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Smart Home Security and Surveillance System Using Raspberry Pi

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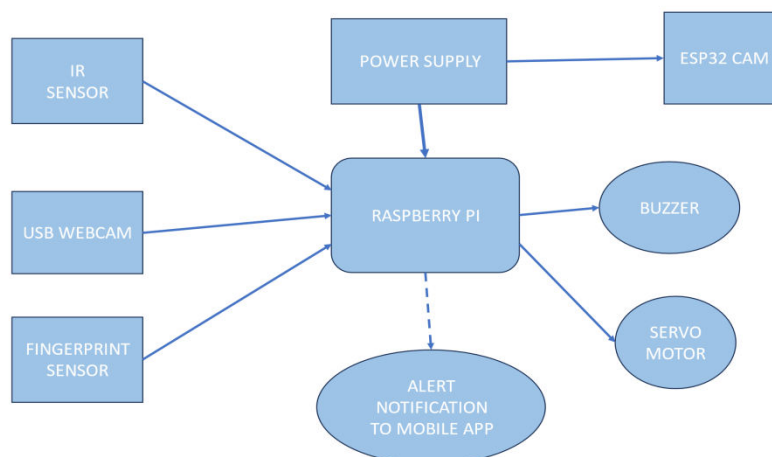
ABSTRACT: Security is the main problem in our daily life. Each and every individual needs to be secure. Our project aim is to develop an affordable home security and surveillance system. The system utilizes a raspberry pi 4 model B single board computer along with a ESP32 camera, fingerprint sensor and USB webcam. The door unlocking through fingerprint and face recognition adds an additional security to the home. We use CNN algorithm for face and fingerprint recognition. The surveillance feature with ESP32 camera gives an additional security. If any unauthorized person is detected by the USB webcam, then it captures and sends the image of that person to the owner through mobile application. We can monitor the surroundings through ESP32 camera. We use Micro SD card for saving the captured data. Thus, the security of a home can be enhanced.

KEYWORDS: Raspberry pi 4, CNN, USB Webcam, Fingerprint Sensor, Buzzer, ESP32 cam.

I. INTRODUCTION

Home security and surveillance systems are setups designed to protect our homes and its occupants from unauthorized access, thefts and other security threats. Now-a-days we have advanced door unlocking systems for enhanced security and also surveillance systems. Our project utilizes a raspberry pi 4 model B single board computer along with a fingerprint sensor for fingerprint recognition, USB webcam for face recognition for door unlocking and a ESP32 camera for surveillance. CNN (Convolutional Neural Network) algorithm is used for face and fingerprint recognition. This system alerts the owner when unauthorized person is detected by ringing the buzzer and captures and sends the image of unauthorized person to the owner's mobile through mobile application.

