

Face Recognition-Based Door Locking System with OTP Verification

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Abstract: *In the world of the digital era, AI has had a major influence. With the advancement of technology, people can experience extraordinary innovations that not only make life more comfortable, but also make it simpler. As a part of AI, We have created a door locking mechanism that uses face recognition with OTP verification using Open CV. At the stage of identification of faces, the HOG algorithm is used for finding the face at the backend. This project is developed using both hardware and software. With the help of smart doorbells, home owners can get notifications when a visitor is at the door and identify the visitor. They enhance the development of smart homes and greatly improve people's quality of life. The purpose of this project is to make the home or office area secure and can also be used to minimize criminality. Only one form of authentication is offered by the existing systems, which makes them less secure. Thus, for secure access, we have proposed a safe door locking system with two factor authentication that can authenticate and validate the user as well as open the door in real time. We have come up with an idea which should recognize the guest, relatives or a stranger and alert the user*

Keywords: Doorstep security system, facial recognition, the authentication code, authentication, Open CV, Global system for mobile communication, residence safety

I. INTRODUCTION

In this modern era home security systems are growing in need of the hours to protect our home from burglars, invaders, etc. We have used Face recognition technology. The requirement for face recognition in security systems is ascribed to the growth of business interest and, consequently, the creation of technology that can support this development. Bio science, surveillance, law enforcement, multimedia management (such as the automatic identification of a specific person among a group of digital photos), passport checks, smart cards, access control management and criminal investigations are among the major commercial interest areas.

These days, a house and family cannot be sufficiently safeguarded by a door lock alone. People used to defend their homes using conventional techniques. Password, RFID sensors [1], [2], fingerprint scanners, and face recognition technologies [3]-[6] can all be used to control an entrance guard. The most natural approach of biometric authentication between people is likely face recognition. Furthermore, after fingerprints [8]-[10], it is the second- most predominant biometric characteristic.

Although there have been several facial recognition system implementations, they most only offer a single type of authentication and are expensive [7]. A multi-modal system will undoubtedly require more work in terms of organization and computing costs. A functional system must therefore be efficient, useful, and affordable.

Arduino UNO is used here which is a programmable device. It uses the least amount of power compared to other available microcontrollers and has a user interface that is simple to program, and it is cost-effective.

II. PREVIOUS WORK

Only mechanical locks were available in the past, which were inadequately secure. To stop additional theft and unauthorized entrance, modern electronic locks were introduced to the market as technology advances. The password-based locking system is one of the most recent electronic lock systems that employs a password as a verification factor. A biometric lock system was later developed such as face recognition, voice recognition [15], fingerprint recognition [14], iris recognition [16], etc.

There are numerous more approaches, including IOT [7], Wi-Fi, Bluetooth [14], and NFC (Near field communication) [17] based lock systems that function through a network and a Smartphone. The most recent safe access technology is One Time Password (OTP). According to [18], every time an OTP is created; it is unique, making it highly unlikely and challenging to hack.

The author in [13] proposed an embedded Linux platform-based face detection-based ATM security system. The Raspberry Pi board with embedded software was used by the author to implement their projects. A SD Card is built into this board for data storage. The SD Card, Pi camera, LCD, Speaker, GSM module, and matrix keyboard are required for the full project. The door to the ATM area is also locked and unlocked by a stepper motor. An OTP that is sent to the mobile device is required to unlock the door. The GSM module is used to put this into practice. By using facial recognition, the author ultimately gave the ATM system the highest level of security. In this proposed system, we have developed a door lock system using face recognition with OTP as an additional authentication factor.

In [18], the author has used Twilit service to send SMS, which requires internet access to operate the system. We have used a GSM module to send SMS, so the proposed system can be operated offline. We have also used APR voice module to provide audio message about the visitor which is an added feature when compared to the existing systems which will greatly help the elderly and disabled people.

III. SYSTEM DEVELOPMENT

REQUIREMENT ANALYSIS:

Hardware requirements

Arduino

Arduino is a microcontroller board. It makes use of a battery, an AC to DC adapter, or a computer linked via USB connection to get started and it is programmable.

Keypad

The horizontal and vertical sections of an array are used to arrange keyboards. Because the CPU uses ports to access both rows as well as columns, a chip with a microprocessor can be wired to an eight by eight key of vectors using 2 eight-bit ports. The columns and rows only join when a key is thumped; if not there is no connection between them.

