

Home Security and Automation System: An Approach to Reduce Investment

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Abstract: In today's rapidly moving world where almost everything is driven by technology, it has become the central and essential part of living. With increasing rate of crime, protecting our loved ones and our belongings has become important. However, Home Security and Automation System achieved great popularity in the last decades and it increases the comfort and quality of life. Nowadays most home security and automation systems consist of a smart phone and micro controller. A smart phone application is used to control and monitor the home appliances using different type of communication techniques. This basically helps us to provide the comfort in the human life with less investment of money. The main focus of this study to reduce uses of hardware and investment cost. There are various existing systems that are used for security purposes such as Bluetooth-based systems, Micro controllers, Arduino boards etc. But they have some disadvantages like limited range, limited accessibility etc. One of the problems associated with this is the threat dangling above our heads, that do our loved ones are safe at home or not, do our belonging are safe or not. Living a secure and peaceful life has become everyone's fundamental goal. Technology has become most essential and dependent factor in every human's life. In this study the automation of security was achieved by designing an application on Raspberry Pi through various sensors such as motion sensor -PIR (Passive Infrared) sensors for detection of any intruder in the house.

Keywords: Camera, CCTV, Home automation, Raspberry Pi, Security, Sensor.

I. INTRODUCTION

The concept of home automation is not new. It was started around since the late 1970s. But with the advancement of technology, people's expectations of what a home should do or how the services should be provided and accessed at home has changed a lot during time, and so has the idea of home automation systems. If we look at various home systems over time, they have proved to provide efficient, convenient, and safe ways for home inhabitants to access their homes. Despite of the change in user expectations, advancement of technology, or change of time, the role of a home automation system has remained the same. According to Brand a home can be broken down into the "Six S's" namely Site, Structure, Skin, Service, Space Plan and stuff. Home automation systems mainly deal with last three "S's," i.e. Service, Space Plan, and Stuff. Some of the early challenges faced by home automation systems include high manufacturing, development, installation costs, additional service and support costs, deficit of home automation standards, consumer unfamiliarity with technology, and confusing user interfaces. With the rapid development in technology and processing power leads to a considerable reduction in device cost and size, which leads to make these system more popular and now people are no longer confused about the use of computer, mobiles, or tablets. As per A.J. Brush et al (2011), the main hindrances in modern home automation systems are: the high overall cost of the system

- Inflexibility due to use of different devices into the home automation system
- Lack of reliable devices at home
- Complex user interfaces
- Reliance on skilled consultants.

Due to above factors it is very difficult to control and provide complete security. Now a day's houses are equipped with numbers of devices such as multiple cameras, microphones, different sensors, actuators, device controllers, and home databases. All these gadgets can be control by using remote whenever required by user. Beside home database these can also give various information like on healthcare, financial, videos, pictures, live video feeds from home, daily habits or routines, favourite music, movies, and sometimes even a personal dairy. Research work is still going on to have better automation system at home and making it accessible via the Internet or mobile phones, saving energy, technology assisted living for senior citizens, and security. The regular surveillance of the CCTV camera is replaced with Automated CCTV surveillance. This Automated CCTV surveillance run with automated algorithm using image processing. The human efforts needed for vigilance on the screen using CCTV camera is reduced in great extent using this system. Following are some noted drawbacks of a CCTV camera:

- Requires human vigilance on the CCTV monitor
- No alertness provided during the time of mis happening
- No action taken regarding the mis-happening. These are the vital criteria to be fulfilled by the automated CCTV.

Keeping in mind these draw backs, a study was planned to emphasize security aspect of home automation to reduce hardware application and cost.

II. MATERIAL AND METHODS

To carry out this study, Raspberry Pi, PI Camera module, PIR sensor, LED. Bread Board, Resistor (1k), Connecting wires, Power supply, SD Card were used. These were sourced from e retailer. The description and specification of some of the main components are given below:

Raspberry Pi:

The Raspberry Pi is invented by Raspberry Pi Foundation located in England. It is based on a series of small single-board computers as shown in Fig. 1. The main aim of this development is to popularize learning and teaching of basic computer science in educational institutes in developing countries. Its first model became so much popular than the expectation. The main feature of this is that it does not require peripherals like keyboards, mouse etc. The accessories may be provided as per the requirement of users. This study is carried out by using Raspberry Pi 3B+ model with following specifications:

- 1.4GHz 64-bit quad-core processor,
- Dual-band wireless LAN, Bluetooth 4.2/BLE, faster Ethernet
- Power-over-Ethernet support (with separate PoE HAT).