II. BLOCK DIAGRAM



III. WORKING

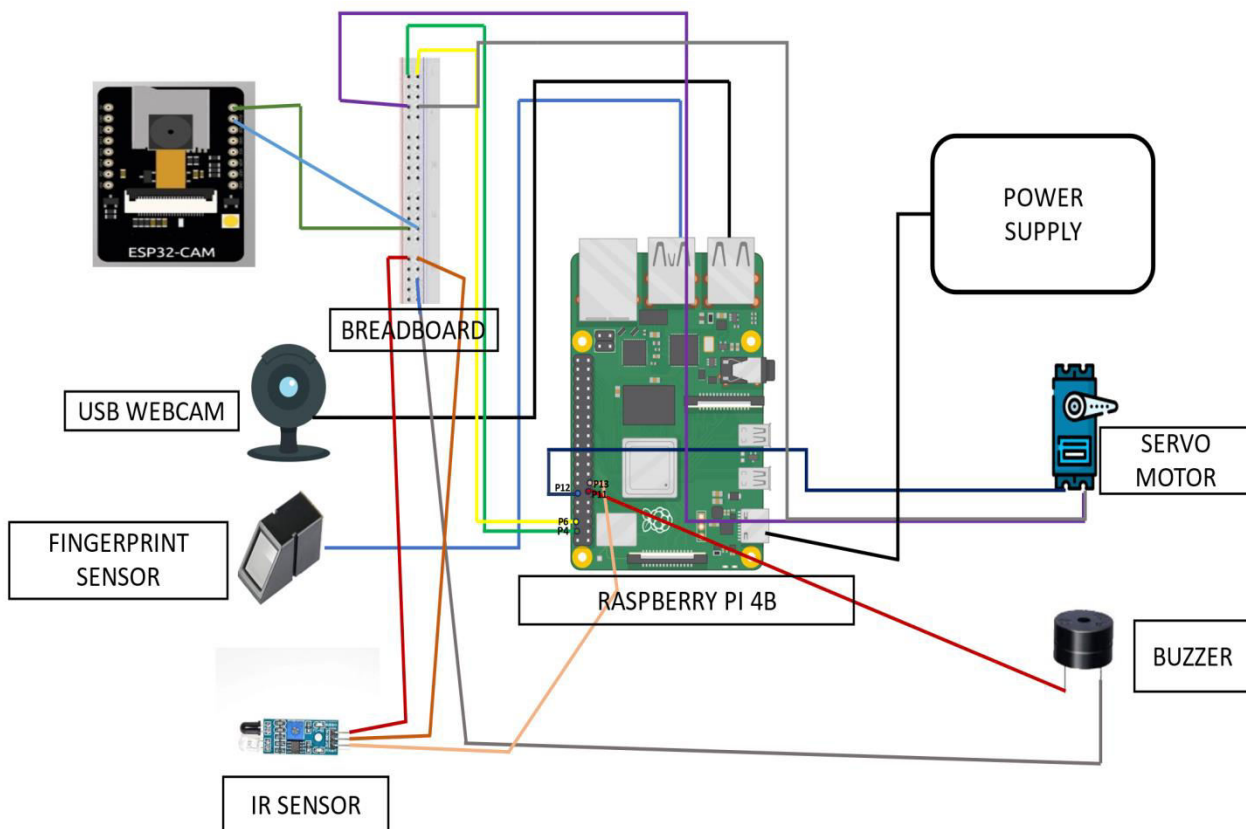
The working principle of this system involves the use of various components such as IR sensor, fingerprint sensor, USB web cam, ESP32 cam, Raspberry pi 4 Model B, buzzer, servo motor.

Raspberry pi is the brain of the system. It takes the inputs from fingerprint sensor and USB webcam. Output devices will be servo motor, buzzer. The door unlocking system will be activated when the IR sensor detects any object. Then the USB webcam gets activated and captures the image of that object and compares it with the trained image. If the object matches with the trained image, then the fingerprint sensor gets activated. CNN algorithm is used for both face recognition and fingerprint recognition. If both the face and the fingerprint get recognized then the servo motor activates.

