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Project Proposal

AttendanceEye
A Computer Vision Attendance System

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Abstract

The accurate tracking of employee attendance is paramount in organizational operations, ensuring fairness in compensation and accountability for workforce engagement. Traditional attendance methods, such as fingerprint scanning and eye scans, have faced hygiene and discomfort challenges, which have been exacerbated by the COVID-19 pandemic. To address these issues and enhance attendance management, our project introduces an innovative and cost-effective solution based on Computer Vision powered facial recognition technology. We set out with the purpose of revolutionizing attendance tracking, making it more efficient and convenient for organizations. By capturing individuals' images and cross-referencing them with a comprehensive database, our system ensures accuracy and provides an affordable alternative for small-scale businesses. Through the development of a real-world metal gate used as part of the test bed for assessing the face recognition attendance system, we learned that our technology-driven system outperforms traditional methods. In conclusion, our research underscores the importance of embracing modern, accessible, and hygienic attendance solutions, ultimately contributing to the efficiency and success of organizations.

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Introduction:

In the dynamic landscape of organizational management, the tracking of employee attendance emerges as a fundamental and strategic function. The precise monitoring of employees' presence not only safeguards the principles of equitable compensation but also serves as a pivotal indicator of their commitment to fulfilling job obligations. Central to this attendance management process is the meticulous maintenance of accurate attendance records for every individual. However, this administrative task often proves to be laborious and time-intensive, prompting an increasing number of enterprises to seek solace in the realm of automated attendance solutions.

In response to the evolving demands of modern workplaces, a remarkable solution has gained prominence, harnessing the capabilities of cutting-edge technology. This solution involves the integration of artificial intelligence (AI) and camera-based automation to revolutionize the traditional concept of attendance tracking. By harnessing the power of Computer Vision, this innovative approach presents a transformative shift in how employee attendance is managed and monitored. By delving into the nuances of this Computer Vision-driven attendance automation, we can uncover its mechanisms, benefits, and implications for the realm of workforce management.

Computer Vision-driven attendance automation presents a multitude of advantages compared to conventional methods of attendance tracking. Traditional approaches, such as manual timesheets, are known to be both time-consuming and susceptible to errors. In contrast, AI-driven attendance automation offers significantly enhanced speed and accuracy. Furthermore, Computer Vision-based attendance automation exhibits superior scalability. The utilization of fingerprints may raise hygiene concerns, and eye scanners, given the direct laser exposure to the eye, can be potentially discomforting. Conversely, AI-driven attendance automation provides a notably more straightforward scalability solution, as it can be seamlessly implemented in workplaces of varying sizes, contingent upon the availability of adequate resources.

Objectives:

1. Automated Attendance: This includes eliminating the need for manual data entry and paperwork. Implement an automated attendance recording process that saves time for both attendees and administrators. Ensure that the face attendance system is user-friendly and convenient for attendees. This includes easy enrollment and a seamless, non-intrusive attendance-checking process. Simplify attendance record keeping by providing long-term storage and easy retrieval of attendance records for historical reference.

2. Minimizing Human Error: This approach not only diminishes the probability of errors and inaccuracies inherent in manual methods (human error) but also promotes environmental sustainability by curtailing paper consumption through the substitution of paper-based attendance sheets.

3. Automated Image Capture: The system incorporates face detection capabilities through a camera at the entry gate, automatically capturing images of individuals as they approach.

4. Visual Verification: Using computer vision and a database of registered employees' images, the system performs face recognition to verify the identity of the person. Successful recognition is indicated by a green light.

5. Real-world Testing Environment: To ensure the system's reliability and effectiveness, a real-world test bed shown in (**[fig 1]**) will be established at the entry gate. It allows for practical testing and validation of the face detection and recognition components in a live operational setting.

6. Facial Data Collection: We shall engage in the acquisition of facial images from students at Fast University for the purpose of augmenting our facial recognition system. It is pertinent to emphasize that we currently lack access to datasets comprising Indian or Pakistani students. Hence, our project endeavors to establish a fundamental dataset that can serve as an essential resource for subsequent researchers wishing to extend their investigations within this field.

Scope:

1. Limited to only Ideal Lighting Conditions: The system will be designed and optimized to work efficiently under ideal lighting conditions. It may not provide reliable results in extreme lighting conditions, such as very low light or harsh direct sunlight.

2. Strict Face Visibility: The system will be configured to recognize faces that are not overlapped or obscured in any way. Attendees must present their faces clearly and without any obstructions for the system to register their attendance.