Fig. 1: Raspberry Pi

PI Camera module:

In this project, Raspberry Pi Camera v2 is used as shown in Fig. 2. It is a high quality 8-megapixel Sony IMX219 image sensor with fixed focus lens. It is capable of 3280 x 2464-pixel static images, and supports 1080p30, 720p60 and 640x480p60/90 video.

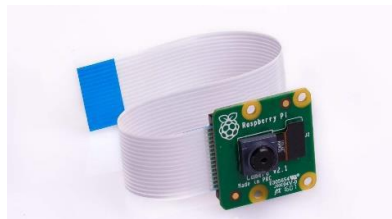


Fig. 2: Pi Camera Module

PIR Sensor:

A PIR Sensor is an electronic sensor that senses IR light radiating from objects. PIR sensors are commonly used in security alarms and auto lighting applications. PIR sensors detect general movement, but do not give any information on who or what moved. PIR sensors are commonly called simply "PIR", or also sometimes "PID", for "passive infrared detector". The term passive refers to the fact that PIR devices do not radiate any sort of energy for detection purposes. The Fig. 3 shows PIR Sensor.



Fig. 3: PIR Sensor

The procedure begins with the switching on the automated surveillance system along with the software. This activates the CCTV camera along with the software installed on the server. On observing any sort of unusual activity under the surveillance, a picture is sent to the user's email. If the user ratifies the activity, the software algorithm will be suspended for a while. If not ratified, the software will deploy all the necessities for security for instance:

- Save images of the suspect.
- Use only for indoor purpose
- Prevent significant variation in vigilance like automatic moving machinery or lighting and flashes.

The technical architecture and working of the system is given shown in Fig. 4.

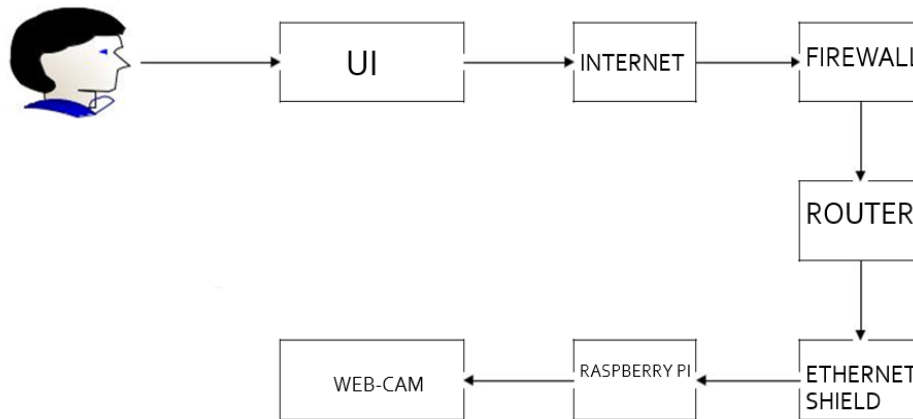


Fig-4: Technical architecture and working system

III. RESULTS AND DISCUSSIONS

The architecture of system contains 3 parts: home environment, home gateway and remote environment.

- Remote environment allows the authorized users to remotely control and monitor the home appliances using a smartphone, which supports Wi-Fi, 3G or 4G and android application.
- Home environment contains the hardware and home gateway. The function of home gateway is to provide the data transfer service between internet, router and Raspberry Pi Ethernet server.
- The most important part of home gateway is a micro web server which is built by using a Raspberry Pi Ethernet shield.
- Pi Camera is connected at the camera slot of the Raspberry Pi and PIR is connected to
- GPIO pin 18. A LED is also connected to the GPIO pin 17 through a 1k resistor.

The circuit diagram is shown in the Fig. 5.

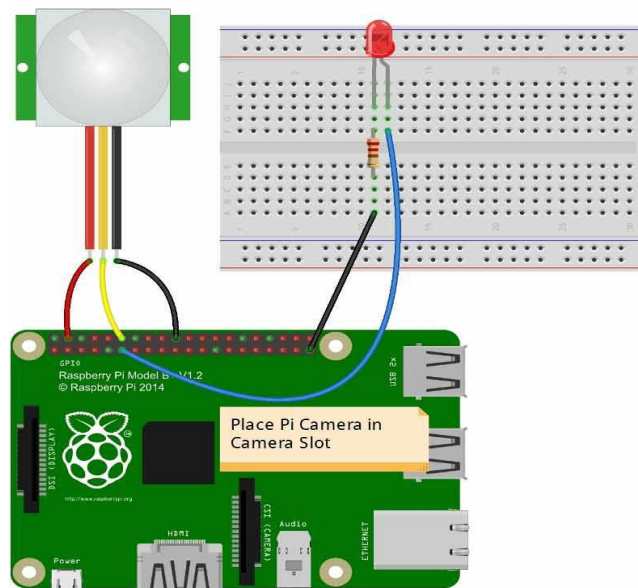


Fig. 5: Circuit Diagram

Use-Case diagram:

The main actors in the system are User, Wi-Fi, RPi and different controlling files such as python script for GPIO, IP, username and password. When user is connected to RPi through Wi-Fi, sends the request to RPi. The R-pi with the help of other commands (control files) sends the request to Web-Cam, which display's the requested image to the user. The Use-Case diagram is shown in the Fig. 6.

