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FACIAL RECOGNITION DOOR LOCK USING RASPBERRY PI

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Abstract – In today's world, we are confronted with security challenges on every level. As a result, we must use modern technologies to address these difficulties. The Face recognition module is being used in this project to capture human photos and compare them to photographs stored in a database. The detection of persons who enter or leave the house is the most crucial element of any home security system. Instead, then using passwords or pins to monitor this, unique faces can be used because they are a biometric property. We want to build this system on the Raspberry Pi 4 to make the house only accessible when your face is identified by the Open CV library's recognition algorithms and you are authorized in by the house owner, who can monitor entry remotely. it identifies the face and unlocks the door if the face is registered; This is how things function in the system.
Keywords: GSM Module, Open CV, Python, Raspberry-pi 4.

1. INTRODUCTION

Biometrics is a type of identification that is unique to an individual and is used in a variety of security systems. A given face is compared to the faces kept in the database in order to identify the individual in the face recognition methodology. The goal is to find a face in the database that is the closest match to the given face. This article explores the concept of secure locking automation using the Raspberry Pi for door unlocking to give critical security to our homes, bank lockers. It employs an image capture approach in a Raspberry Pi server-based embedded system. The Raspberry Pi (RPi) is in charge of controlling the video camera in order to capture it and turn on a relay to unlock the door.

An SMS will be sent alerting the user that an unknown individual is attempting to get entrance. The majority of today's facial recognition technologies operate in a controlled setting. Lighting, position, facial expression, occlusion, ageing, and other factors all have a significant impact on the face detection and recognition. Face detection, face recognition, a personalized password, a GSM module, and a door lock are all part of the system. The method of finding the face region in an image is known as face detection.

Face detection is done using the Haar-like feature, while face identification is done with the Local binary pattern histogram (LBPH). Door locks can now be opened using systems that include fingerprint sensors, passwords, RFIDs, and facial recognition, among other features. A webcam is used to recognize faces, and a solenoid door lock is used to unlock the door. Every user recognized by the webcam will be compared to the system's database to ensure compatibility. The password box will display if the face is recognized. The password will be entered by the user. The door will automatically open if the password is accurate. The GSM module, on the other hand, will send a notification to the unknown person's owner. Raspberry Pi is the system's principal control circuit. The OpenCV Library and Python were utilized.

2. LITERATURE SURVEY

We uncovered a number of publications related to the security framework. [1] introduced a unique face recognition strategy based on Gabor filtering and supervised categorization by the author. The 2D filter bank is utilized to create a 3D robust face for vector average distance in supervised classifier and threshold-based face verification method. This methodology results in a high facial recognition rate. The author of [2] suggested a face detection technique that is both efficient and effective.

The author of [3] presented a mechanism to ensure automotive security. The Arduino-based device captures the image of the individual attempting to start the vehicle. PCA is the face recognition method employed. In [4], the authors employed an Embedded platform that was both innovative and simple to build. They presented an image capturing methodology for a Raspberry Pi-based embedded device.

The author's project in [5] was "Raspberry Pi Face Recognition in Treasure Box," which is a wonderful example of how to combine the Raspberry Pi and Pi camera with Open CV's computer vision techniques. It may access the latest and most interesting computer vision techniques, such as facial recognition, by generating the current version of Open CV. all of which was done on a Raspberry Pi running Raspbian OS.

The authors proposed their work in [7] using a Raspberry Pi 2 B+ model with camera interface to capture a picture and convert it to grayscale using a digital image processing technique. In [8], the author presented a real-time application of the Face Recognition idea by producing a MATLAB code utilising the picture capture toolbox, based on the basic methodology of PCA with Eigen faces. The authors in [9] devised a security system in which whenever someone came to the door.

3. PROPOSED WORK

For face recognition, we use the Local Binary Pattern Histogram (LBPH) in this system. I Eigenfaces, (ii)

Fishersface, and (iii) Local Binary Pattern Histogram are three built-in face recognition algorithms in Open CV, an open-source computer vision toolkit (LBPH). In comparison to the other algorithms, the LBPH can recognise not only the front face but also the side face, making it more adaptable. Fig.1 shows the conversion of grayscale image to decimal. As a result, the face recognition algorithms employed here are Local Binary Pattern Histogram and Local Binary Pattern Histogram (LBPH) and the result as a binary number. The binary number is subsequently converted to a decimal number, which is subsequently used to determine the new value of the centre pixel [10,11].