3. Exclusion of Caps: Attendees will not be allowed to wear caps or headgear that obscures their facial features during the attendance check.

4. Absence of Liveness Detection: The system will not include liveness detection mechanisms to verify that the presented face is from a living person. It will solely focus on facial recognition based on static images.

5. Profile View Requirement: The system will be designed to work specifically with frontal or near-frontal views of faces. Attendees will need to present their faces directly to the camera without significant tilting or turning. The system will not be optimized to recognize faces from side or 3/4th views.

6. Exclusion of Real-time Attendance Tracking: The system will not offer real-time attendance tracking capabilities, allowing for immediate identification of attendees and absentees during the event or class.

7. Efficiency and User-friendliness: User convenience and efficient attendance recording will be prioritized in the system's design. The user interface should be straightforward and non-intrusive.

8. Potential for Future Data Insights: While the current project focuses on automating attendance recording and access control, the system's architecture and data capture capabilities lay the foundation for future exploration of attendance insights. These insights, derived from the system's online data, have the potential to inform strategic decisions, enhance operational efficiency, and optimize resource allocation, but their development and implementation will not be considered as project's scope.

Literature review:

[1] Optimizing Face Recognition Inference with a Collaborative Edge–Cloud Network (Nov 2022)

- combining the edge and cloud is an effective way to accelerate the inference process
- Implemented MTCNN consisting of P-net, R-net, and O-net and trained it using randomly cropped patches from WIDER FACE dataset for positives, negatives, and part face with additional data from cropped faces from the CelebA dataset and the Python face recognition library, Dlib-m
- Support vector machine (SVM) is used for classification problems.
- a feed-forward algorithm, a multilayer perceptron (MLP) for classification problems

[2] A Literature Review on Smart Attendance Systems (July 2022)

- Used the Local Binary Pattern Histogram (LBPH), Open CV
- Used d NVIDIA's Jetson Nano
- Android Face Recognition with Deep Learning approach

[3] YOLO-face: a real-time face detector (March 2020)

- Used modified version of Yolo V3.
- Modified version of darknet-53 as the backbone of Yolo V3.
- Used 3 different anchor boxes.
- Used a modified version of loss function.

[4] Real Time Automatic Attendance System for Face Recognition (March 2020)

- Used Yolo V3 and Azure API
- First detect faces and then do facial recognition.
- Used spreadsheet to register attendance of registered and non registered students.

[5] Online Attendance System (2017)

- After faces have been extracted, they are compared with an existing database of images and on successful recognition an attendance list is saved.
- The FDF includes four directional(vertical, horizontal, and both diagonals) features of the input image.
- One fast face detection based on optimized Ada Boost algorithm with high speed and high detection rate, second the SOC hardware framework to speed up detection operations and third software distribution strategy to optimize the memory sub-system.

- Skin color detection, morphology,Fast connected-component labeling algorithm, Implementation of the Fast connected component labeling algorithm, Horizontal edge detection.
- The classifier works by training a model using positive face images and negative face images
- (Pyfaces - http://pyfaces.blogspot.com/) which takes advantage of eigenfaces to identify a face.
- Works on only frontal images.
- Multiple images of the same person with time.On each consequent scan of a student, the recognition module starts comparing images from the database, sorted by date in descending order.
- Unidentified faces and the teacher is able to manually connect a captured face with a student from the list.

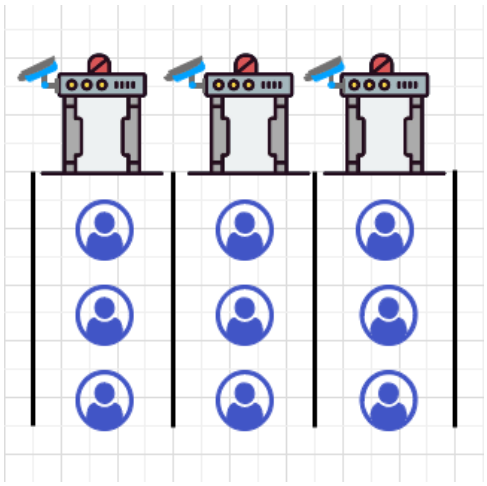
Methodology:

Design Phase:

In the Design Phase, an Agile methodology will steer the creation of a system-based attendance management application and database. Adhering to the SDLC Cycle, meticulous requirements analysis will focus on core functions such as facial detection and recognition. The application will be responsible for capturing facial input from strategically placed cameras atop metal gates. This facial data will be securely transmitted to the application, which will house the Facial Recognition Computer Vision Algorithm. The algorithm will cross-reference the input with the database to determine user existence. This phase, characterized by iterative development, will lay the foundation for subsequent stages.