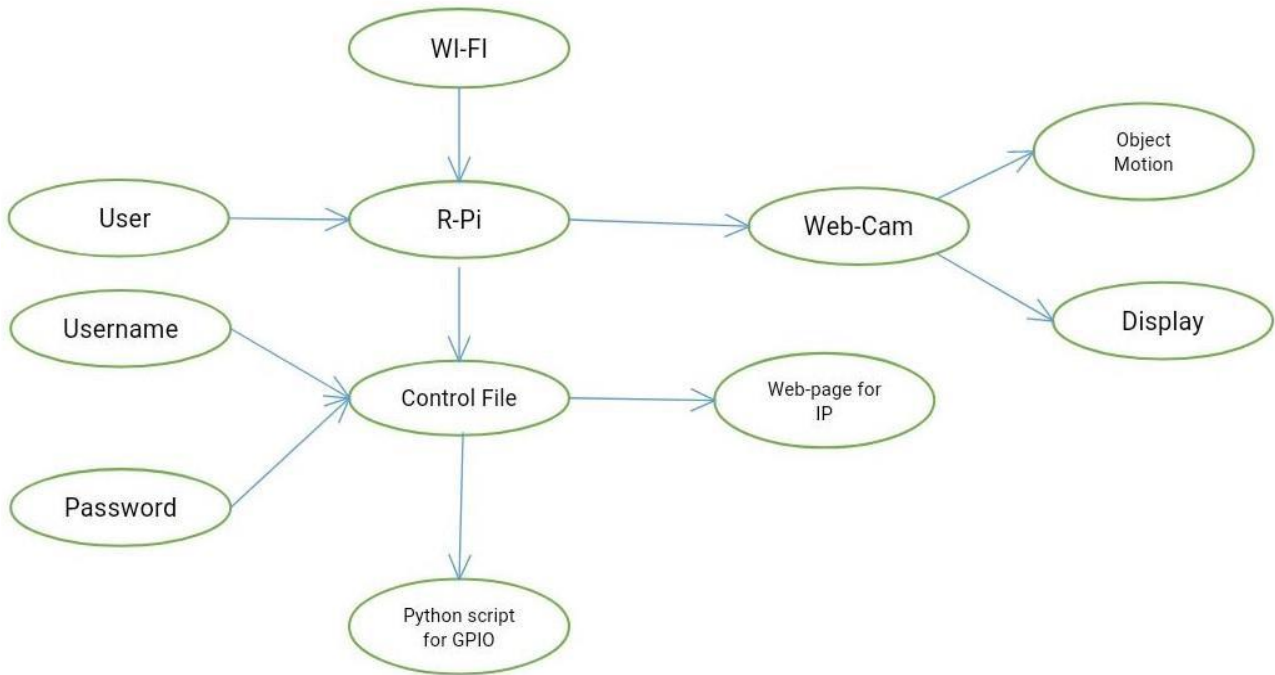


Fig. 6: Use-Case Diagram

Sequence diagram:

The user will have to first request for the current status of the object. Then with the help of the RPi the status will be sent to the user. Then User will send the updated image to the RPi, which will send the command to the web-cam. After this, user will be allowed to access the status of the object. If user requests for the live streaming to the RPi, the access of the live status will be given to the user with the help of components in the RPi. The Sequence diagram is shown in Fig. 7.