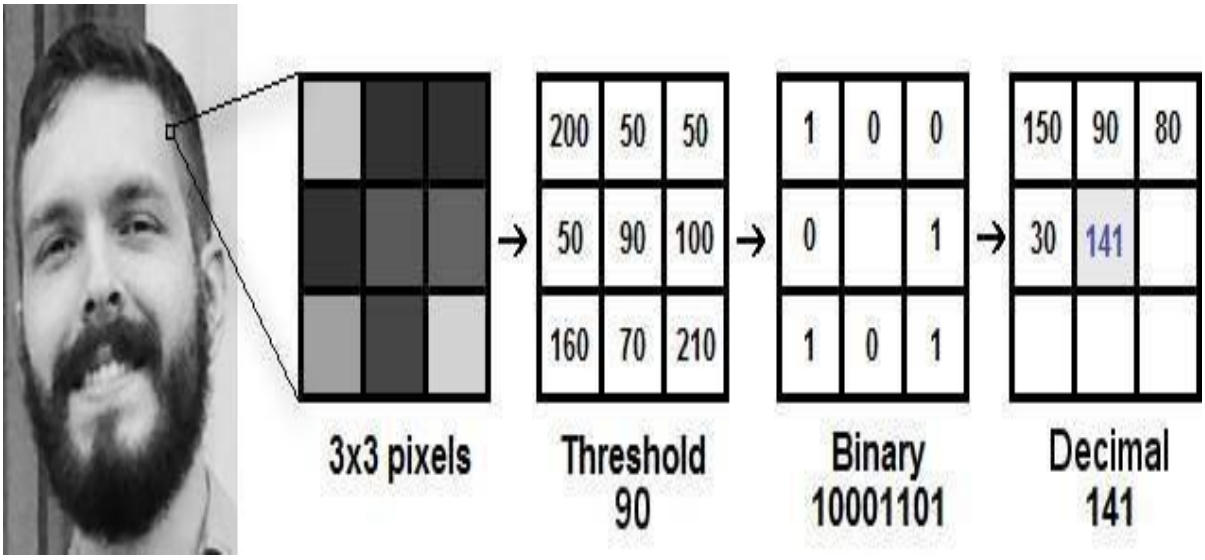

Fig. 3.1 Conversion of grayscale image to decimal

We must first save photographs using data sets, and then train those faces using the LBPH algorithm, which will then be stored in the database. It turns colour images to grey scale images before converting them to pixels for detection. It divides the image into numerous portions before storing the values of each pixel. If there are fewer pixels than 0, they will be represented as 0; if there are more pixels than 1, they will be represented as 1. Fig. 2 shows the block diagram of raspberry pi-based system for door unlocking. The images on screen will be grouped in a 3x3 matrix style for recognizing them in comparison to database recorded photos. The following are the proposed works:

- Interfacing of camera to capture live face images.
- Create a database of authorized person if they exist.
- Capturing current image, save it and compare with the database image.
- Interface GSM module to send alert to authorized person while unlocking the locked door in the form of SMS and CALL.
- Interface relay as an output.

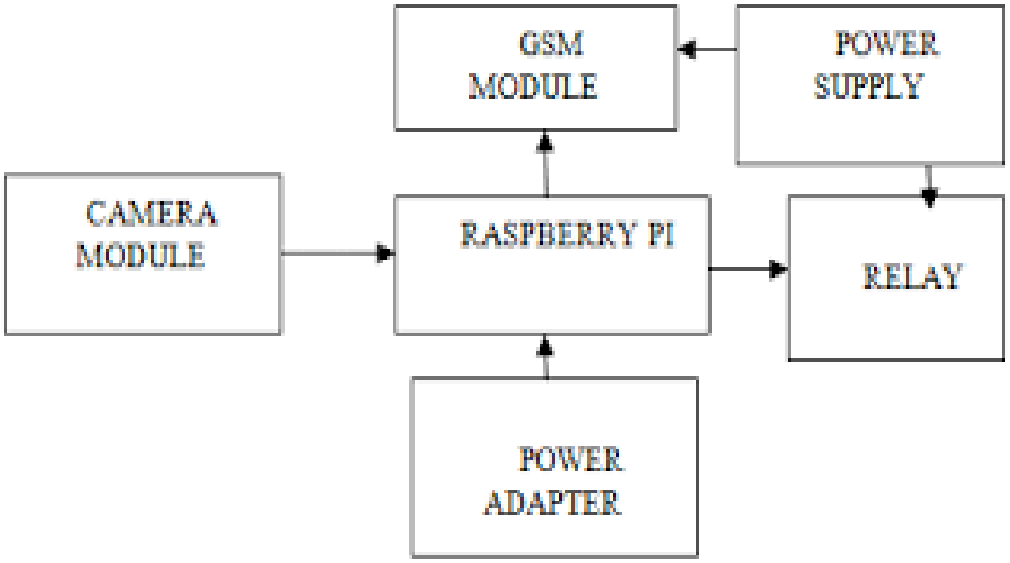

Fig. 3.2 Block diagram of "Raspberry pi based face recognition system for door unlocking"

