Smart Home security system using AI and IOT

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Abstract-With burglary rate shooting up every day, deploying a strong and affordable security surveillance system at home becomes imperative. In this work, a Raspberry-pi based intruder alert system is designed to accomplish the above goal. This system works using the principle of face recognition and continuously monitoring the area in front of the main door of the home. When it identifies an intruder/burglar appearing in front of the door, it immediately sends their picture to the owner through mail, in addition to alerting him with an alert-notification. This device is intended to provide the best security to all at low cost. It is a design that doesn't compromise efficiency for cost.

1. Introduction

Home automation and its security ideas have been around since the late 1970s. However, due to technological advances and the accompanying concepts of home automation and its security systems, our perception of the home has changed significantly over time. Looking at various home automation systems over time, they have always sought to provide home dwellers with a reliable, easy and secure way to access their homes.

An IoT based Intruder Detection System Using GSM has been proposed in [1]. The system has been build using an AVR atmega 8A microcontroller as CPU and GSM for establishing effective communication with the application. Low-cost security systems for home and industrial use using the IoT are proposed in [2]. By sending a message to the user, the system alerts the owner of any unauthorised entry or each time the door is opened [2]. The user can perform the necessary action after receiving the notification. The security system interfaces between the components using an Arduino Uno, monitors the condition of the door with a magnetic read sensor, sounds an alarm with a buzzer, and transmits data through WiFi using an ESP8266 module. However, they are unreliable for everyday use. A Raspberry Pi-based automatic service request system for smart home security has been suggested in [3].The system can use a wireless network to connect to a web server or cloud via the Internet. Using a variety of sensors, the proposed system can keep an eye on the status of the home. The Raspberry Pi processes the sensor data, and when an abnormality is found, it instantly sends the data subject a service request for the anomaly[3]. The architecture proposed in this system was very complex and very expensive, thus not a viable option for a lot of users.

[4] describes a smart house with a computer, a smartphone, and additional smart sensors or actuators connected to the Internet of Things.This idea needs a huge database to work, which will increase cost and processing power. We can monitor lighting, heating, humidity, and gas appliances thanks to an android app developed for smart homes in [5]. Our mobile application connects to the smart home system and controls the lamp to be manually turned on or off when motion is sensed in a particular room.In [6], a microcontroller-based home security system is suggested. This system includes a PIR sensor, an Android app, an ATmega8 microcontroller, a Bluetooth module (HC-05), and a cloud-based application. Users can simply monitor their homes in real-time from any location via the Internet. This does not use face detection and is not cost-efficient.

This paper presents a design of an affordable and a strong smart surveillance system by implementing a face recognition model using Raspberry Pi. The unique feature of the proposed system as compared to the other existing system are as follows:

1) Sends picture of intruder with alert notification

2) Also specifies the number of times an intruder has previously appeared

3) New person's image can be added as known directly, as his picture is already present in the device.

4) Retraining the system happens in a matter of seconds, once the command to add new person is given.

5) Sends acknowledgement mail when a person's face is added/removed to/from known.

The remainder of the report is structured as follows: We will utilise a few screenshots from the suggested intelligent monitoring system to describe its methodology and workflow in the following portion of this introduction. Section 3 presents the experimental findings. Finally, the conclusions and future directions of the proposed system are outlined in Section 4.

2. Methodology and Workflow of the proposed smart surveillance system

A simple real-time demonstration of the proposed system is shown in figure 1, figure 2 and figure 3. In figure 1, a Raspberry Pi V2 camera is place in front of the door to continuously monitor the presence of the intruder. The Raspberry Pi running the smart surveillance application is placed inside the home as shown in figure 2 to monitor and alert the owner by sending the message via E-mail. The proposed smart surveillance application uses Raspberry Pi camera module, openCV, and face-recognition library to continuously check whether any human is appearing in front of the door. If it sees a person, it immediately encodes his/her face and compares it with the already stored face encodings of known faces. If none of them match with the person's face, then a mail is sent to the user, with the unknown person's image and the list of dates on which he/ she appeared previously. A sample of such an intruder alert message is shown in figure 3.

Making an unknown person 'known' and making a known person 'unknown' can be done by just sending a mail to Raspberry Pi's mailbox with appropriate commands specifying the actions that need to be performed. In case the user needs to see the entire database, a command "database" when sent to the registered mail will result in the generation of a zip file containing the same. All request mails from the user are replied with appropriate acknowledgment mails after successfully completing, or failing to do, the tasks requested by the user. This ensures that the user knows what's happening inside the system.

Figure 2. Raspberry Pi setup for smart surveillance application

Figure 1 Raspberry Pi V2 surveillance Camera Setup

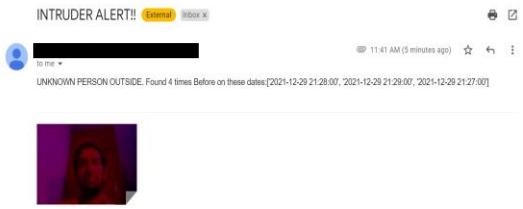

Figure 3. A sample of Intruder Alert message

The complete functional workflow of the proposed smart surveillance system is shown in figure 4 and its flowchart equivalent is shown in

figure 5. The user interaction aspect of the same is shown in figure 6.

