A Smart System for Robbery Detection and Alerting Using Raspberry Pi 3

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Abstract- *Now a days the technology is increasing rapidly, that leads to an upgradation in home security system. Automation in security sector makes it more authentic. In order to secure and guard our places, we are in need of safe locks in our absence, here we are providing home security for the theft detection by implementing smart surveillance system using Camera along with Raspberry Pi 3 where we use image processing to detect theft using motion. In this system, we also use IR for night vision, GSM, and USB drive. The Camera, Raspberry Pi3 and GSM are integrated in such a way that any unauthorized person enters the room, the system immediately uses image processing to detect an exact area of motion occurrence and transmits the images to be viewed by the user online. In addition to this, it uses the GSM to make an alert call for owner and USB drive to store the footage for future reference. Thus, the system provides an innovative approach for Theft Detection using Raspberry Pi3 and puts forward design of flexible standalone, low-cost smart detection system.*

Keywords- Raspberry Pi 3; Infra-red sensors (IR); Image Processing; Motion Detection; Internet of Things (IoT), Theft Detection System (TDS).

I. INTRODUCTION

Theft is one of the most common and criminal behaviors and it is increasing day by day. The crime rate has increased worldwide. Due to increase rate of theft, the people have suffered in fear and loss. In order to stop this increasing theft across the world, there is a need for a theft detection and monitoring system that is convenient in use, relatively free from false alarms and does not require frequent user action to arm and disarm the system. There were lots of inventions developed in the field of IoT and the most recognized one is smart surveillance system development. There were lots of advancements in the wireless technologies such as domain, cloud and many other technologies which were included in the system to show something new. IoT will include many devices such as electronic, electrical and IT related works. Among many IoT applications the smart surveillance system plays a vital role in realizing the smart cities also The Government of India has planned develop many smart cities across the country which will create a huge demand for smart home automation solutions in near future. So here, we propose theft detection project using Raspberry Pi3 where we use image processing on live video to detect theft using motion and also highlight the area where motion occurred. This smart and automated system rules out the work of humans to be present all the time.

II. LITERATURE SURVEY

A great deal of research has been performed for automatic theft detection. A significant amount of literature was reviewed for the same. Ying-Wen Bai et al. [1] have used a many ultrasonic sensors for the detection of intruders. If someone pass through the sensors, transmission will be blocked, and the system knows the situation. Major Voting Mechanism (MVM) is used to turn on the video camera. A. Anbasari et al. [2] presented a method for network indoor home automation and evaluated the wireless smart homes. It also helps the future researchers for developing a practical and sustainable smart home. This system provides a gathered information to communication protocols, multimedia devices, sensors and systems. Haipeng Chen et al. [3] provided a ARM based video surveillance using embedded remote. The system sends the captured video to the user's mobile through e-mail. During long-term monitoring the system adapts to the ambient light changes. For sudden appearance in highlight, it provides good resistance. A survey has been conducted by Gayathri P. Sonawane et al. [4] on different video monitoring system. Most of the system used ARM9 and ARM11 for their implementation. The different compression technique available for video compression is MPEG, H.264 and JPEG. H.264 provides a better way of usage without degrading the image quality. O. Urfaliglu et al. [5] have used Conditional Gaussian Mixture Models (CGMM) for classification of human motions. This approach is based on Bayesian. The PIR sensor is used to detect the motion. The human activities are monitored through a camera. Luo Wei et al. [6] developed a smart home system using AT89552SCM and ARM. They have implemented a GPRS, GSM, camera, sensors, smart phone and speech recognition in an integrated way into their system. U. Ramakrishna et al. [7] has implemented the

security surveillance system using RP. It stores the captured images and videos into the cloud and at the same time SMS and email notifications are sent to the owner. Live streaming video is also used for better monitoring purpose.

III. CHALLENGES IDENTIFIED IN THE EXISTING IOT BASED ANTI-THEFT SYSTEM

In existing system, the system used to detect the theft is not reliable. In existing system, there is an emergency alert system for alerting the nearby people which is not sufficient to identify the burglar since it only triggers the alarm and goes off after some time. This system sends out emergency message through GSM. If in case the GSM message is not delivered to the owner on time, then the whole system is considered as failure. To overcome all these drawbacks, we propose a new system for theft detection monitoring.
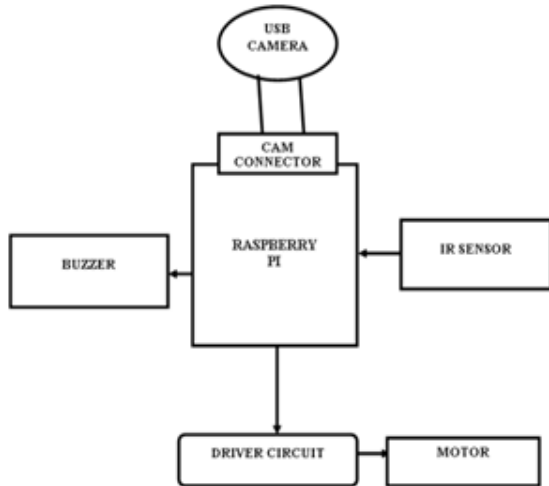

