A Project Report

On

SUMMER TRAINING

At

Hindustan Aeronautics Limited
Transport Aircraft Division, Kanpur Nagar

Submitted By
ISHAN CHATURVEDI
210911312

Department of Information Technology,

Manipal Institute of Technology, Manipal

Certificate

*This is to certify that "**Face Recognition Attendance System**" is a document of work done by **Ishan Chaturvedi** fulfils the requirements of Industrial training program at **Hindustan Aeronautics Limited, Transport Aircraft Division, Kanpur** under our supervision and guidance, during the period of 12th June, 2024 to 11th July, 2024.*

Mr. Mahesh Ch. Srivastava	***Mr. Rajveer Singh***
Senior Manager (IT)	***DGM (MS, IT, Lean)***
HAL, Transport Aircraft Division	***HAL, Transport Aircraft Division***

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"Face Recognition Attendance System"*.*

Ishan Chaturvedi
210911312
MIT, Manipal

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History of HAL

HAL (Hindustan Aeronautics Limited):

Hindustan Aeronautics Limited (HAL) based in Bangalore, India, is one of Asia's largest aerospace companies. Under the management of the Indian Ministry of Defence, this state-owned company is mainly involved in aerospace industry, which includes manufacturing and assembling aircraft, navigation and related communication equipment.

HAL built the first military aircraft in South Asia and is currently involved in the design, fabrication and assembly of aircraft, jet engines, and helicopters, as well as their components and spares. It has several facilities spread across several states in India including Nasik, Korwa, Kanpur, Koraput, Lucknow, Bangalore and Hyderabad. The German engineer Kurt Tank designed the HF-24 Marut fighter-bomber, the first fighter aircraft made in India.

Hindustan Aeronautics has a long history of collaboration with several other international and domestic aerospace agencies such as Airbus, Boeing, Sukhoi Aviation Corporation etc.

History:


Seth Walchand Hirachand

Hindustan Aeronautics Limited (HAL) came into existence on 1st October 1964. The Company was formed by the merger of Hindustan Aircraft Limited with Aeronautics India Limited and Aircraft Manufacturing Depot, Kanpur.

The Company traces its roots to the pioneering efforts of an industrialist with extraordinary vision, the late Seth Walchand Hirachand, who set up Hindustan Aircraft Limited at Bangalore in association with the erstwhile princely State of Mysore in December 1940. The Government of India became a shareholder in March 1941 and took over the Management in 1942.

Today, HAL has 20 Production Division and 10 Research & Design Centres in 8 locations in India. The Company has an impressive product track record - 15 types of Aircraft/ Helicopters manufactured with in-house R & D and 14 types produced under license. HAL has manufactured over 3658 Aircraft/Helicopters, 4178 Engines, and Upgraded 272 Aircrafts and overhauled over 9643 Aircrafts and 29775 Engines.

During the 1980s, HAL's operations saw a rapid increase which resulted in the development of new indigenous aircraft such as the HAL Tejas and HAL Dhruv. HAL also developed an advanced version of the Mikoyan-Gurevich MiG-21, known as MiG-21 *Bison*, which increased its life-span by more than 20 years. HAL has also obtained several multimillion-dollar contracts from leading international aerospace firms such as Airbus, Boeing and Honeywell to manufacture aircrafts are parts and engines .

By 2012, HAL was reportedly bogged down in the details of production and had been slipping on its schedules. On 1 April 2015, HAL reconstituted its Board with TS Raju as CMD, S Subrahmanyan as Director (Operations), VM Chamola as Director (HR), CA Ramana Rao as Director (Finance) and D K Venkatesh as Director (Engineering & RnD). There are two government nominees in the board and six independent directors.

In March 2017, HAL's chairman and managing director T Suvarna Raju announced that the company had finalized plans for an indigenisation drive. The company plans to produce nearly 1, 000 military helicopters, including , LCH (Light Combat Helicopter) ALH (Advanced Light Helicopter), and over 100 planes over the next 10 years. HAL will manufacture the Kamov 226T helicopter under a joint venture agreement with Russian defence manufacturers.

