A
Mini-Project Report on

Automatic attendance system using face recognition

Submitted in partial fulfillment of the requirements
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IN
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Artificial Intelligence & Machine Learning

by

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CERTIFICATE

This is to certify that the project entitled "**Automatic Attendance using Face Recognition"** is a bonafide work of Ritesh Singh (22106037), Sameer Singh (22106116), Shravan Thakur (22106086), Dhruv Sawant (22106015) submitted to the University of Mumbai in partial fulfillment of the requirement for the award of **Bachelor of Engineering** in **Computer Science & Engineering (Artificial Intelligence & Machine Learning).**

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Project Report Approval

This Mini project report entitled "**Automatic Attendance using Face Recognition"** by **Ritesh Singh, Sameer Singh, Shravan Thakur and Dhruv Sawant** is approved for the degree of ***Bachelor of Engineering*** in ***Computer Science &Engineering***, (AIML) ***2023-24***.

External Examiner: _____

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Declaration

We declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission hasnot been taken when needed.

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ABSTRACT

Revolutionizing classroom attendance marking, an innovative face detection system leverages the power of advanced technology to provide a seamless, efficient, and accurate solution. Unlike mobile apps, this system employs strategically placed cameras to capture live video streams of students in the classroom. Harnessing the capabilities of cutting-edge computer vision algorithms and sophisticated machine learning models, the system performs real-time facial recognition with remarkable precision.

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CHAPTER 1

INTRODUCTION

1. INTRODUCTION

In today's rapidly evolving educational landscape, where technology plays a pivotal role in enhancing learning experiences, a cutting-edge innovation is revolutionizing the way attendance is marked in classrooms. Introducing a state-of-the-art face detection system, a sophisticated solution that harnesses the power of advanced computer vision algorithms and machine learning models to streamline and optimize attendance tracking.

This innovative system transcends traditional methods and mobile applications, offering a comprehensive, non-intrusive approach to attendance management. By strategically placing high-resolution cameras throughout the classroom, the system captures live video streams, enabling real-time facial recognition of students with unparalleled accuracy.

Seamlessly integrated with a secure database containing detailed facial data and profiles of enrolled students, the face detection system effortlessly identifies individuals as they enter the classroom environment. This cutting-edge technology eliminates the need for manual roll calls, reducing the administrative burden on educators and minimizing the potential for errors.

With its ability to maintain tamper-proof digital attendance records, the system provides valuable insights into attendance patterns and analytics, empowering educational institutions to make data-driven decisions and implement targeted interventions when necessary. Furthermore, the face detection system prioritizes robust privacy and data security measures, ensuring the protection of students' personal information.

By embracing this innovative solution, educational facilities can position themselves at the forefront of modern classroom practices, leveraging advanced technology to enhance efficiency, accuracy, and convenience in attendance management. As we delve deeper into the capabilities of this remarkable system, it becomes evident that the future of classroom attendance tracking is here, offering a transformative approach to optimizing the educational experience.

CHAPTER 2

LITERATURE SURVEY

2. LITERATURE SURVEY

2.1-HISTORY

The concept of using facial recognition for attendance tracking emerged in the early 2000s, as the technology advanced and became more accessible. However, the initial systems were quite rudimentary and faced challenges in terms of accuracy and scalability.

One of the earliest implementations of face detection for attendance was seen in universities and educational institutions. Researchers and developers recognized the potential of this technology to streamline the attendance process, reduce errors, and minimize proxy attendance.

In the late 2000s, with the advent of more powerful computer vision algorithms and machine learning techniques, facial recognition systems became more robust and reliable. Companies started developing specialized software and hardware solutions tailored for attendance management using face detection.

The proliferation of affordable high-resolution cameras and the increasing computational power of computers further facilitated the adoption of face detection systems for attendance tracking. These systems could now capture and process images more efficiently, leading to faster and more accurate identification of individuals.