3.1. Flowchart

The system will be split into two halves. The first step is to capture the image and store it in a database. The second step is to compare the image to the database's image storage. Eigen faces will be employed for feature extraction, while Euclidian distances will be employed for face identification.

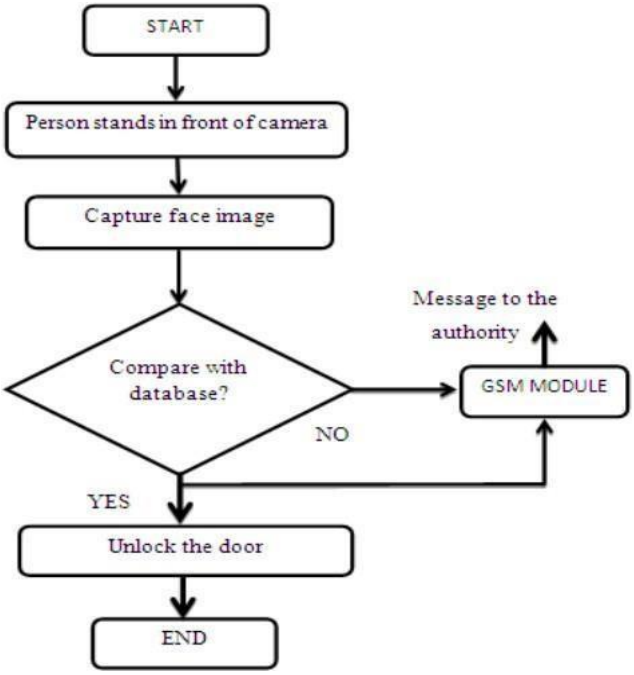

Fig. 3.3 Flowchart of Image capturing and database comparison

3.2 Camera Module

It's used to take pictures and send them to the Raspberry Pi module when they've been clicked. Ambient light circumstances are light circumstances that are not expressly supplied by the environment and are handled by cameras that have LEDs and flashes [12].

3.3 Raspberry Pi Module

When a Raspberry Pi image is taken, it is compared to a database image. When we capture a picture to construct a database for the first time, the Raspberry Pi module collects several photographs to construct a database in the system, which is then compared to the live captured photos [13].

3.4 GSM Module

Based on the output, the GSM module sends a message to the authorized people. If the result is positive, a "Information matched Access granted" message will be delivered to the allowed people; if the result is negative, a "Access denied" message will be delivered. Unknown individual is attempting to open the door." Message to the system's certified users [14, 15].

4. RESULT ANALYSIS

We created a Secured Door Lock System using Face Recognition in this system. In this case, we're employing a Raspberry Pi, which has a variety of characteristics that allow the user to customize its use in various smart applications. Face recognition was implemented using the OpenCV library loaded on the Raspberry Pi in this project. Python IDLE 3.6.5 was utilised, and SQLite Studio was utilised as the database.

The initial step was to implement the face detection technique, which was done with the help of the face detection algorithm that we utilised. To begin, we captured the photographs with a web camera. Five users have been designated as approved users, and their photos have been stored in the database. We captured ten facial photos for these people, each with a distinctive position and attitude. Here below are the different facial images in the database as shown in Fig. 4.1.

Fig. 4.1 Different Facial Images with different expression

The face photos in the database were trained in the experiment. That the facial images have been taught successfully. The input face photographs are compared to database facial images using the LBPH algorithm for

identification. The password box will display if the face is recognized. The user will enter the password. If the password is correct, the door will open automatically. On the other hand, the password is wrong in three times, GSM module will send the notification to the owner for the unknown person.