The Kamov 226T will replace the country's fleet of Cheetah and Chetak helicopters. Over the next 5 years, HAL will carry out major upgrades of almost the entire fighter fleet of the Indian Air Force including Su-30MKI, Jaguars, Mirage and Hawk jets to make them "more lethal". The company will also deliver 123 Tejas Light Combat Aircraft to the IAF from 2018 to 2019, at a rate of 16 jets per year. LCH production will now take place in a newly built Light Combat Helicopter Production Hangar at Helicopter Division in HAL Complex.

Transport Aircraft Division, HAL

HAL TAD Kanpur refers to the Transport Aircraft Division (TAD) of Hindustan Aeronautics Limited (HAL) located in Kanpur, India.

The Transport Aircraft Division was established in 1960 as a part of Hindustan Aircraft Limited, which later merged with Aeronautics India Limited and Aircraft Manufacturing Depot, Kanpur to form Hindustan Aeronautics Limited (HAL) in 1964.

The TAD Kanpur is one of the major divisions of HAL and is responsible for the design, development, production, and overhaul of transport aircraft, including military transporters, trainers, and helicopters. The division has played a significant role in the development of India's aerospace industry and has contributed to the country's self-reliance in defense production.

Some of the notable projects undertaken by HAL TAD Kanpur include:

HS-748 Avro: A transport aircraft developed in collaboration with the UK-based Hawker Siddeley Aviation.

Hindustan 228: A light transport aircraft developed by HAL TAD, Kanpur.

AN-32: A medium-lift transport aircraft developed in collaboration with the Ukrainian company Antonov.

Cheetah/Chetak Helicopters: Light helicopters developed in collaboration with the French company Sud-Aviation (now Airbus Helicopters).

The TAD Kanpur has also been involved in the development of indigenous aircraft, such as the HAL HTT-40 basic trainer and the HAL LUH (Light Utility Helicopter).

Today, HAL TAD Kanpur continues to play a vital role in India's aerospace industry, with a focus on design, development, production, and overhaul of transport aircraft, helicopters, and other aerospace systems.

Abstract

This project is an Attendance Management System utilizing facial recognition technology to automate the attendance process. It employs OpenCV, an open-source computer vision library, to detect and recognize faces.

The system captures images of individuals, extracts facial features, and trains a classifier using the Local Binary Patterns Histograms (LBPH) algorithm for facial recognition.

Key Components:

- **Face Detection**: Uses Haar-cascade classifiers to detect faces.
- **Data Collection**: Captures multiple images of each individual for training.
- **Training**: Trains the LBPH recognizer with collected images to build a model for face recognition.
- **Recognition**: Identifies faces in real-time video streams and logs attendance.

The project includes a user-friendly Graphical User Interface (GUI) built with Tkinter, which allows users to easily interact with the system.

Workflow:

- **Image Capture**: During the registration phase, images of new users are captured via a webcam.
- **Feature Extraction**: The system extracts facial features and stores them in a structured format.
- **Model Training**: The LBPH algorithm is applied to train the facial recognition model using the captured images.
- **Real-time Recognition**: The system continuously monitors the video feed, recognizing faces and logging attendance in real-time.

Through the GUI, users can register new faces, train the model, and track attendance records efficiently. This integration of machine learning and computer vision technologies offers a practical and automated solution for attendance management, enhancing accuracy and reducing manual effort.

Additionally, the system is designed to ensure all necessary directories are created if they do not exist, improving robustness and user experience. The focus on reducing latency in the GUI ensures smoother performance and better real-time interaction.

Face Recognition – Computer Vision

Face Recognition – Computer Vision

Face recognition is a biometric technology that identifies individuals by analyzing and comparing their facial features. It involves capturing an image, detecting the face within it, extracting unique facial features, and matching them against a database of known faces using algorithms like Local Binary Patterns Histograms (LBPH). This technology is widely used for security, authentication, and attendance management due to its accuracy and efficiency in real-time applications.