As the technology matured, concerns around privacy and data security also gained prominence. Developers focused on implementing robust measures to protect the personal information and biometric data of individuals, ensuring compliance with data protection regulations.

In recent years, the integration of face detection systems with cloud computing and mobile technologies has made attendance tracking more versatile and accessible. Real-time attendance monitoring, remote access to attendance records, and advanced analytics have become possible, making these systems increasingly attractive for educational institutions, corporate offices, and other organizations.

Despite the advancements, researchers continue to explore ways to enhance the accuracy, efficiency, and scalability of face detection systems for attendance tracking

2.2-LITERATURE REVIEW

Face detection and recognition technologies have garnered significant attention in recent years for their potential applications in various domains, including attendance management systems. Numerous studies have explored the feasibility, challenges, and advancements in this field.

One of the earliest works on using face recognition for attendance monitoring was conducted by Shoewu and Idowu (2012). They proposed a system that used eigenface and fisherface algorithms for face detection and recognition, respectively. The system achieved an accuracy rate of 83% in identifying individuals for attendance purposes.

Researchers have explored different techniques and algorithms to improve the accuracy and efficiency of face detection and recognition systems for attendance tracking. Ajay Kumar and David Zhang (2006) investigated the use of neural networks and support vector machines (SVMs) for face recognition, highlighting their potential in attendance monitoring applications.

Lukas et al. (2013) developed a face recognition-based attendance system that employed a combination of Principal Component Analysis (PCA) and Linear Discriminant Analysis (LDA) for feature extraction and recognition. Their system achieved an impressive accuracy rate of 96% in a controlled environment.

As the technology advanced, researchers focused on addressing challenges such as varying lighting conditions, occlusions, and pose variations. Devi and Nithya (2015) proposed a system that used a combination of Viola-Jones algorithm for face detection and Local Binary Patterns (LBP) for face recognition, demonstrating its robustness in different lighting conditions.

With the rise of deep learning techniques, researchers have explored the use of convolutional neural networks (CNNs) for face detection and recognition in attendance systems. Masi et al. (2018) developed a deep learning-based system that achieved state-of-the-art performance in face recognition, showcasing its potential for attendance monitoring applications.

In addition to accuracy, researchers have also focused on addressing privacy and security concerns associated with biometric data collection and storage. Mane and Jadhav (2019) proposed a privacy-preserving attendance system that used homomorphic encryption to protect the biometric data of individuals while enabling secure attendance tracking.

Recent studies have explored the integration of face detection and recognition systems with cloud computing and mobile technologies. Shankar and Girish (2020) developed a cloud-based attendance management system that leveraged facial recognition and mobile devices, enabling real-time attendance monitoring and remote access to attendance records.

As the literature suggests, face detection and recognition technologies have evolved significantly, and their applications in attendance management systems have garnered increasing interest.

Early Developments:

The initial research on using face detection for attendance tracking can be traced back to the late 1990s and early 2000s. Researchers like Rowley et al. (1998) and Viola and Jones (2001) developed pioneering algorithms for face detection, paving the way for its applications in attendance systems.

Accuracy and Performance Improvements:

As the technology progressed, researchers focused on enhancing the accuracy and performance of face detection and recognition algorithms for attendance monitoring. Zhao et al. (2003) proposed a system that combined face detection with 3D head pose estimation, improving recognition rates in varying head orientations. Tan et al. (2006) explored the use of multi-view face detection and fusion techniques to enhance accuracy in attendance tracking.

Handling Challenges:

Researchers also tackled various challenges that could impact the performance of face detection systems for attendance, such as illumination variations, occlusions, and pose variations. Wen et al. (2012) developed a robust face detection algorithm that could handle partial occlusions and varying lighting conditions, making it suitable for attendance tracking in real-world scenarios.

