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AI-Enabled Face Recognition Attendance System with Cloud Connectivity

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Abstract

Today, people remember more passwords and carry more cards, so security becomes more important. However, such implementations are becoming less safe and feasible as an biometric attendance. A biometric attendance system works by capturing a unique physical characteristic of an individual, like their fingerprint, iris scan, or facial features, and comparing it to a stored database to verify their identity and register their attendance. The designed system capturing a person's face image using a raspberry pi camera, then analyzing the facial features using artificial intelligence algorithms to compare them against a database of registered faces, automatically recording attendance if a match is found and produce voice greeting with it essentially, identifies individuals based on their unique facial geometry, eliminating the need for physical ID cards or manual timekeeping.

Introduction

The majority of people are using smartphones, which frequently use face recognition technology to unlock the device. This technology provides a powerful approach to protect personal data and ensure that sensitive data remain unavailable to the criminal even if the phone is stolen.

On a mobile phone, face recognition works by using the device's camera to capture an image of your face, then analyzing specific facial features like the distance between your eyes, the shape of your nose, and the contour of your jawline to create a unique "faceprint" which is then compared to a stored template of your face in the phone's database to verify your identity; this process is powered by sophisticated algorithms utilizing machine learning and computer vision to achieve accurate recognition even under varying lighting conditions and facial expressions. Facial recognition technology works by capturing an image of a person's face, then using complex algorithms to analyze and measure the unique distances and patterns between key facial features like the eyes, nose, mouth, and jawline, creating a mathematical representation called a "faceprint" which is then compared to a database of stored faceprints to identify or verify the individual's identity; essentially, it's like a digital fingerprint of the face, enabling the system to match a new image to a known person within a database, leveraging artificial intelligence and computer vision to perform this complex facial feature analysis.

Design Methodology

Below Figure shows how the project is designed for identifying individuals marking attendance and greet the accordingly with cloud integration.

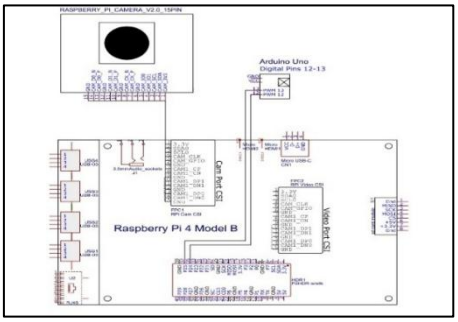


Fig. 1. Design of project

Hardware Requirement

In this project, the raspberry pi is the system microcontroller that makes all decisions, such as recognizing the face and performing different algorithms. The system is provided with a raspberry pi camera connected to the Raspberry pi,which is responsible for capturing the images. Figure 1 shows the connection of raspberry pi with camera while Figure 2 shows the connection of raspberry pi with ardiuno Uno. The basic elements required for this project are listed below

- Arduino UNO
- Raspberry pi
- ultrasonic sensor
- Raspberry pi camera
- sound
- servo motor

A Raspberry Pi camera is a dedicated camera module designed to connect directly to a Raspberry Pi board using a dedicated CSI (Camera Serial Interface) connector, allowing the Pi to capture still images and video footage with resolutions up to 1080p at 30 frames per second; it typically features a 5-megapixel sensor and is considered a cost-effective way to add camera functionality to a Raspberry Pi project

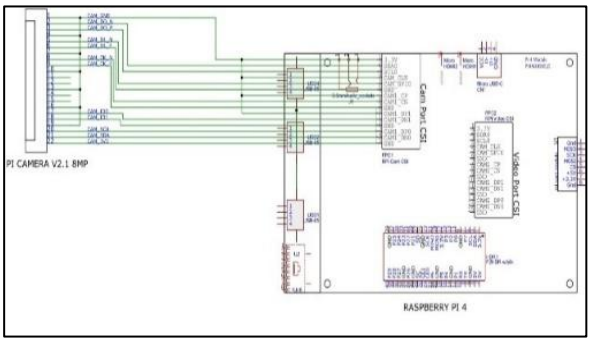


Fig. 2. Raspberry pi camera connected to the Raspberry pi

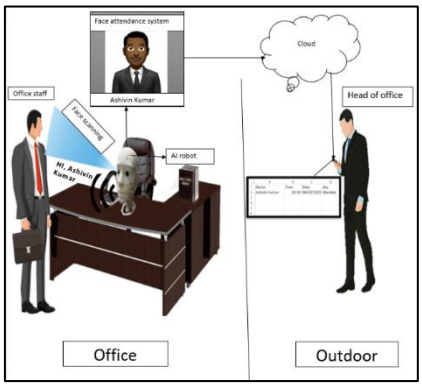


Fig. 3. Raspberry pi with ardiuno Uno

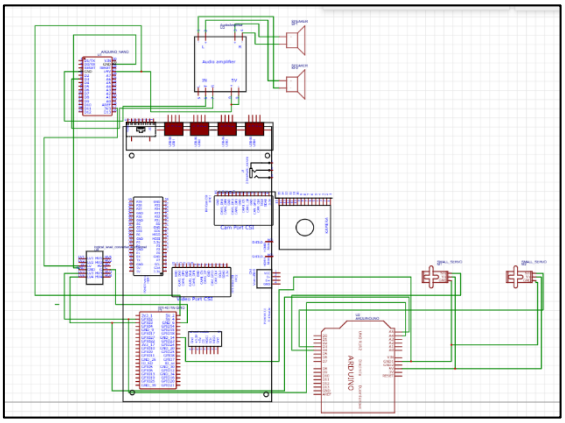


Fig. 4. Circuit diagram

SOFTWARE FRAMEWORK

1) Step 1: Installing Python on the Computer

2) Step 2: Install Vnc and angree bird softwareVNC stands for Virtual Network Computing. It is across-platform screen sharing system that was createdto remotely control another computer.