Challenges in Face Detection and Recognition

Some challenges in face recognition include:

- **Variations in Lighting**: Changes in lighting conditions can significantly affect the appearance of a face, making it difficult for the system to recognize the individual accurately..
- **Aging and Facial Expressions**: Natural aging and different facial expressions can alter facial features, complicating recognition.
- **Occlusions**: Objects like glasses, hats, masks, or even hairstyles can partially cover the face, hindering accurate detection and recognition.
- **Similarity Between Faces**: High similarity between faces, especially among family members or identical twins, can lead to misidentification.
- **Scalability and Performance**: As the size of the database grows, maintaining high accuracy and performance in real-time applications becomes challenging.

Face Recognition Techniques in Machine Learning

1. **Local Binary Patterns Histograms (LBPH)**: This technique labels the pixels of an image by thresholding the neighborhood of each pixel and considers the result as a binary number. The histograms of these patterns are then used for face recognition. LBPH is robust to monotonic illumination variations and is computationally efficient.
2. **Convolutional Neural Networks (CNNs)**: Deep learning-based methods, such as CNNs, have revolutionized face recognition. CNNs can learn complex representations of faces from large datasets. Techniques like VGG-Face, FaceNet, and DeepFace utilize CNNs to achieve high accuracy in face recognition.
3. **Histogram of Oriented Gradients (HOG)**: This technique involves counting occurrences of gradient orientation in localized portions of an image. It is used to detect the structure and appearance of faces, and can then be combined with other algorithms for recognition.

Haar-Cascade Classifier

Haar-Cascade Classifier

The Haar Cascade classifier is a machine learning-based approach for object detection, introduced by Paul Viola and Michael Jones in 2001. It is widely used in computer vision applications for detecting objects, particularly faces, in images and videos. This classifier uses features extracted from images and applies a cascade of increasingly complex classifiers to efficiently detect objects.

Architecture of HCC

The Haar Cascade classifier consists of a series of stages, each containing a set of Haar-like features. These features are simple rectangular patterns that represent the difference in intensity between adjacent regions of the image.The classifier uses an integral image representation to quickly compute these features at various scales and locations. Each stage in the cascade is a strong classifier that combines multiple weak classifiers, trained using AdaBoost to focus on the most informative features. The cascade structure allows for quick elimination of non-object regions, progressively applying more complex classifiers only to promising regions.