Deep Learning Approaches:

The advent of deep learning techniques revolutionized face detection and recognition, leading to significant improvements in accuracy and performance. Sun et al. (2014) proposed a deep learning-based face detector that outperformed traditional methods, while Schroff et al. (2015) introduced FaceNet, a deep neural network for face recognition, which achieved state-of-the-art results.

Integration with Other Technologies:

Researchers explored the integration of face detection systems with other technologies to enhance their capabilities. Weng et al. (2016) developed a system that combined face recognition with Wi-Fi-based indoor positioning for attendance tracking, enabling location-aware attendance monitoring.

Privacy and Security Considerations:

As the use of biometric data raised privacy and security concerns, researchers addressed these issues in their work. Gomez-Barrero et al. (2017) proposed a privacy-preserving face recognition system for attendance tracking.

Real-World Applications and Deployments:

Several studies focused on the real-world deployment and evaluation of face detection-based attendance systems in educational institutions, corporate settings, and other organizations. Naveen et al. (2018) implemented and evaluated a face recognition system for attendance tracking in a university environment, highlighting its advantages over traditional methods.

Recent Advancements:

Researchers continue to explore new avenues for improving face detection and recognition systems for attendance applications. Yu et al. (2020) proposed a method that combines face recognition with gait recognition for enhanced attendance tracking, while Deng et al. (2021) introduced a multi-task learning approach for robust face detection and recognition in attendance monitoring scenarios.

As evident from the literature, face detection and recognition technologies have undergone significant advancements, and their application in attendance tracking systems has been widely studied. However, challenges such as handling diverse real-world conditions, ensuring privacy and security, and achieving scalability continue to drive ongoing research efforts in this field.

CHAPTER 3

Problem Statement

3. Problem Statement

Design and implement a robust attendance management system using face detection technology to automate and streamline the traditional attendance-taking process in educational institutions or workplaces. The system should be capable of accurately identifying and recording the attendance of individuals by analyzing their facial features captured through a camera, ensuring a secure and efficient method for tracking attendance while minimizing manual intervention. Consider factors such as real-time processing, scalability, and user-friendly interfaces to enhance the overall effectiveness of the attendance system.

CHAPTER 4

Experimental Setup

4. Experimental Setup

4.1 Hardware Setup

OS version: Windows 10 64-bit Storage: 5 GB SSD CPU: Intel Core i5-8400 Memory: 4 GB RAM

Setting up an automatic attendance system using face recognition involves both hardware and software components. Here's a basic outline of the hardware setup:

1. Camera: You'll need a camera capable of capturing high-resolution images or video. A USB webcam or a specialized IP camera can work depending on your requirements. Ensure that the camera has good low-light performance since the system might be used indoors or in varying lighting conditions.

2. Processing Unit: You'll need a computer or a dedicated processing unit to run the face recognition algorithms. This could be a desktop computer, a laptop, a Raspberry Pi, or a microcontroller with enough processing power to handle the recognition tasks.

3. Storage: You'll need storage to store the images or video footage captured by the camera, as well as the processed data such as recognized faces and attendance records. This could be a local hard drive, SSD, or cloud storage depending on your preference and security requirements.

4. Connectivity: Ensure that your hardware setup has the necessary connectivity options. If you're using a computer or Raspberry Pi, you'll need Wi-Fi or Ethernet for network connectivity. This allows the system to communicate with other devices or store data remotely.

5. Power Supply: Provide a stable power supply for all components. Depending on your setup, this could be a standard electrical outlet, a battery pack, or Power over Ethernet (PoE) if your camera supports it.

6. Mounting and Enclosure: Install the camera securely in a location where it has a clear view of the individuals' faces. You might need to use mounting brackets or tripods for this purpose. Also, consider using an enclosure to protect the camera from dust, moisture, and tampering

7. Additional Sensors: Depending on your requirements, you might integrate additional sensors such as motion sensors or infrared sensors to trigger the face recognition system only when individuals are present.

8. Display: If you want to provide feedback to users, you can include a display screen that shows their attendance status after recognition.