Setup Configuration: Three-Lane Testbed:

In the setup configuration, the project entails the establishment of a three-lane testbed shown in [fig 1]. Each lane within the testbed is equipped with a dedicated camera system, designed to facilitate the detection and recognition of individuals. Notably, the system is tailored to recognize one person at a time, with the individual standing in the first position of each respective lane. This configuration allows for parallel processing and evaluation of the system's capabilities across multiple lanes, ensuring its efficiency and accuracy in various real-world scenarios.



[Fig 1. Test Bed]

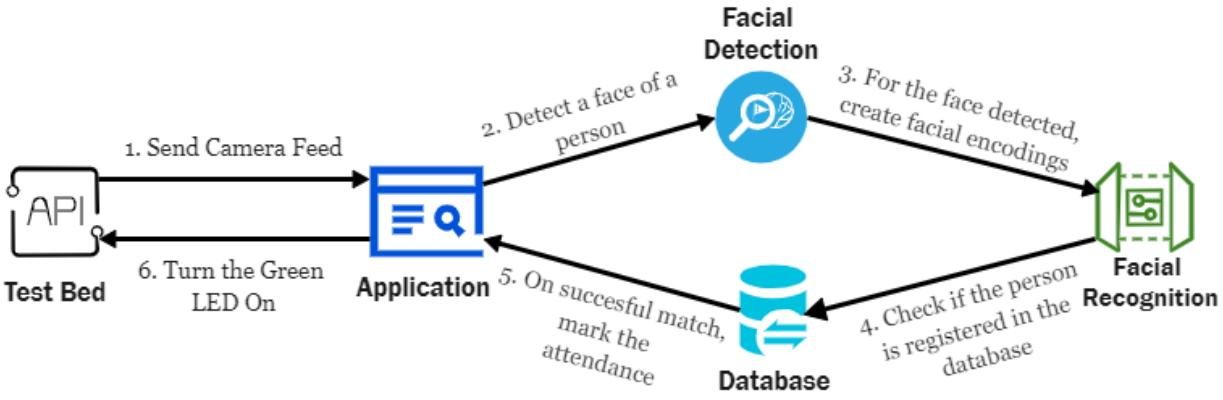
Implementation Phase:

During the Implementation Phase, Agile practices and sprints will play a pivotal role in enabling iterative development of the system. In parallel with design insights, the interface will be

meticulously crafted to encompass user-friendly features, including the capability for administrators to register users. During the dataset collection phase, we shall meticulously acquire facial images from a diverse group of students enrolled at Fast University. We will capture individual facial images sequentially, one at a time, to ensure the precision and accuracy of our dataset.

The application component, at the heart of which lies a robust MongoDB database, will be realized as a facial recognition application. This application will seamlessly integrate facial detection and recognition capabilities, harnessing a fusion of cutting-edge technologies such as facial encodings, machine learning, or deep learning algorithms. First we will detect the face by using the facial detection module using Histogram of Oriented Gradients (HOG). After detecting faces, the system locates specific facial landmarks, such as the eyes, nose, and mouth, using a method called face landmark estimation. This step helps align the faces and make them consistent for comparison. These facial embeddings represent unique features of the face and are used for recognition. Finally, the application will conduct a real-time comparison between the image currently captured by the camera and the stored facial embeddings. In the event of a successful match, the system will proceed to record the attendance of the identified user.

These components will work collaboratively, orchestrating the capture of facial input, the application of recognition algorithms, and the comparison of results against the registered user database. [fig 2] With each sprint, incremental progress and refinement aligned with the Software Development Life Cycle (SDLC) will pave the way for a robust and user-centric system.



[Fig 2. Sequence Diagram]

Expected Outcome:

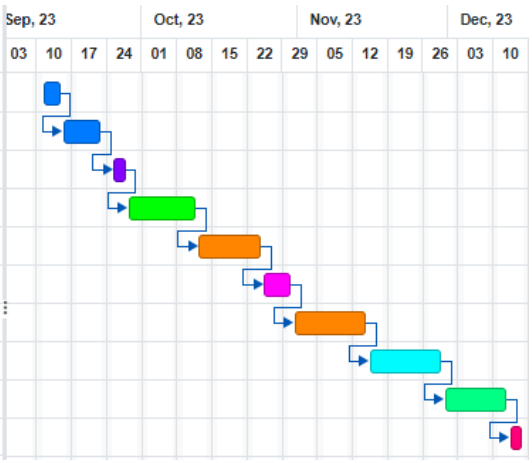
The expected outcome involves the implementation of a fully automated attendance marking system. It includes the use of a camera situated at the entry gate to capture an individual's image. Subsequently, advanced computer vision technology is employed, utilizing a database containing employee images. If the system successfully matches the captured image with the database, it triggers a green light, signifying successful recognition. Upon recognition, authorized employees are granted access to the building, and their attendance is automatically recorded, including the timestamp of their arrival.