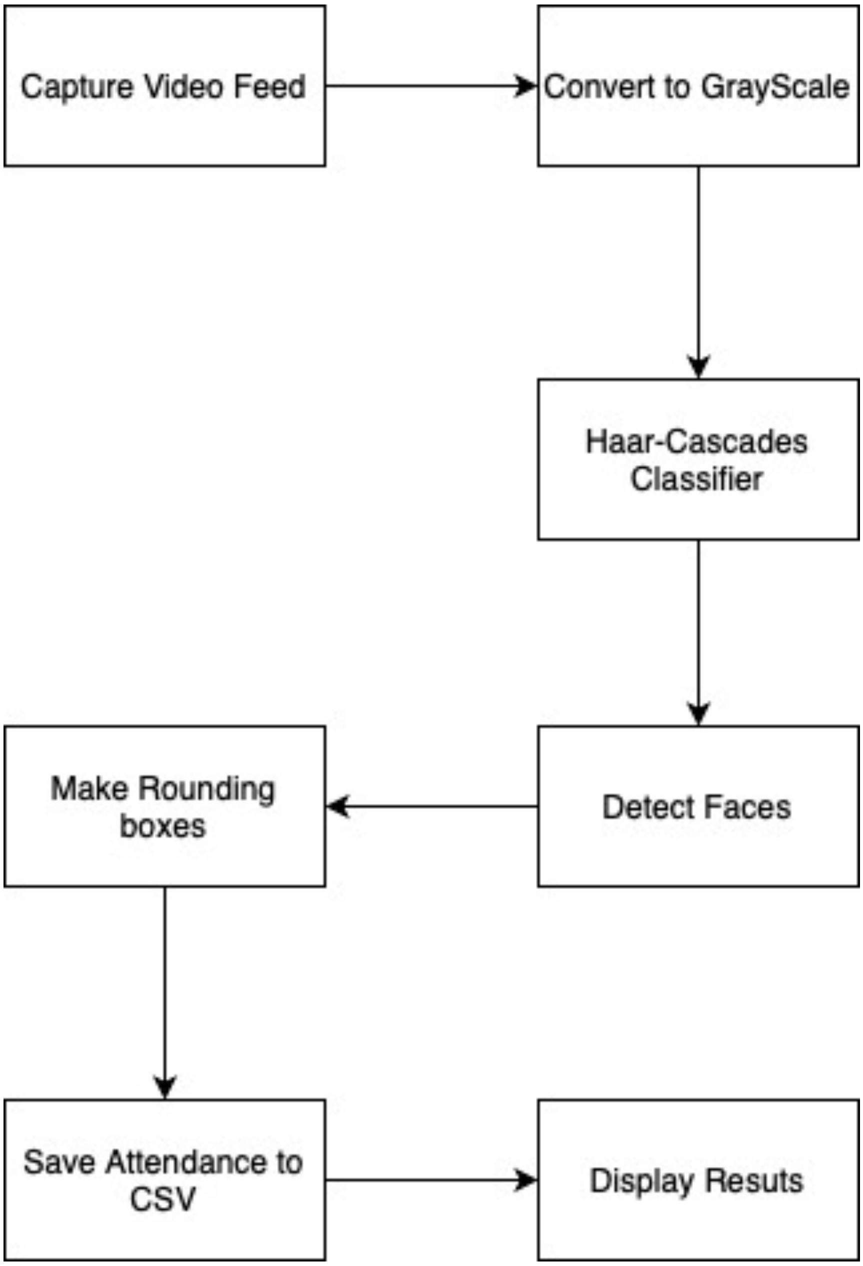
Advantages

1. **Efficiency**: The cascade structure allows for rapid detection by quickly eliminating non-object regions.
2. **Real-time Performance**: Haar Cascade can achieve real-time detection, making it suitable for applications like face detection in video streams.
3. **Robustness**: It can detect objects under various lighting conditions and partial occlusions.
4. **Simplicity**: Implementation is straightforward, and the classifier can be easily trained with labeled images.

Uses

1. **Face Detection**: Widely used in applications such as digital cameras, smartphones, and surveillance systems to detect and focus on faces.
2. **Object Detection**: Can be trained to detect other objects like cars, pedestrians, and animals.
3. **Gesture Recognition**: Utilized in interactive systems to detect hand gestures and body movements.
4. **Automated Attendance Systems**: Used in conjunction with facial recognition to mark attendance in classrooms and workplaces.