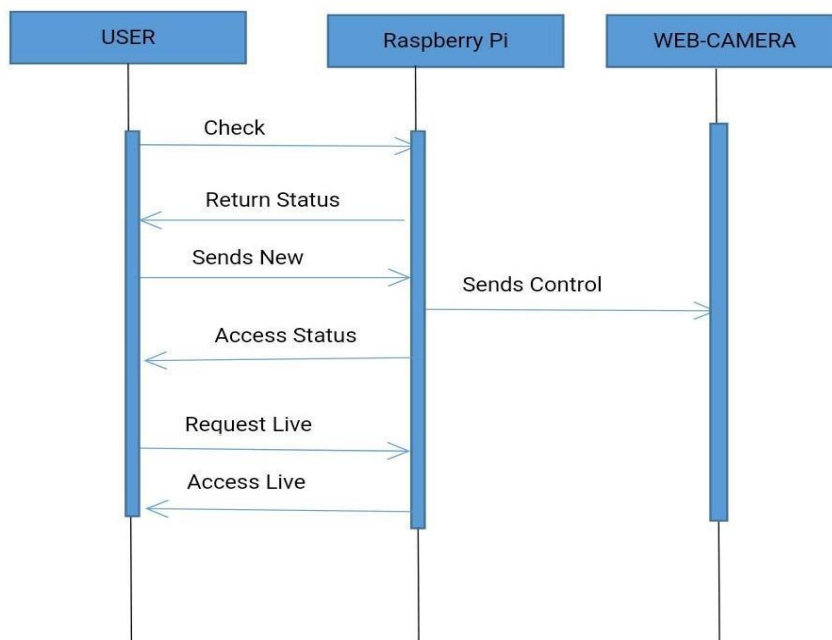


Fig. 7: Sequence Diagram

Component diagram:

Component diagram is a kind of diagram in the UML. The purpose is also different from other diagrams. It does not tell the functionality of the system, but it tells the components used. Following are the different components interacting (as shown in Fig. 8) with each other for the process:

- Wi-Fi is connected to RPi and device.
- RPi is connected to web-cam, power supply and PIR sensor. These are the components which will be used in the HOME SECURITY AND AUTOMATION SYSTEM.
- Functional description of the components:
 - **Wi-Fi:** Helps in connecting different components.
 - **Web-Cam:** Used for the display and controls motion of the object.
 - **Power Supply:** Provides power to the R-pi.
 - **PIR Sensor:** Detects the presence of any other object.
 - **RPi:** Main part of the system. Contain components which controls the whole system.

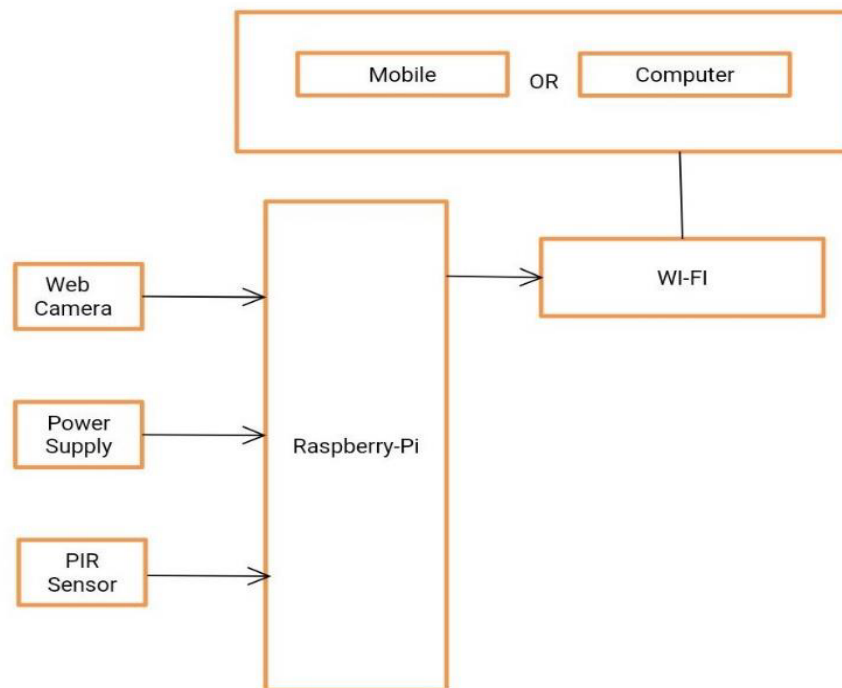


Fig 8: Component Diagram

IV. CONCLUSION

- The study indicated that implementation of Home Security and Automation System is very effective.
- Analysing the effectiveness of any future implementation of Home Security and Automation System would benefit greatly if such implementation is preceded by careful design.
- This system will help to achieve the online mode to successfully work, providing timely emails with screenshots of the things happening in the house.
- The web interface that is the offline mode also worked perfectly, supporting multiple views from different devices simultaneously.
- Achieving security without any human interference was also achieved using this system.
- This system required less hardware compare to the existing system.
- This system is having more processing power compare to the existing system.
- The overall system is cost effective compare to the existing system which was achieved with Wi-Fi and use of Raspberry Pi.

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