

Design and Implementation of a Smart Surveillance Security System

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ABSTRACT

Home security is essential for occupant's conveniences and protection. This research project designed and implemented a comparatively inexpensive smart surveillance security system that automatically captures an intruder's image through a raspberry pi camera module and PIR sensor and sends mail to the user via Wi-Fi using the users registered email address. This system operates by triggering the Pi Camera through Raspberry Pi whenever an intruder comes in range using PIR sensor. The Pi camera will capture the image, save it and send the image of the intruder via mail to the user through the help of the command codes embedded in the Raspberry pi microcontroller. This research project will enable home/supermarket and office owners to secure their facilities and monitor the activities of their employers at any location at cheaper cost which is the earnest desire of an Engineer. Proteus 2022 was used as the simulation tool. **Keywords:** Security, Spy camera, Raspberry pi, IOT, smart security system.

INTRODUCTION

Security is the first attention everyone wishes to have everywhere at every point in time in human life. The innovations in Technology have increased/improved the safety and security of human lives and property [1, 2, 3]. Home Security systems involved the combination of both human and electronic devices mechanism to detect intrusions in our environments and homes. The growth of Internet of Things (IOT) is referred to as a daily technological innovation which involves devices connecting to one other to create a pervasive computing [4, 5, 6]. These devices exchange data and information about the environment, while reacting independently to different events [7, 8, 9]. They influence the surroundings hence creating services with or without human intervention. The IOT has potential applications in all areas of life. One of the applications of IOT is smart security system [10, 11, 12]. The application uses IOT to process its data and by using this application, one will be able to monitor his households from a distance with the help of interconnected devices that

communicates through the internet [13, 14, 15]. The smart security system can detect any object movement, take a picture of the object and after sends a notification to the owner [16, 17, 18]. This application can be used in homes, in shops, in hotels and in other places around the world and it's the best application for monitoring and controlling a home/shops or super markets from a distance [1, 19, 20, 21]. The system in [2] provides two methods to implement home security using IOT. One of using web cameras such that whenever there is any motion detected by the camera, it sounds an alarm and sends a mail to the owner [22, 23, 24]. This method of detecting intrusion is quite good but somehow expensive due to the cost of cameras involved in the process [3, 25, 26,]. The cameras to be used are to be of good quality which means they should have a wide range and the picture quality should be high enough to detect the movement of an intruder [4, 27, 28]. The result in [5] is the automatic smart home security system that has the capability of controlling and automating

most of the home appliances. In this system embedded features like gas leakage alerts to user by sending simple text message and immediate signals to the server of the personal computer (PC) [29, 30, 31, 32, 33, 34]. Server sends message to user android mobile application connected with server of the pc through Wi-Fi. User can take immediate action on receiving SMS from server by automatically turning off the cylinder valve and opening windows. The system also has fire alarm embedded to sense increase temperature above threshold value. Server will take proper action by sending message through android application to the user [33, 34, 35].

The study in [6] is the IOT ruler which sends alerts to the owner over voice calls using the internet. If any sort of intruder or human movement is sensed near the entrance of his house and raises alarm upon the user's discretion whereby the provision of sending alert messages to concerned security personnel in case of critical situation is also built into the system and vice versa. The advantage of this smart security system is that when operating it the owner doesn't need to have data on his phone, the system just runs fine with the launch pad connected to Wi-Fi at home or office [7, 8, 9, 36, 37]. The researcher in [7] researched on home automation and security together with its major objective to help handicapped and aged people to control home appliances and alert them in critical conditions. In this system, a sensor senses the status of appliances and updates the webserver. If the user is far away from home, he/she can access and change status of the appliances for example switching a certain appliance on/off [10, 11, 12, 38,39,40].

The researcher in [8], researched on a home security system based on internet of things via favorite platform. In this project the device is equipped with passive infrared sensor that monitors

MATERIAL AND METHODS

This design and implementation of smart surveillance security system is basically designed to provide security for households using the spy camera and SMTP server which are all embedded in the system by the use of a raspberry

the presence of the intruder and any unauthorized entry. There is a Blynk application on the device that is used as the main switch which can activate the device whenever necessary. The home security system based on the Internet of things (IOTs) can help the users to monitor the house even when they are absent and a favorite platform helps the users to receive alerts as soon as possible [13,14,15].