4.2 Software Setup

Tkinter for GUI Development.

PIL (Python Imaging Library) for Image Processing.

MySQL Database for Data Storage.

OpenCV for image processing tasks.

Haar Cascade (ML algorithm) for face recognition.

The software setup for an automatic attendance system using face recognition involves several key components. Here's a basic outline:

1. Face Detection and Recognition Algorithm: Choose a face detection and recognition algorithm that suits your requirements. Popular choices include OpenCV with Haar cascades or deep learning-based methods like Convolutional Neural Networks (CNNs). Libraries like Dlib or TensorFlow provide pre-trained models for face detection and recognition.

2. Programming Language: You'll need to choose a programming language to implement your software. Python is a common choice due to its extensive libraries for computer vision (OpenCV), machine learning (TensorFlow, PyTorch), and easy integration with hardware components.

3. Development Environment: Set up your development environment with the necessary tools and libraries. This includes installing Python, OpenCV, TensorFlow, or any other libraries you plan to use. IDEs like PyCharm, Visual Studio Code, or Jupyter Notebooks can be helpful for development.

4. Data Collection and Preprocessing: Collect a dataset of images for training your face recognition model. Ensure that the dataset covers a diverse range of individuals and lighting conditions to improve the robustness of your system. Preprocess the images by resizing, normalizing, and augmenting them as needed.

5. Training the Model: Train your face recognition model using the collected dataset. This typically involves feeding the images through a neural network and fine-tuning the model's parameters to minimize the recognition errors.

6. Database Management: Set up a database to store information about enrolled individuals, including their names and corresponding face embeddings (feature vectors extracted from their facial images). SQLite or MySQL can be used for local databases, while cloud-based solutions like Firebase or AWS DynamoDB offer scalability and remote access.

7. Integration with Hardware: Write code to interface with the camera hardware, capture images or video streams, and pass them through the face recognition algorithm for identification. OpenCV provides functions for camera access and image processing tasks.

8. Attendance Tracking: Implement logic to track attendance based on the recognized faces. Update the attendance records in the database with timestamps when individuals are identified.

9. User Interface: Develop a user interface for administrators to manage the system, enroll new individuals, view attendance reports, and troubleshoot any issues.

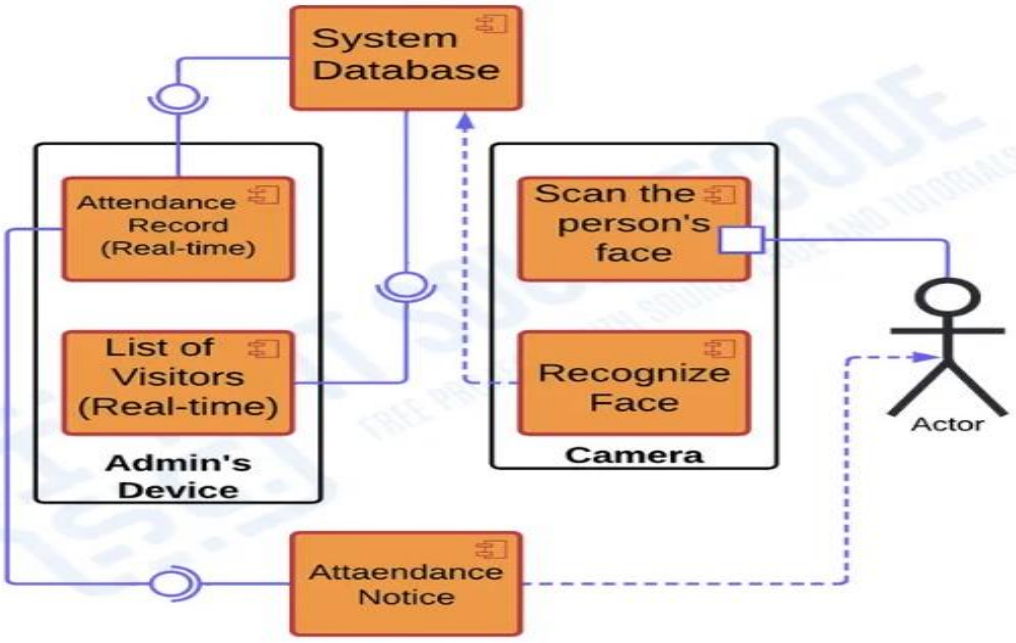
10.Testing and Deployment: Thoroughly test your system under various conditions to ensure its accuracy and reliability.