GSM

Sim800C GSM module is used for SMS, audio, and data transfer applications that require multimedia-to-multimedia connections. You can do audio calls as well as send and receive SMS with this modem.

APR

Even if the module's power supply is removed, the recorded audio is still available. Replayed audio displays excellent quality and little background noise.

LCD

The display screens are made up of a number of discrete areas known as pixels that can be adjusted to show information.

Speaker:

In order to make sound and notify the home's owner of a visitor, speakers must be connected to the system.

Software requirements:

Arduino IDE:

The ATmega328 processor on the Arduino UNO board has been set up using a boot loader, making it possible to write fresh code to it without the need for a third-party programming tool. The integrated development environment for Arduino can be used to program the Arduino UNO.

Jupiter Notebook IDE

It is a Python integrated development environment created with freshmen in view. It provides many methods of performing sequential code analysis.

IV. SYSTEM DESIGN

Systems design is the process of creating a system's elements, such as its component design, elements, and their information and interface. The design flowchart is depicted in Fig. 1, and the system architecture is shown in Fig. 2. A person needs to be in front of the camera for the facial recognition process to start. The dataset will then be searched by the system for the matching face. If the person is recognised or if the face equals one in the dataset, it will send a verification code to unlock the door. If the dataset does not contain it, it will merely notify the owner of the unknown visitor. Additionally, a spoken message about the visitor will be provided, and the same message will be shown on the Display of the system.

SYSTEM ARCHITECTURE

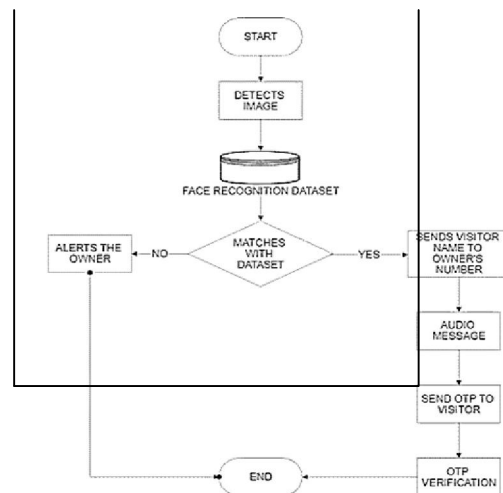


Fig1.Flowchart

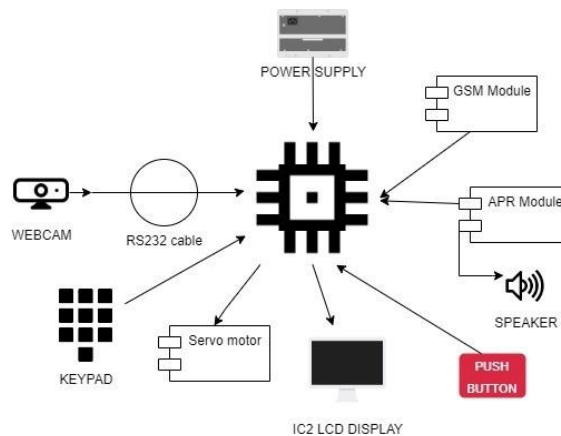


Fig2. Architecture diagram

The architecture of this system consists of Arduino UNO, RS232 cable, sim800c GSM Module, APR9600 module, speaker, push button, I2C LCD, Servo motor. The data from the Face recognition module is passed to the Microcontroller using RS232 cable which is then sent to GSM module. Sim800c GSM is used for OTP mechanism. The Sim800c GSM module contains a sliding SIM card tray and an RS232 port for direct computer communication. It accepts 2G/3G/4G sim cards.

The hardware serial pins (pin 0 and 1) of the Arduino Uno are used to connect the SIM800C module. Set the right baud rate for the Arduino Uno serial interface. It reads the data you wish to send and sends it to the SIM800C module through the serial port by writing code in the Arduino IDE. The AT commands "AT+CMGF=1" and "AT+CMGS" can be used to set the SMS text mode and send an SMS message respectively. The recipient's phone number and the message text can be concatenated to create the message. The message will then be sent to the recipient's phone over the cellular the corresponding pins every face in our data that has been stored in the file. In order to compare this embedding to the rest of our embeddings. If the resulting embedding resembles or is similar to another embedding, we can identify the face.