Fig. 1 IoT Based Anti-Theft System Block Diagram

IV. CHALLENGES OVERCAME IN THE PROPOSED GSM BASED ANTI-THEFT SYSTEM

This anti-theft system consists of USB camera, IR sensor, Speaker & GSM for bot calling. The system overcomes the drawback of the existing system. This anti-theft system consists of USB camera, IR sensor, Speaker & GSM for bot calling. The USB camera is used for monitoring & detecting theft using digital Image processing. The IR sensor is also used as an alternative for Camera during night or dark vision. If the item to be preserved is stolen, then an alert is provided to the user using E-mail about the missing of the item and a bot call is made to the owner simultaneously. Even if bot call is not made on time the footage is stored in USB drive for future reference. The E-mail sent to the respective owner is highlighted with a frame where the inactivity or motion has occurred.
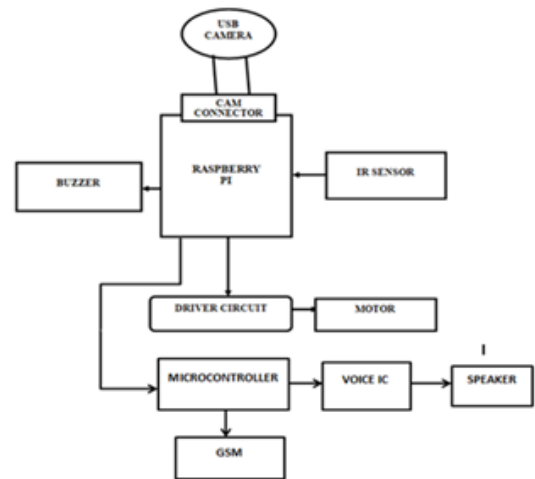

Fig. 2 Block Diagram of Proposed GSM based Anti-Theft Device

The system recognizes the unauthorized person based on the test images run by the user. A motor is used to lock the doors as soon as the item is detected as stolen to catch the thief before he escapes. The Buzzer is used to alert the surrounding about the theft. A sprayer filled with anaesthesia is attached with motor to make the burglar unconscious. A voice IC is connected to microcontroller, which is used to record voices and the pre-recorded voices play through the speaker attached with the IC when any theft occurs. This provides the warning to the surrounding for burglar alert.
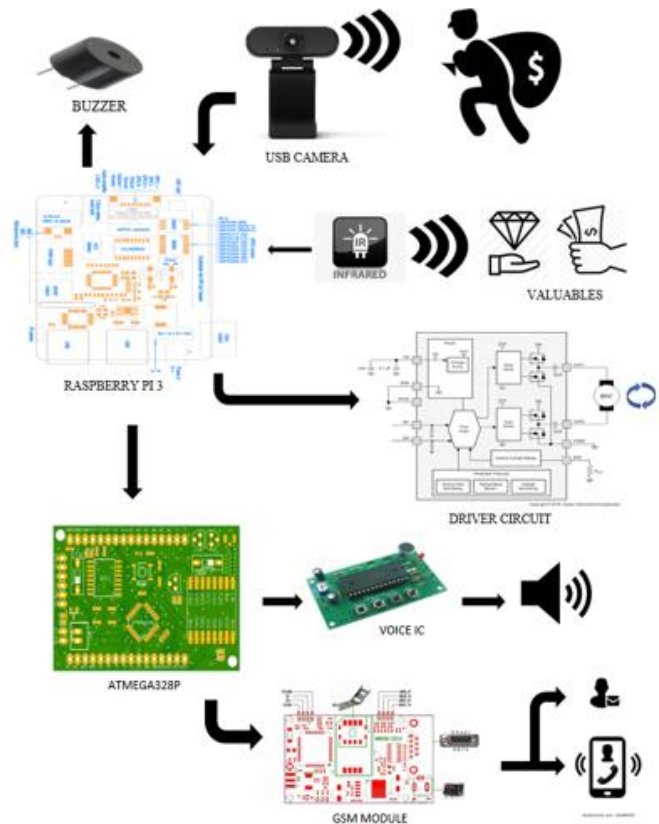

Fig. 3 Framework of Proposed model

Fig. 5 Model of USB Camera

V. HARDWARE COMPONENTS

A. Raspberry Pi 3

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B. Whilst maintaining the popular board format the Raspberry Pi 3 Model B brings you a more powerful processer, 10x faster than the first-generation Raspberry Pi. Additionally, it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs.

Fig. 4 Model of Raspberry Pi 3

B. USB Camera

A webcam is a video camera that feeds or streams its image in real time to or through a computer-to-computer network. When captured by the computer, the video stream may be saved, viewed, or sent on to other networks via systems such as the internet, and email as an attachment. When sent to a remote location, the video stream may be saved, viewed or on sent there. Unlike an IP camera (which connects using Ethernet or Wi-Fi), a webcam is generally connected by a USB cable, or similar cable, or built into computer hardware, such as laptops.