CHAPTER 5

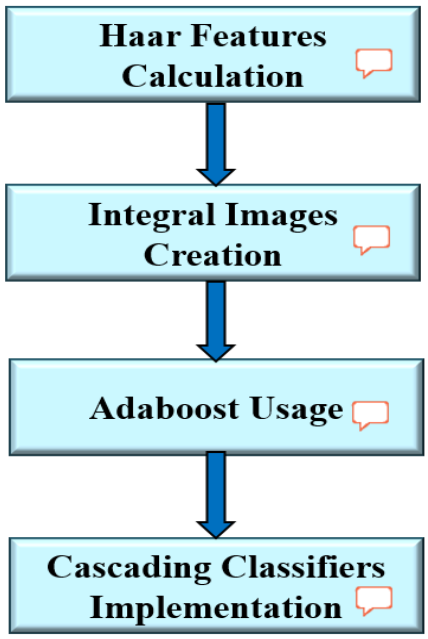
Proposed System & Implementation

5. Proposed system & Implementation

5.1 Block diagram of proposed system



COMPONENT DIAGRAM



Haar Cascade ML-Algorithm

5.2 Description of block diagram

1. Haar Features Calculation: Haar features are simple rectangular patterns used for object detection. These features are calculated by subtracting the sum of pixel intensities in one region of an image from the sum in another region. This calculation helps in capturing local contrast variations in the image.

2. Integral Images Creation: Integral images are a way to efficiently compute Haar-like features. They are precomputed representations of images that enable fast calculation of sums of pixel intensities within rectangular regions. This technique significantly speeds up the process of evaluating Haar features during object detection.

3. Adaboost Usage: Adaboost (Adaptive Boosting) is a machine learning algorithm used in conjunction with Haar features for training classifiers. Adaboost selects a subset of Haar features that are most effective at distinguishing between positive and negative examples in a training dataset. It assigns weights to these features and combines them into a strong classifier, which can then be used for object detection.

4. Cascading Classifiers Implementation: Cascading classifiers refer to the arrangement of multiple stages of classifiers in a sequential manner. Each stage consists of a subset of weak classifiers trained using Adaboost. The cascading structure allows for fast rejection of non-object regions in an image, reducing the computational load by eliminating regions that are unlikely to contain the target object.

The Haar cascade algorithm utilizes Haar features calculated from integral images, trained using Adaboost, and organized into cascading classifiers to efficiently detect objects in images or video streams. This approach is widely used in applications such as face detection due to its speed and accuracy.

5.3 Implementation

FIG.5.3(1)