V. IMPLEMENTATION

The implemented idea involves face detection and face recognition from images taken by webcam. To support real-time computer vision applications, the Open CV library is vital. Installed on our system are the most current version of Python and Visual Studio, which serve as an Integrated Development Environment (IDE). Among the crucial libraries installed are PIP, Open CV, data time and Face Recognition. The face recognition code is run by the Jupyter IDE, and the result and data is collected through RS232 cable and passed to the Arduino. In the image recognition process, the extracted feature image is compared with pictures stored in the database. The loaded image is converted to RGB for better processing. Finding the faces in the image is done by locating the faces and the face is encoded by using a face recognition package. We are comparing the faces encoded with the already encoded image to find similarities. If the image is matched, the system will access the matched visitor's information from the database. The system will then transmit a verification code to the known visitor's mobile phone number using a GSM module. If the person enters the correct verification code the servomotor will start to turn, depicting the door unlocking. The owner is informed about the unfamiliar person if their image is not matched or present in the dataset.

The known visitor's name will be displayed in the IC2 LCD display. APR9600 module is integrated with the Arduino UNO which is connected to a small speaker attached to the system. APR9600 device features 40–60 second playback time, real single-chip voice recording, and non-volatile storage. APR module helps to produce audio messages announcing the visitor's name. A push button is connected to the system through which the owner can give access to the visitor from inside the house.

Additionally, we are providing a feature which stores the unknown faces with date and time of their arrival as a separate file when they appear in front of the camera. The photos of the unknown person will be stored separately in a folder. The next day of storing the unknown faces will be based on stack algorithm. One who appeared currently will be represented as the first image in the storage folder for the follow up days. The arrival time of the unknown person will be stored in an Excel sheet. Whenever the system gets restarted the stored data in excel sheet will be deleted automatically to avoid flooding of data.

Arduino and the message will be displayed on the display. We use servo motor to depict the opening and closing of door. In the Arduino IDE, Servo library is included. My servo. Write () method to set the angle of the servo motor. The closed position is represented by a value of 0 degrees, and the open position by a value of 180 degrees. A push button is finally linked to the system.

VI. ALGORITHM

We use face recognition algorithm to recognize person in front of the door. The face recognition algorithm comprises of three steps which includes feature detection and feature extraction.

Input data:

Creating an empty list to store the images.

Images= []

Image names=[]

Feature detection:

In the image our first duty is to look for faces. Now that we are aware of the exact positions and location of the face for processing. Specifically, every face is turned into a vector using face embeddings. Deep metric learning is the process

of turning the faces of the images to a vector. Specifically, every face is turned into a vector using face embedding vector.

Feature Extraction:

We can now extract certain aspects from the image since the face has been removed. A neural network generates an output vector that represents the main facial characteristics using an image of a person's face as data. We refer to this vector as a face embedding vector because it is simply referred to as an embedding in machine learning. The neural network gains the ability to create similar vectors for faces that resemble one another after being trained. The vectors connected to the faces are comparable, or more accurately, relatively near together in vector space.

Encoded image:

We send this pre-trained network all of the photos in the database to obtain their corresponding embeddings, and then save these in a file for the following step.

Comparison:

In this we need to identify a fresh image that is not already in our data because we have face embeddings for

VII. RESULTS

Face recognition:

TABLE.1

Testing scenarios	Description
T1	Known person (wearing face mask)
T2	Known person (wearing specs)
T3	Known person without specs and mask
T4	Unknown person