In [9], the researcher developed a smart home security system using object recognition and PIR sensors which is capable for human detection. The IOT system is used to monitor the presence of an intruder in the house by the combination of motion detection and object recognition. The motion detection is performed using the PIR sensor, the web camera takes the picture of the suspicious spot. The system performs the object recognition by using the histogram of gradient (HOG) and support vector machine (SVM) methods. The system recognizes the appearance of an intruder and warn the house owner via alarm. The system is implemented on raspberry pi [16, 17, 18].

Smart security system with wireless camera is a system normal use in various homes to secure lives and environments through remote monitoring techniques like Internet of Things (IOT).

From the review above, many draw backs were discovered such as (a) nonchalant attitudes or misbehaviors/maltreatment by home caretakers of vulnerable age groups like toddlers, children and elders especially in Uganda. (b) The avoidable mistakes and stealing in the stores and super markets. This research work will address the problems of intrusions from unknown individuals or home burglars by designing and implementing a smart surveillance security system using internet of things technology that will create and send a notification email together with the happening image to the user's email address using Raspberry Pi.

pi microcontroller. The system comprises of hardware and software application program for the raspberry pi which was developed using python script code as a programming language. The hardware units compose of DC fan,

Ip Spy camera, raspberry pi and power units (voltage regulator, battery etc.) components.

Materials

1.Power Supply: This is an electrical charger that supplies a rated power to an electrical load. The system uses a smartphone charger with a green/red indicator which when blinks showed that the charger is passing on electrical energy.



Figure 2: Smartphone Charger

2. Voltage Regulator: This is a system designed to automatically maintain a constant voltage level, depending on the design and specifications of the voltage regulator to be used (DC or AC). 5V DC regulator was used for this design [10][11].

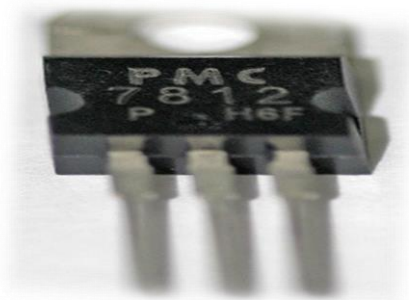


Figure 3: voltage regulator

3. Dc cooling Fan: The direct current fans are powered with potential fixed values of voltage such as voltage of battery. Typical voltages for dc fans are 5v, 12v, 24v and 48v. It is used to keep

5. Raspberry Pi-3: The raspberry pi is a low-cost credit card sized computer that plugs into a computer monitor or TV and uses a standard keyboard and mouse. a raspberry pi microcontroller is used in embedding the spy camera and SMTP

the raspberry pi microcontroller cool to avoid overheating. The fan is plugged directly into Raspberry Pi's 5V+GND GPIO power pin [19][20].



Figure 4: DC cooling fan

4. Passive Infrared (PIR) Sensor: PIR sensor is an essential for emitting infrared (IR) radiation through its movement. PIR is an electronic sensor that used to detect the object motion by receiving the infrared (IR) as light radiates from the external environments. The sensor compares the intensity of the infrared radiation from time to time. If there is an object movement in the room, the intensity changes and detecting the object movement takes place. The PIR Sensor is small in size, inexpensive in price, uses low power, easy in use and connectivity [21][22]



Figure 5: Passive Infrared (PIR) Sensor

server for interfacing and communication between the devices and the programming codes [4][23].



Figure 5: Raspberry Pi3 Model B.

6. Ip Spy Camera /raspberry pi camera module

This is a type of digital video camera that receives control data and sends image data via an IP network commonly used for surveillance camera. The Camera Module Rev 1.3 is a type of camera that was specifically designed

for Raspberry Pi model A and B. The camera module connects to Raspberry Pi 3 by Camera Serial Interface (CSI) connector using a 15cm ribbon cable to the 15 pin CSI connector. Some Specific configuration settings were done to initialize the camera and accepts Python scripts to enable it take pictures.



Figure 6: Ip Spy Camera /Raspberry Pi Camera Module

7. Simple Mail Transfer Protocol (SMTP) Server: This is a communication protocol for electronic mail transmission. SMTP Server is an application server that primarily send,

receive and or replies an outgoing mail between senders and receivers. SMTP is mainly designed to send email or SMS notifications to a user.

RESULTS AND DISCUSSION

The block diagram and the circuit diagram of this security smart surveillance design are presented as shown in figure 7 and figure 8. The block

diagram consists of the major components that make up the system as in figure 7.

