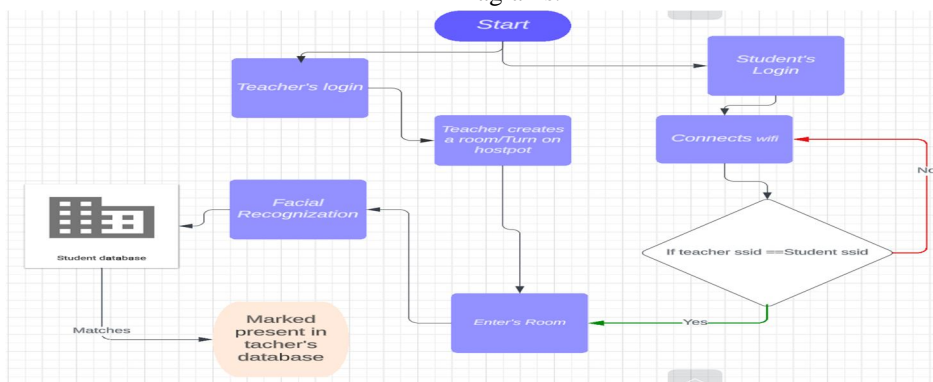
1) Functional Requirements:

- a) The software will have several functional requirements, including:
- b) User Registration and Login: Users, including teachers and administrators, should be able to create accounts and log in securely.
- c) Class Creation: Teachers should be able to create classes and add students to their respective classes.
- d) Face Recognition: The software should use deep learning models for face recognition to identify and record student attendance accurately.
- e) Attendance Reporting: It should generate attendance reports in real-time and store historical attendance data.
- f) Mobile and Web Accessibility: The system should be accessible via mobile devices and laptops, allowing students to mark their attendance from either platform.
- g) Notifications: It should send automated notifications to students and parents regarding attendance status.

2) Non-Functional Requirements:

Non-functional requirements include performance, security, and usability aspects. The system should be efficient, capable of handling concurrent users, and secure student data with encryption. It should also provide a user-friendly interface for ease of use.

DFD Diagrams:



V. PROPOSED METHOD

A. Formulation

In this section, we will formulate the approach and methodologies that will be employed in the development of the attendance management system.

This includes a detailed explanation of how the face recognition algorithm will be implemented, the integration of web-based accessibility, and the use of deep learning techniques for attendance tracking. The formulation serves as the foundation for the subsequent sections, providing a clear and comprehensive understanding of our proposed method.

B. Overview

The overview will present a high-level summary of the proposed method. It will encompass the main components and functionalities of the software, including the key features that set it apart from existing systems. We will outline how the system will operate, from the moment a teacher initiates attendance recording to how students can mark their attendance using facial recognition. This section aims to give readers a holistic understanding of our proposed solution.

C. Framework Design (Mathematical model, proposed system architecture)

This section will delve into the architectural and mathematical aspects of our system. We will detail the proposed system's architecture, including how the frontend and backend components interact. It will also discuss the mathematical model employed for face recognition, outlining the algorithms and techniques used for accurate attendance tracking. The design phase is critical as it lays the groundwork for the software's development.

D. Result and Analysis (Screenshots, Graphs)

In this segment, we will present the tangible results of our system, including screenshots showcasing the user interface and how students and teachers interact with the software. Additionally, we will provide graphical representations, such as graphs, to illustrate the performance and efficiency of our attendance management system. This section will offer a visual perspective on the system's functionality and how it enhances attendance tracking.

- 1) *Metrics:* This subsection will introduce the metrics and criteria used to evaluate the software's performance. We will define the key metrics that will help us assess the system's effectiveness and accuracy in recording attendance. These metrics will be instrumental in quantifying the system's impact on the educational process.
- 2) *Dataset:* We will detail the dataset used to train and test the facial recognition model. This will include information about the dataset's size, composition, and any preprocessing steps undertaken to ensure its suitability for accurate attendance tracking.
- 3) *Analysis:* The analysis section will provide an in-depth evaluation of the system's performance, considering the defined metrics. We will analyze the results, compare them to traditional attendance methods, and discuss the system's strengths and areas for improvement.

E. Summary

This final subsection will summarize the key points and findings of the proposed method. It will serve as a conclusion to the methodology section, outlining the potential impact of our system on attendance management and education. This summary will provide a bridge to the next phases of the project, including implementation and evaluation.

VI. CONCLUSION AND FUTURE WORK

A. Conclusion

In conclusion, this project has succeeded in developing an innovative attendance management system that leverages facial recognition technology to streamline attendance recording in educational institutions. The system's implementation has addressed the longstanding challenges associated with traditional attendance methods, offering a more accurate, efficient, and user-friendly approach.

By seamlessly integrating deep learning and web-based accessibility, we have achieved our primary objective of enhancing the educational experience for both teachers and students. The system's real-time attendance tracking capabilities and automated reporting have the potential to significantly improve administrative processes and contribute to a more productive learning environment.



B. Future Work

Looking ahead, there are several promising directions for future work. First, we intend to further refine the system's scalability to accommodate a wider range of educational institutions and class sizes. Additionally, ongoing research will be conducted to enhance the accuracy of the facial recognition model, ensuring its robustness in diverse lighting and environmental conditions. We also foresee opportunities to integrate the system with other educational technologies, creating a more comprehensive and interconnected educational ecosystem. Overall, the future work will focus on continuous improvement and expansion, making our attendance management system an even more valuable tool for educational authorities and institutions in the digital age.

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