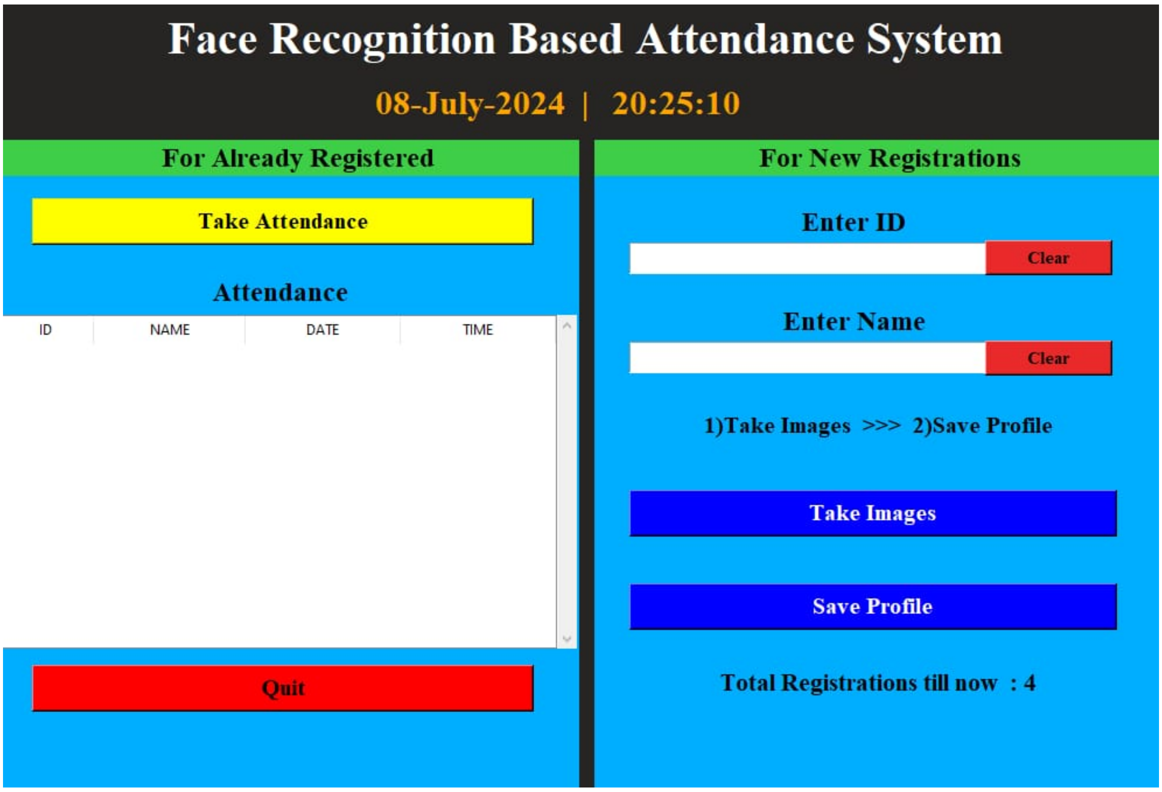
Flow chart

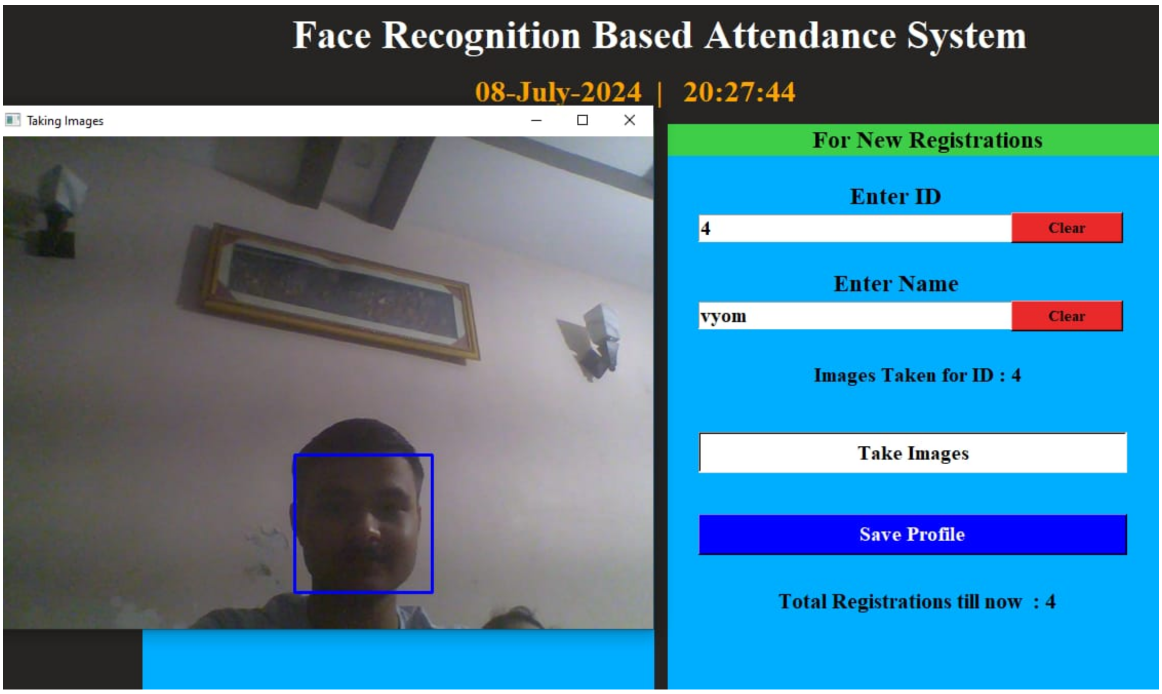

Capture Video Feed
Convert to GrayScale
Haar-Cascades Classifier
Detect Faces
Make Rounding boxes
Save Attendance to CSV
Display Resuts