Another expected outcome is the establishment of a streamlined access control process. This entails the efficient identification of registered employees through facial recognition technology. Those recognized are seamlessly granted access to the premises, reducing access bottlenecks and enhancing overall security.

As part of the expected outcomes, attendance processes are automated to eliminate manual record-keeping. The system's ability to automatically mark attendance and record arrival times contributes to a more accurate and efficient attendance tracking process, reducing administrative burdens.

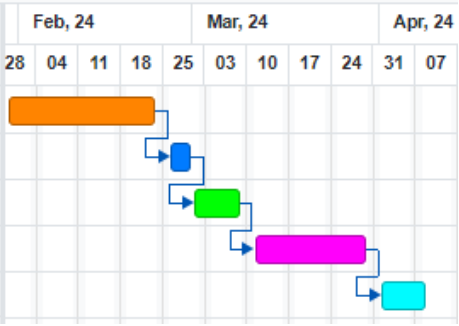
Timeline:

Name	Start Date	End Date	Duration
Project Proposal	Sep 11, 2023	Sep 14, 2023	4 days
Frontend - Skeleton	Sep 15, 2023	Sep 22, 2023	6 days
Proposal Defense	Sep 25, 2023	Sep 27, 2023	3 days
Camera Integration	Sep 28, 2023	Oct 11, 2023	10 days
Data Collection - Cleaning & Preprocessing	Oct 12, 2023	Oct 24, 2023	9 days
Mid 2	Oct 25, 2023	Oct 30, 2023	4 days
Data Collection - Clearning & Preprocessing	Oct 31, 2023	Nov 14, 2023	11 days
Frontend - Polished	Nov 15, 2023	Nov 29, 2023	11 days
Facial Detection	Nov 30, 2023	Dec 12, 2023	9 days
FYP 1 - Final Evaluation	Dec 13, 2023	Dec 15, 2023	3 days



[Fyp - 1 Timeline]

Name	Duration	Start Date	End Date
Facial Recognition	19 days	Jan 30, 2024	Feb 23, 2024
Mid 1	4 days	Feb 26, 2024	Feb 29, 2024
Database Connection	6 days	Mar 01, 2024	Mar 08, 2024
Multiple Camera Integration	15 days	Mar 11, 2024	Mar 29, 2024
Final Testing	6 days	Apr 01, 2024	Apr 08, 2024



[Fyp- 2 Rough Timeline]

Resources Required:

- Intel Core i7 with 16GB RAM
- Anaconda
- Pycharm
- Visual Studio Code
- Metal Gate
- IP Camera
- LED Lights

- Tensorflow
- Pytorch
- Python
- Javascript

Conclusion:

The implementation of a face recognition attendance system represents a transformative step towards optimizing attendance management processes. By leveraging cutting-edge computer vision technologies, this system offers a seamless and efficient means of marking attendance, enhancing accuracy, and promoting accountability. Its capabilities, coupled with user-friendly interfaces, streamline administrative tasks. With the potential to revolutionize attendance tracking, this system not only meets immediate needs but also paves the way for future advancements in biometric technology and data-driven decision-making.

References:

[1] Paul P. Oroceo,Jeong-In Kim,Ej M. Francisco, Sang-Ho Kim,Sang-Ho Kim,"Optimizing Face Recognition Inference with a Collaborative Edge–Cloud Network ",1 November 2022

[2] B.Ali Abdalkarim - "A Literature Review on Smart Attendance Systems"July 2022

[3] W.Chen, H.Huang, S.Peng, C.Zhou , C. Zhang,- "YOLO-face: a real-time face detector",March 2020

[4] S.Khan,A Akram,N. Usman, "Real Time Automatic Attendance System for Face Recognition",March 2020

[5] Dr. A. Babu Karuppiah, M. Jeyalakshmi, L. Johnsilin Shiny, B. Sri Devi,"Online Attendance System",2017