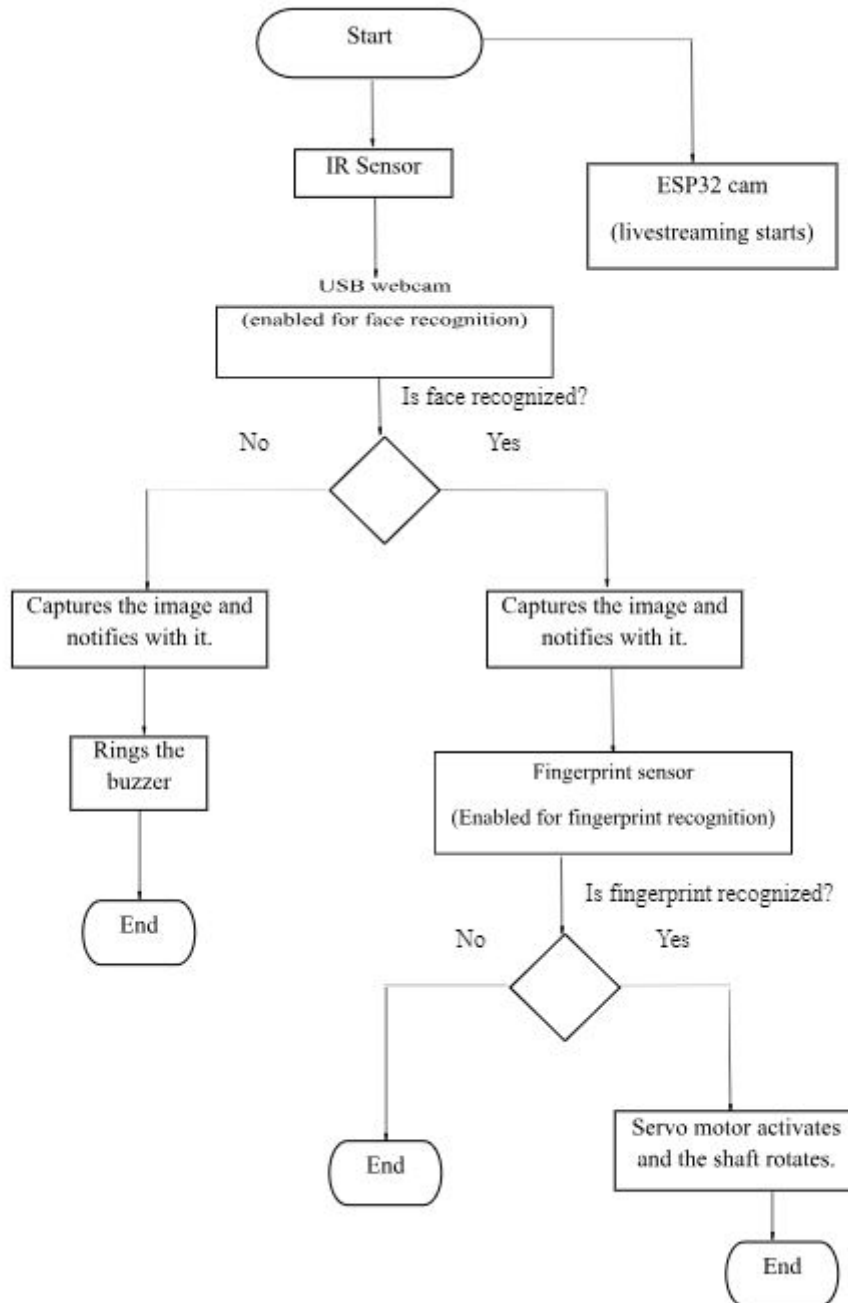
If the USB webcam does not recognize the object, then it captures and sends the image of that object to the user's mobile through mobile application with the caption "unknown person detected". If object gets recognized by the USB webcam even then the camera captures and sends the image of that object to the user's mobile. The ESP32 cam will be used for the surveillance purpose. If both face and the fingerprint get recognized then only the system grants the door access.

Hence, this system involves the integration of these components and thus, enhances the security system of a home.

IV. CIRCUIT DIAGRAM



V. FLOW CHART



VI. EXPERIMENTAL SETUP

Each component used in this project has been tested properly to get best out of them. The algorithm we used in this project is CNN (Convolutional Neural Network) because of its beneficial features. CNN algorithm improves the accuracy in recognising any image. The ESP32 cam is used for the surveillance purpose. Hence, each component is properly integrated for faster and better output.

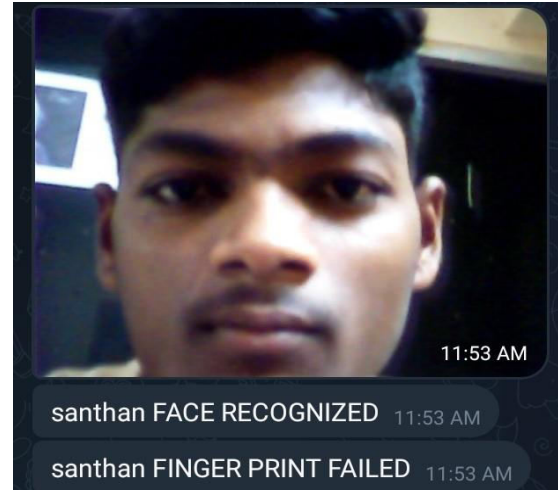
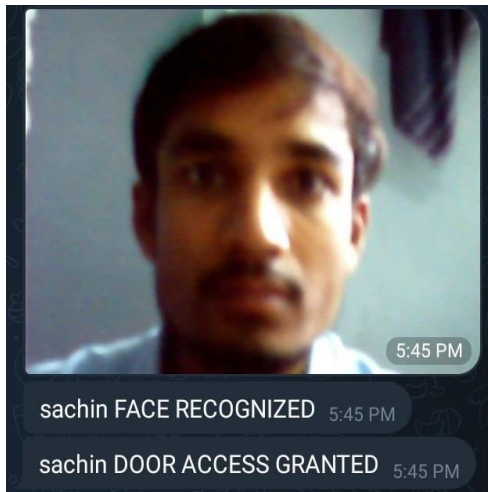
VII. RESULTS