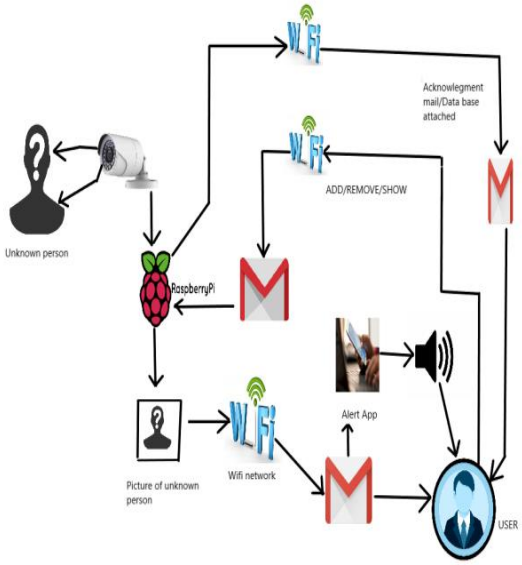

Figure 4. Functional workflow of the proposed smart surveillance system

3. Experimental Outcome and Discussions

The prototype of the proposed smart surveillance system is tested many times with known and unknown faces as visitors. Almost all the time it identifies the known people and sends the alert in case it identifies any unknown person as visitors. The trial of conducting the experiment helped to counter many complications, mainly in the code complexity and readability. We scaled down the size of the code reasonably by splitting it into various structured modules and refining the logic wherever possible.

During the long trials, We noticed that there was a slight delay in the runtime and communication time of the system. To tackle this issue, various counter measures were implemented to try to increase the framerate and refine the computation time. As the entire project was carried by python and the aim was to keep the product reasonably priced, the delay was kept but at a usable range so as to not compromise the purpose.

This refining and error control phase proved to be the most critical for the expected outcome of our project. The team discovered various limitations during this time and were able to double down and bring the project to new levels that seemed impossible before. By the time the final trials were carried out, the performance of the system exceeded expectations and the net cost proved to be economical. The code became extremely efficient to carry out the tasks and the outcome to provide an affordable home security system became a realisable reality.

4. Conclusion and future scope of the proposed system

This work has presented an automated home security system based on Raspberry pi 4 with a Raspberry Pi V2 CSI camera. This project has utilised assistance from apps like Gmail and eNotify Lite. This home security system helps in preventing potential threats in the form of burglary. It notifies the owner of the house immediately on spotting an unknown person. If the same unknown person is spotted more than once, an intruder alert mail with a clear cropped image of that unknown person is sent to the house owner along with the number of occurrences, times and dates of those occurrences are included in the alert mail as well. If the house owner is not in a state to read the mail, an alert ringtone from the eNotify app can be played to get the mail acknowledged by the house owner.

This project can be made more cost efficient in future by using a Raspberry pi 0 , Jetson Nano-2g or ESP 32 CAM. A 360º surveillance cam can be used for better identification of the unknown person. Telegram feature can be used in place of mail. More sample images can be used for a known person to get more accurate recognition from the AI. By adopting the above-mentioned methods, this project helps the people in keeping their house safe from burglary.

5. References

1. Iyer Saikumar, Gaonkar Pranjal, Wadekar Shweta, Kohmaria Nayan and Upadhyay Prashant, “IoT based Intruder Detection System Using GSM”, Proceedings of the 3rd International Conference on Advances in Science Technology (ICAST) 2020, April 8, 2020.

2. Anitha A, “Home security system using internet of things”, IOP Conference Series: Materials Science and Engineering, Volume 263, Issue 4, 2017

3. Pranav Kumar Madupu, Karthikeyan B, “Automatic Service Request System for

Security in Smart Home Using IoT," 2018 Second International Conference on Electronics, Communication and Aerospace Technology (ICECA), 29-31 March 2018

4. AKM Jahangir Alam Majumder and Joshua Aaron Izaguirre, "A Smart IoT Security System for Smart-Home Using Motion Detection and Facial Recognition," 2020 IEEE 44th Annual Computers, Software, and Applications Conference (COMPSAC), 13-17 July 2020

5. Haki Mehmet ERZ, Ahmet Arif AYDIN, "IoT Based Mobile Smart Home Surveillance Application," 2020 4th International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT), 22-24 Oct. 2020

6. Md. Hanif Ali Sohag, Md. Asif Ahamed, "Smart Home Security System Based on Microcontroller Using Internet and Android Smartphone", International Conference on Materials, Electronics & Information Engineering, ICMEIE-2015 05-06 June, 2015.

7. Mridhula Ramesh, S Akruthi, K Nandhini, S Meena, S Joseph Gladwin, R Rajavel, "Implementation of Vehicle Security System using GPS, GSM and Biometric" 2019 Women Institute of Technology Conference on Electrical and Computer Engineering (WITCON ECE), 22-23 Nov. 2019.

8. Sharada Murali, R Shrivatsan, V Sreenivas, Srihaarika Vijjappu, S Joseph Gladwin, R Rajavel, "Smart walking cane for the visually challenged", 2016 IEEE Region 10 Humanitarian Technology Conference (R10-HTC), 21-23 Dec. 2016.

9. Poorani Ravindhiran, Pradeep Gopal, S Joseph Gladwin, R Rajavel, "Automated indoor waste management system employing wavefront algorithm and received signal strength indicator values-based mobile robot", 2017 IEEE Region 10 Humanitarian Technology Conference (R10-HTC), 21-23 Dec. 2017.