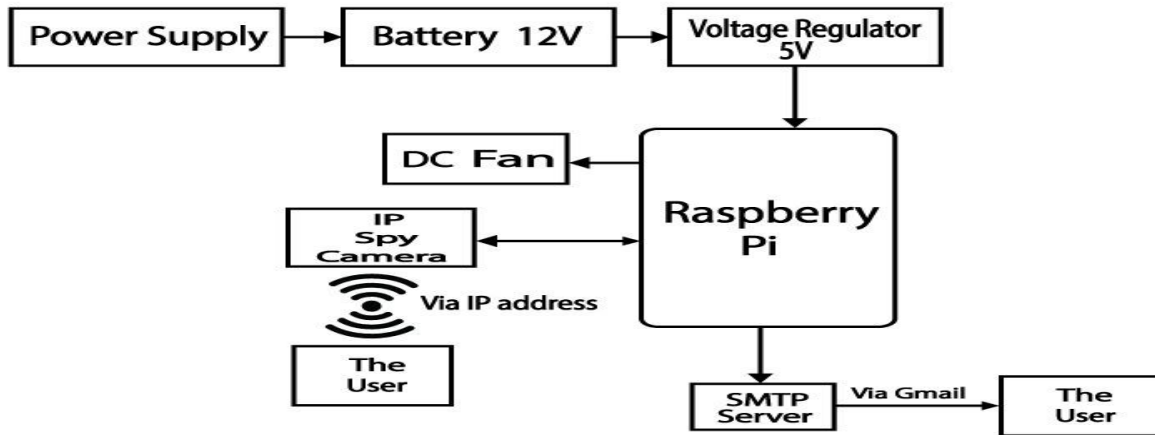


Figure 7: Block diagram of smart surveillance security system

The step-by-step block connections of the smart surveillance security system that details how the block diagrams where connected. Power supply block supplies energy to the Raspberry pi where the codes were embedded and at the same time were interactions between

other blocks takes place. It is from the Raspberry pi that the decision to take picture if there is intruder and sent email to was initiated. The fan cools the system when it heats and the IP spy camera takes picture whereas the SMTP server sends mail to the user.

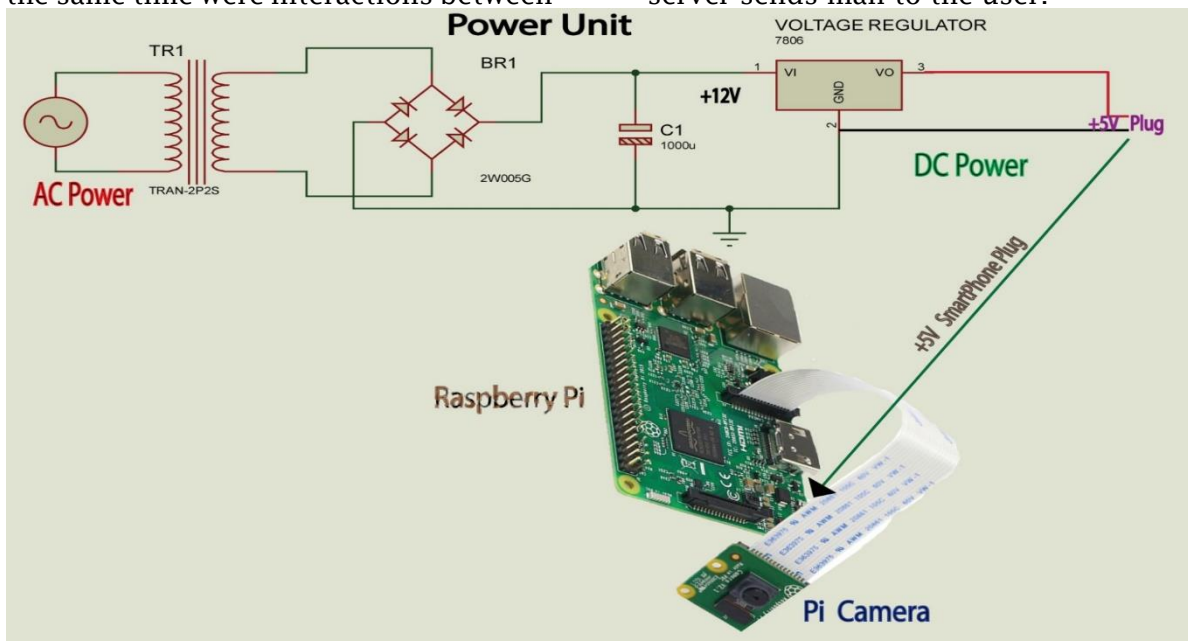


Figure 8: Circuit Diagram of Smart Surveillance Security System

This circuit diagram showed the interconnections between different components that constituted the circuit. This focused on developing a surveillance system that detects motion and as well respond to it immediately by capturing the image and administering it to the device administrator through

email. The system can be monitored by the user form anywhere in the world. This is achieved by the combination of some hardware and a python written software program script to accomplish a real time surveillance system as designed in this research.