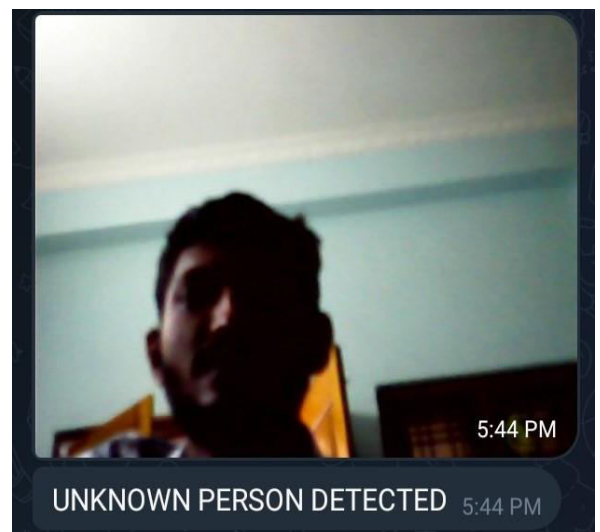
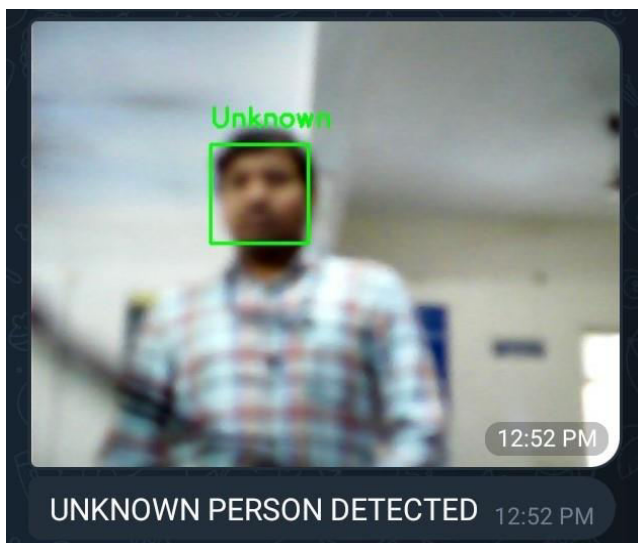
Hence, the home security and surveillance will be enhanced with this system. This project involves the two-layer protection for door unlocking (i.e., face and fingerprint recognition). User will receive alert notifications through mobile application and the surveillance is possible through the ESP32 cam provided in the system. We can watch the live streaming in our mobile phone.

NOTIFICATIONS SENT TO THE MOBILE PHONE:

FOR THE AUTHORIZED PERSONS



FOR UNKNOWN FACES (also rings the buzzer)



VIII. ADVANTAGES

- This system is easily installable and customizable.
- Two layered security
- User friendly interface
- Real time monitoring
- Affordable and efficient

IX. APPLICATIONS

- It can be used in house for security purposes.
- This system can also be a guard to shops, banks, industry and educational institutes.
- Detects burglaries and package deliveries.



- Child and pet monitoring
- Community and neighbourhood watch

X. CONCLUSION

Integrating features of all the hardware components used have been developed in it. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. The integration of CNN model for the face and fingerprint detection allows us to unlock the door through face and fingerprint recognition. Real time monitoring through ESP-32 cam and the alert notifications to the mobile makes this project more reliable and an enhanced version of security system.

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