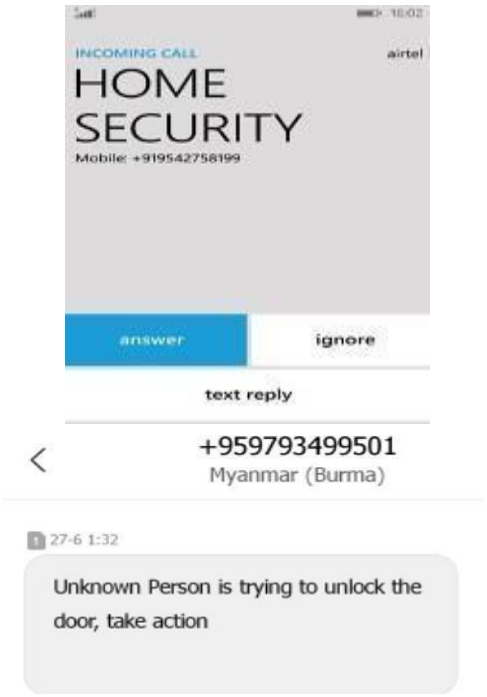

Fig. 4.2 Call or SMS from GSM Module

Some important point to look up to in this project are as follows:

- The system is tested with the same person and other persons, including authorised and unauthorised users, and the findings demonstrate that the system correctly recognises users 9 out of 10 times.
- As a result, it has a 90% efficiency rating with a 10% tolerance.
- However, when it comes to calculating the requisite recognition time, the system is tested ten times and the average is taken. The average recognition time was discovered to be 15 seconds.
- The experiment was conducted in a well-lit room with sufficient distance between the user and the Raspberry Pi camera. To get the optimum accuracy. Taking the photo from a closer distance will not result in a successful recognition because the entire face must be seen inside the photo.
- When the image capture resolution is low, the accuracy appears to suffer since there isn't enough data to process. This problem is reduced when a hierarchical strategy is used.
- Before comparing the user image to the training image, it is taken in high resolution and then downsized to a smaller size. This resulted in a high recognition rate.
- A high-resolution training image can be used to improve accuracy, as a result, the best option to get the desired outcomes is to use a smaller image.
- One of the system's limitations is that the user must look exactly like the training image they shot. For instance, if the intended user does not wear spectacles while taking a sample image, he will be unable to do so during authorization. It can also be sensitive when the user smiles broader than usual because the size of the lips varies from the training image.
- Why The Raspberry Pi has an excellent power management system, however the internal power supply is sufficient for the board itself, but providing power to external sources is inefficient.
- Unlike the Arduino's GPIO pins, the Raspberry Pi has limited power to deliver to these pins, forcing developers to use alternative methods like as merging two boards.
- A low-power relay was utilised in place of a standard relay; however, it can only handle low-voltage loads. This is one of the current Raspberry Pi board's limitation.

5. APPLICATIONS

Facial Recognition Door Lock Using Raspberry Pi founds many applications. Those are listed below:

- **Offices**: Physical access to workspace facilities.
- **Government**: Transfer important document safely.
- **Banking and Telecom**: Help to know the current process to the customer, allow authentication of credit/debit cards.
- **Education**: Allow attendance tracking of the students and entry to labs.
- **Construction**: Control access to specific point at a site.
- **Real Estate Commercial**: Offers access to campus facilities like residence halls, common area,

cafeteria, etc**.**

- **Manufacturing**: Control and record access to specific locations for employees, visitors, vendors and maintenance staff.
- **Aviation**: Paperless travel at airports.
- **Warehouse**: Control process to provision entry and exit of vehicles.
- **Entertainment**: Access to multiplex cinema.
- **Hotels**: Entrance and Exit after reservation in hotels.

CONCLUSION

A Secured Door Lock System Based on Face Recognition with Raspberry Pi and GSM Module is shown in this project. We created a system that gives users with door security locks, comfort, connivance security, and energy conservation.

We used a combination of a webcam, Raspberry Pi, relay, solenoid door lock, and GSM module to create this system. In order to recognize the face, we used the Local Binary Pattern Histogram (LBPH). the system smaller, lighter, and function more effectively with less control, making it more handy than a computer-based face recognition system. Send a security alert message to the authorized person in charge of utilities as well. We also provide power backup to ensure that the system runs smoothly and continuously in the event of a power outage. The power bank is used to charge the Raspberry Pi, reducing the chances of the system slowing down. To summarize, a security system based on face recognition and IoT has been successfully implemented. When an unknown being is spotted by IoT, facial recognition can recognize the face and send a notification to the user.

FUTURE SCOPE

To ensure that there is no security compromise, highly secure protocols such as TLS can be used. Using a Raspberry Pi and an infrared camera interface, the current project can be adjusted to be utilized in a Smart Surveillance Monitoring security system for any sort of public security that uses living body detection or surveillance.