3) Step 3: Python Code

First up, to get the Python sending data over the serial port, a simple program is needed.

4) Step 4: Arduino Code and raspberry pi code initiate a connection with the Arduino from Python,user should first figure out which COM Port the Arduino is on.

Flow Chart

The flowchart represents the process of a smart face recognition system designed to identify individuals and greet them accordingly.

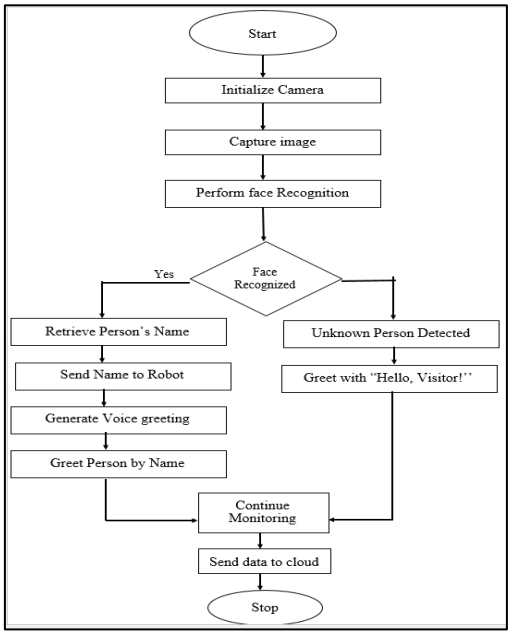


Fig.5.Flowchart

1. Start: The system is activated and begins the process of monitoring for faces.

2. Initialize Camera: The camera is initialized, starting the process of capturing images.

3. Perform Face Recognition: The cloud server processes the image using AI-based face recognition algorithms to determine if the person is in the database.

4. Face Recognized?: A decision point where the system checks if the face matches any pre stored data in the cloud.

o If Yes (Face recognized):

Retrieve Person's Name: The system retrieves the name of the identified person from the cloud database.

Send Name to Robot: The name is sent to the robot or system for further interaction.

Generate Voice Greeting: The system generates a personalized voice greeting based on the retrieved name.

Greet Person by Name: The individual is greeted with a personalized message, such as "Hello, [Name]!".

The system then returns to Continue Monitoring mode to detect new faces.

o If No (Face not recognized):

Unknown Person Detected: If the face is not recognized, the system identifies the person as a visitor.

Greet with "Hello, Visitor!": A default greeting is provided, such as "Hello, Visitor!"

The system then returns to Continue Monitoring mode to detect new faces.

5. Continue Monitoring: After completing the greeting process, the system continues monitoring for new faces.

6. Stop: The process terminates once monitoring is complete or the system is shut down.

This flowchart provides a clear outline of how the AI-driven facial recognition system works in recognizing individuals, retrieving their details, and greeting them with personalized or default responses, making it highly useful for automated interaction systems in various environments like offices or public places.

Result And Discussion

This system is special as computer vision and artificial intelligence are used to detect and track faces. The accuracy of the system has been tested with a condition such as distance and angles.

The final system prototype is shown in fig 6

Fig .6. System prototype

Face recognition accuracy based on detection distance

Trial	**Detection Distance**	**Result**
1	0.5 meter	succeeded in recognizing
2	1.5 meters	succeeded in recognizing
3	2.5 meters	succeeded in recognizing
Face recognition success result		10/10

Table 1: Accuracy obtained based on detection distance.

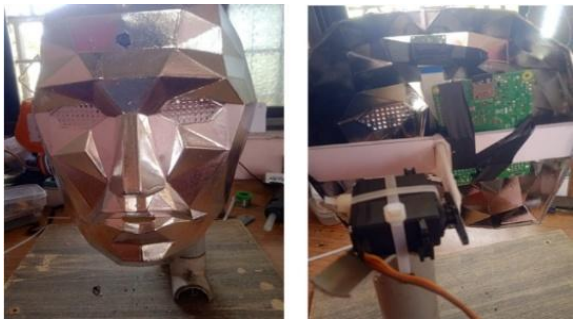
When a person is in close proximity to the Cam (0.5 , 1.5, 2.5) meter away, the system succeeds in detecting face.

Face Recognition Accuracy Based on Multi-Angle Pose

Angle	**Result**	**Face recognition Accuracy**
90°	10/10	100%
135°	10/10	100%
180°	6/10	60%
Accuracy average	86.67%	

Table 2: Accuracy obtained based on multi-angle pose.

The system has been tested based on multi-angle pose and the accuracy of the system is 86.67%



Conclusion

Introduced an intelligent attendance system that combines AI-powered facial recognition with cloud technology to automate attendance tracking. The system is designed to increase accuracy, security, and efficiency by recognizing faces in real-time and logging attendance without human intervention. Using advanced AI techniques like CNN and SVM for facial recognition, ,while cloud integration allows data to be stored securely and accessed easily from anywhere.This solution meets the needs of schools, offices, and other environments where managing attendance is important. It eliminates manual errors and simplifies the entire process, providing real-time updates and secure data storage. The use of cloud technology also makes the system scalable, meaning it can be expanded to fit larger organizations or multiple locations. As AI and cloud technologies continue to develop, this system can be improved even further, with more precise algorithms, better user interaction, and enhanced privacy features. In the future,the system could adapt to new needs and challenges, making attendance management even more efficient and secure. This work demonstrates the potential for AI and cloud integration totransform everyday tasks, making them smarter and more reliable.

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