Source Code

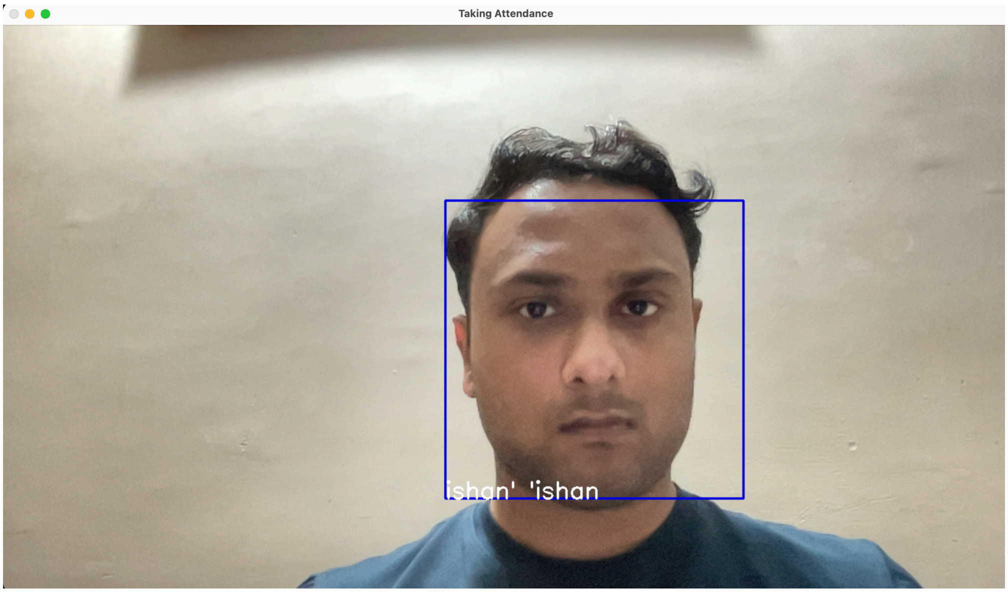
CODE : Github : ishan-0611

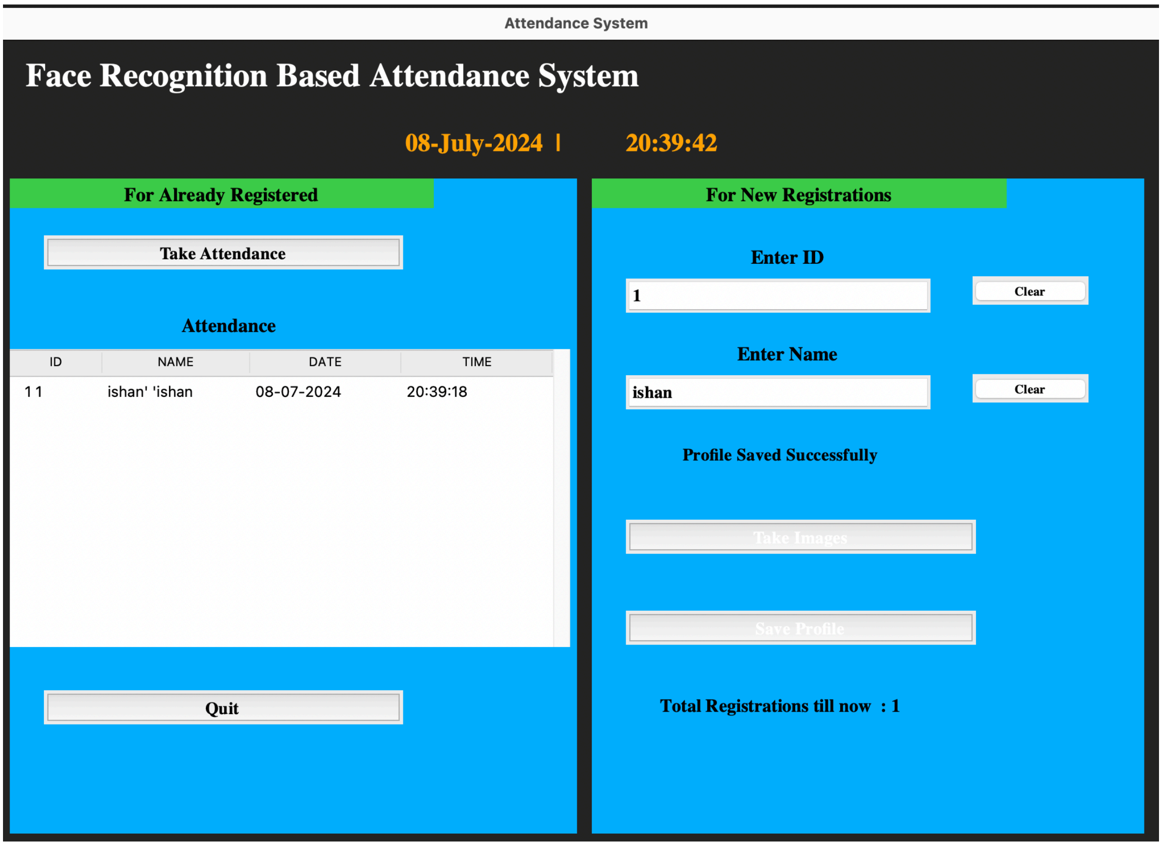
Running the Project / Output





Running the Project / Output





Conclusion

This project has successfully demonstrated the implementation of a real-time face recognition system using OpenCV and the Haar Cascade classifier. By leveraging these powerful tools, we were able to create a robust and efficient face detection and recognition application that operates in real-time, providing immediate feedback to users.

The Haar Cascade classifier, a cornerstone of this project, has proven to be an effective method for face detection. Its use of cascading classifiers, which operate in stages, allows for the rapid and accurate identification of facial features.

This hierarchical approach, combined with integral image techniques, ensures that the system can quickly discard non-face regions and focus computational resources on more promising areas. This efficiency is critical for real-time applications, where speed and accuracy are paramount.

One of the significant challenges addressed by this project was the creation of a user-friendly interface that remains responsive and lag-free, even during intensive video processing tasks. By optimizing the code and ensuring that all necessary directories are created dynamically, we have streamlined the workflow and minimized potential interruptions.

This ensures a smooth user experience and makes the system more reliable and easier to deploy in various environments.

The project also underscores the practical applications of face recognition technology. From security and surveillance to personalized user experiences and automated access control, the potential uses are vast and varied.

This project serves as a foundational prototype that can be extended and customized for specific applications, demonstrating the versatility and power of face recognition technology.

In conclusion, this project is a testament to the capabilities of OpenCV and the Haar Cascade classifier in building a real-time face recognition system. It showcases the importance of efficient algorithms, optimized code, and robust preprocessing techniques in achieving accurate and responsive results.

The system developed here not only meets the functional requirements but also sets the stage for further enhancements and applications in various domains. As face recognition technology continues to evolve, projects like this pave the way for more sophisticated and impactful innovations.

References

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