Also, it can be used in Attendance system of the class, also some profound applications can be implemented using interfacing of Raspberry pi and Arduino UNO board like sensor application of smartcard swapping, finger detection, Temperature sensing using web server, and many more. New studies are being made to allow images to be processed on the GPU of the Raspberry Pi, achieving better results with the use of specific libraries.

REFERENCES

[1] Tudor Barbu “Gabor Filter –Based Face Recognition Technique’’ Processing of the Domain Academy, Series A, Vol.11, No 31, pp. 277-283, 2010.

[2] Paul Viola, Michael J. Jones Robust Real-Time Face Detection, International Journal of Computer Vision 57, 2004.

[3] Kanza Gulzar “Automobile security based on detection & recognition of human face”, Conference Paper, June 2017.

[4] Vamsi, Thulluri Krishna, Kanchana Charan Sai, and M. Vijayalakshmi. "Face recognition-based door unlocking system using Raspberry Pi." International Journal of Advanced Research, Ideas and Innovation in Technology, 2019.

[5] Sai, M. Yashwanth, et al. "Low-cost automated facial recognition system." 2017 Second International Conference on Electrical, Computer and Communication Technologies (ICECCT). IEEE, 2017.

[6] Manish Kumar, Dr. Sunil Kumar, Dr. Harish Nagar, “Enhanced Text and Image Security using combination of DCT steganography, XOR Embedding and Arnold transform”, Journal of Design Engineering, pp. 732-739, Vol. 2021, Issue 3, ISSN: 0011-9342 (Scopus).

[7] Koneru, Nikhil, et al. "Surveillance Camera with Facial Detection and Recognition using machine learning." International Journal of Pure and Applied Mathematics pp.3961-3967, 2018.

[8] Swati Bhargava, Manish Mukhija, “Improved study and literature review on image steganography: A Survey”, National Journal of Multidisciplinary Research & development, Vol. 3, Issue 1, pp. 446-452, ISSN: 2455-9040, January 2018.

[9] Arumugam, Puvanesan, Pin Jern Ker, Jin Yeong Tan, and Dineis Mani, "Microcontroller-based face recognition system with web-based application for car security." Advanced Science Letters 23, no. 5 pp. 4031-4035, 2017.

[10] Shembekar, Ashlesha, Khushbu Zade, Aniket Malghade, Pradyumna Tumaskar, and Sagar Dewani. "Face Recognition Locker." International Journal of Recent Advances in Multidisciplinary Topics 2, no. 6, pp. 97-101, 2021.

[11] Swati Bhargava, Manish Mukhija, “Hide Image and Text Using LSB, DWT and RSA based on Image Steganography”, ICTACT Journal on Image and Video Processing, Vol. 09, Issue 3, pp. 1940-1946, February 2019.

[12] Deshwal, Amit, Mohnish Chandiramani, and Umesh SURANA. "Smart Door Access using Facial Recognition." International Journal of Trend in Scientific Research and Development 2, no. 28, 2019.

[13] Khattar, Shubhang, Anisha Sachdeva, Rishi Kumar, and Richa Gupta, "Smart home with virtual assistant using raspberry Pi." In 2019 9th International Conference on Cloud Computing, Data Science &

Engineering (Confluence), pp. 576-579, IEEE, 2019.

[14] Vishal Pratap Singh, Manish Kumar, Himanshu Arora, "Enhanced image security technique with combination of ARNOLD transformation and RSA algorithm", International Journal of TEST engineering and management, Vol. 83, pp. 30550-30560, May/June, 2020, ISSN: 0193-4120.

[15] Orna, Gustavo, Diego S. Benítez, and Noel Pérez. "A Low-Cost Embedded Facial Recognition System for Door Access Control using Deep Learning." In 2020 IEEE ANDESCON, pp. 1-6. IEEE, 2020.

[16] Sanwta Ram Dogiwal, YS Shishodia, Abhay Upadhyaya, Hanuman Ram, Satish Kumar Alaria." Image Preprocessing Methods in Image Recognition." International Journal of Computers and Distributed Systems, pp. 96-99, vol.-1, issue-3, 2012.

[17] Satish Kumar Alaria and Abha Jadaun, "Design and Performance Assessment of Light Weight Data Security System for Secure Data" Transmission in IoT". Journal of Network Security, Vol.-9, Issue-1, June 2021.

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