Figure 9: Camera Space and charging chord

Figure 9 is the circuit set up for camera positioning and USB charging slot. It shows the implementation procedures and how it was achieved sequentially. A

written program that supports the OS to send email to the user through the raspberry PI microcontroller was used for efficiency and accuracy.

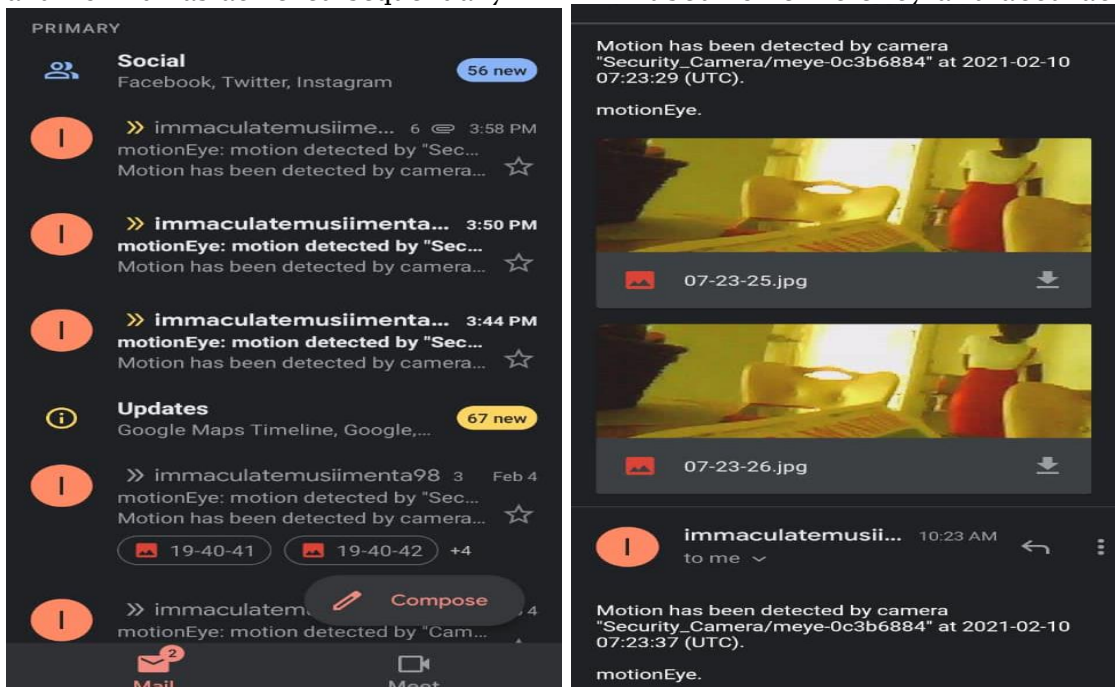


Figure 10: Intruder Notification image

The intruder image was captured by raspberry pi camera embedded in the microcontroller which was fully developed to capture the images of an intruder and notify the user with the happenings in the environment as shown in figure 10. Figure 10, showed the captured image of an intruder when an unusual motion was detected by the developed smart surveillance security system. The detected image of the

intruder together with notification mail was sent to the user to notify him/her on that an intruder was detected. The captured images will be sent to the user via mail within five seconds of discovery for the user to take immediate security action either by calling the external security agency for immediate interventions or by taking every other necessary action to ensure that the environment is secured.

CONCLUSION

This developed smart security system monitors any movement in the premises effectively which was efficiently

achieved using the SMTP server and the python script code program in raspberry PI. This developed smart security system

consists of a raspberry pi, camera module, server and a sensor. The server controls and monitors the various sensors and can be easily configured to handle hardware interface modules (sensors). The system perfectly detects the movement of any intruder, captures

Edozie *et al* the image and sends it to the owner (user) via email. The smart surveillance security system was developed effectively at a very low cost and when commercialized will help in reducing crimes and encourages security in Africa.

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