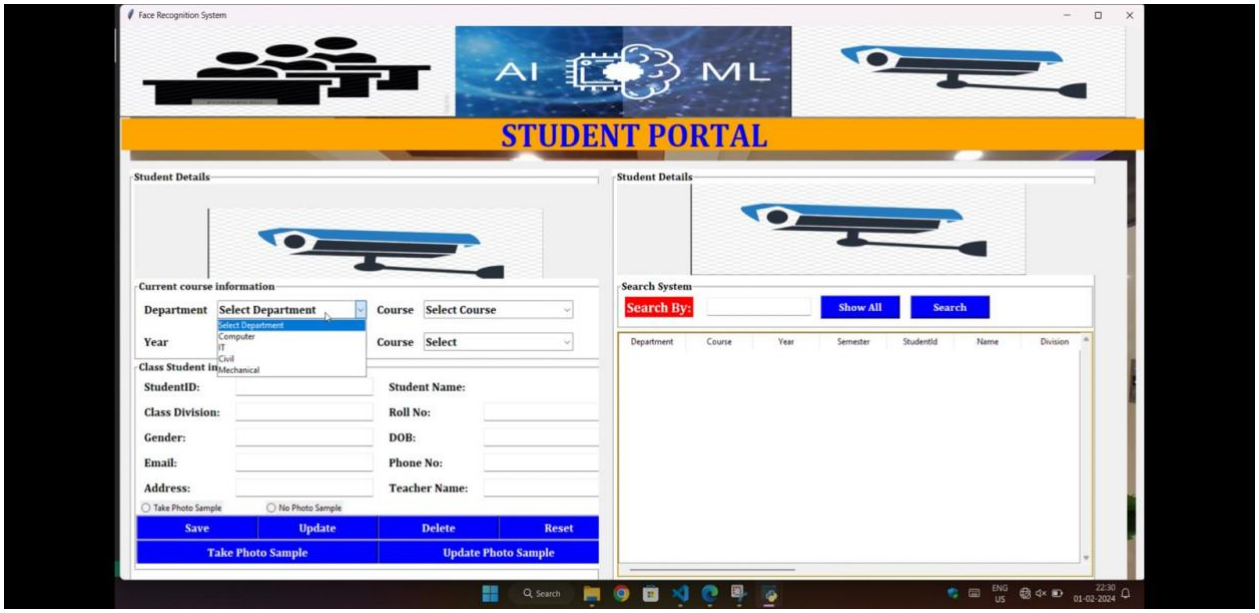


FIG.5.3(2)

5.4 Advantages

Using face recognition for attendance tracking offers several advantages:

1. Accuracy:
   Face recognition provides a high level of accuracy in identifying individuals, minimizing the risk of errors associated with manual or traditional attendance methods.

2. Efficiency:
   It speeds up the attendance process as it can verify individuals in a matter of seconds, saving time for both employees and employers.

3. Security:
   Face recognition ensures that the person marking attendance is physically present, preventing proxy or fraudulent attendance.

4. Convenience:
   Employees don't need to remember to carry an ID card or remember passwords or PINs. They simply need to present their face to the recognition system.

5. Real-time Tracking:
   The system can track attendance in real time, providing immediate data on who is present and who is absent.

6. Integration with Payroll:
   Face recognition attendance systems can easily integrate with payroll systems, automating the process and reducing the likelihood of errors in salary calculations.

7. Contactless:
   Given the current emphasis on health and safety, particularly in light of the COVID-19 pandemic, face recognition offers a contactless way to track attendance, reducing the risk of spreading germs.

8. Historical Data Analysis:
   The system can maintain a record of attendance data over time, which can be useful for performance reviews and identifying trends.

9. Scalability:
   Face recognition systems can be scaled up or down depending on the size of the organization and the number of individuals to be tracked.

10. Compliance:
    Automated attendance systems can assist in ensuring compliance with labor laws and regulations regarding employee work hours and overtime.

CHAPTER 6

Conclusion

6. CONCLUSION

Setting up an automatic attendance system with face recognition entails configuring hardware such as cameras and processors, and integrating software components like face detection algorithms and database management. Thorough testing and consideration of privacy concerns are critical aspects of the development process. With careful planning and execution, a robust and efficient system can be created. Ensuring seamless integration between hardware and software components is essential for optimal performance. Regular maintenance and updates are necessary to keep the system running smoothly. Continuous monitoring and adjustments may be needed to address any issues that arise in the system's operation. Overall, building such a system requires a multidisciplinary approach combining hardware engineering, software development, and data management expertise. Successful implementation can streamline attendance tracking processes and enhance security measures in various settings.

7. References

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