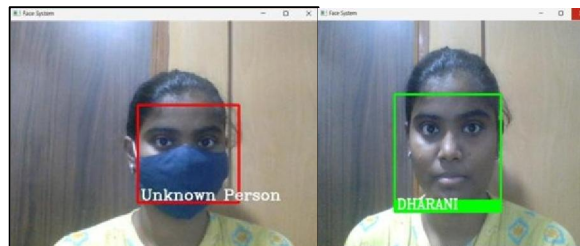


Fig3.T1 Example

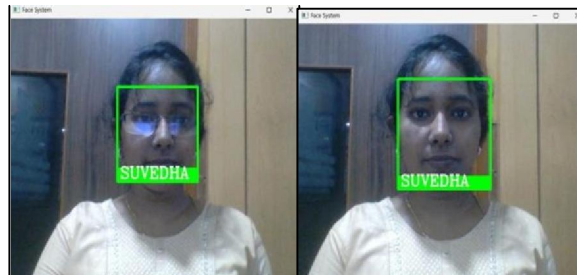


Fig4.T3 Example



Fig5.T2Example

TABLE.2

TESTUSERS	TEST CASES			
	T1	T2	T3	T4
DHARANI	✗	✓	✓	✗
SUVEDHA	✗	✓	✓	✗
SANTHOSH	✗	✗	✗	✓



Fig7.T4Example

SMS alert to the owner:

The owner of the residence will be receiving a message from those who arrived at their doorstep and also a sound message from the speaker attached to the system.

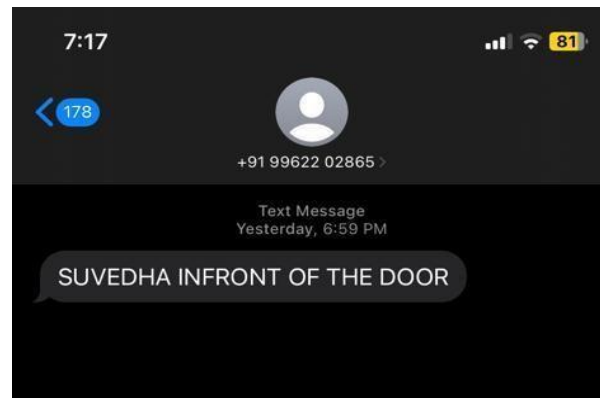


Fig8. SMS alert

Sending verification code:

The known person will be receiving a authentication code to unlock the door

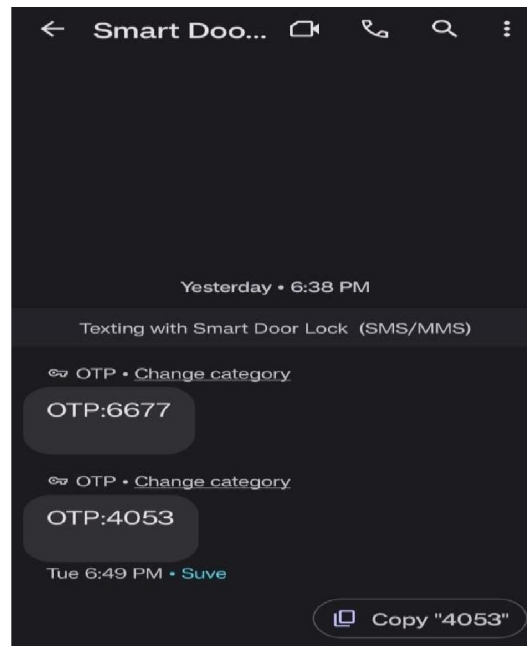


Fig9.OTP alert

Additional emergency tool:

A push button is provided to the owner of the residence to unlock the door by sitting inside the home in case a Visit or forgets their phone.

Storing the unknown faces:

In this step we are storing the face of the person who is not in the dataset whenever appears at the doorstep with their arrival of time.

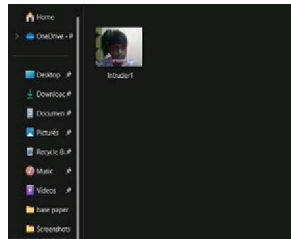
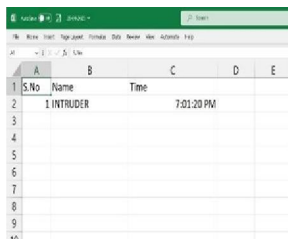


Fig10.Intruder data



S.No	Name	Time
1	INTRUDER	7:01:20 PM
2		
3		
4		
5		
6		
7		
8		
9		
10		

Fig11.Intruder's arrival time

VIII. CONCLUSION

The system's strategy was designed to safeguard the residents of the house. Unwanted invaders will likely have a difficult time accessing or surpassing this system. Simultaneously, this renders it as less difficult for the user to gain entrance to the residence without relying on the home key pairs. This method would benefit consumers since it delivers an effective and extremely safe solution at an economical price. In coming years, this technology will be capable of recognizing faces with better accuracy.

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