C. IR Module- EAEC100100-236

Infra-red sensors are the most often used sensor by amateur roboteers. Understanding how they behave can help address many of your requirements and would suffice to address most of the problem statements for various robotics events in India. Be it a typical white/black line follower, a wall follower, obstacle avoidance, micro mouse, an advanced flavor of line follower like red line follower, etc., all of these problem statements can be easily addressed and granular control can be exercised upon your robots performance if you have a good operational understanding of Infra-red sensors.
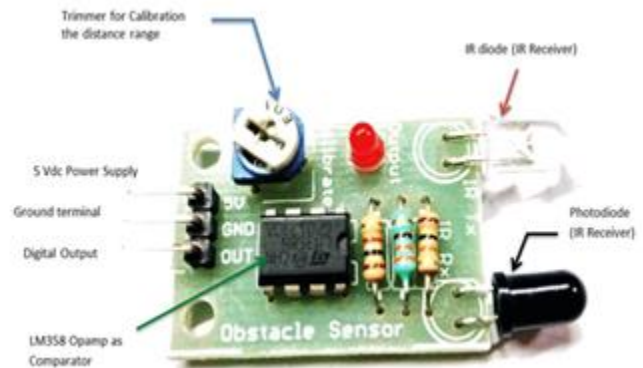

Fig. 6 Model of IR Sensor

D. ATMEGA328P IC- Arduino Microcontroller

Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog I/O pins that can interface to various expansion boards (termed shields) and other circuits. The boards feature serial communication interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an IDE based on a programming language named Processing, which also supports the languages C and C++.

Fig. 7 Model of Arduino UNO

E. APR9600-Sound Recorder IC

The APR9600 device offers true single-chip voice recording, non-volatile storage, and playback capability for 40 to 60 seconds. The device supports both random and sequential access of multiple messages. Sample rates are user-selectable, allowing designers to customize their design for unique quality and storage time needs. Integrated output amplifier, microphone amplifier, and AGC circuits greatly simplify system design. The device is ideal for use in portable voice recorders, toys, and many other consumer and industrial applications.

Fig. 8 Model of Voice IC

F. DRV8871-Driver Circuit IC

The DRV8871 device is an optimized 8-pin device for driving brushed DC motors with 6.5 to 45 V and up to 3.6-A peak current. The integrated current regulation restricts motor current to a predefined maximum. Two logic inputs control the H-bridge driver, which consists of four N-channel MOSFETs that have a typical Rds (on) of 565 mΩ (including one high-side and one low-side FET). A single power input, VM, serves as both device power and the motor winding bias voltage. The integrated charge pump of the device boosts VM internally and fully enhances the high-side FETs. Motor speed can be controlled with pulse-width modulation, at frequencies between 0 to 100 kHz. The device has an integrated sleep mode that is entered by bringing both inputs low. An

assortment of protection features prevents the device from being damaged if a system fault occurs.

Fig. 9 Model of DRV8871 IC

G. BUZZER

A buzzer or beeper is an audio signalling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke

Fig. 10 Model of Buzzer

H. GSM SIM800C Modem

Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz

GSM GPRS SIM800C Modem-RS232 is built with Quad-Band GSM GPRS engine-SIM800C, works on frequencies 850/900/1800/1900MHz. This Modem comes with RS232 interface, which allows you to connect PC as well as a microcontroller with RS232 Chip (MAX232). The baud rate is configurable from 9600-115200 through AT command. The GSM GPRS Modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The onboard Regulated Power supply allows you to connect wide range unregulated power supply. Using this modem, you can make audio calls, SMS, Read SMS, attend the incoming calls and internet etc through simple AT commands.
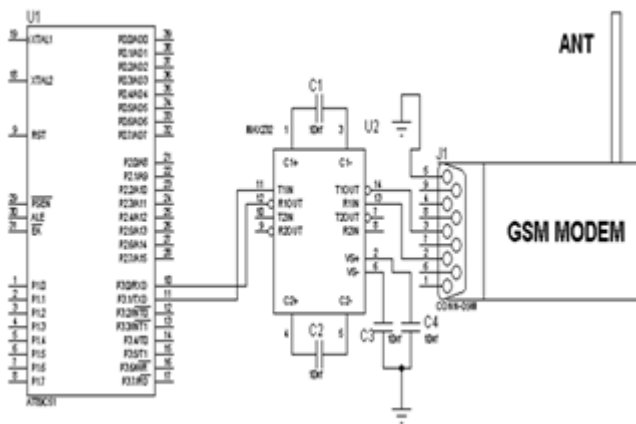
Fig. 11 Circuit Layout of GSM SIM800C

I. HDMI to VGA Converter

The HDMI to VGA Converter is your affordable solution for transferring HDMI signal into VGA and Audio signal. This converts the HDMI digital signal to VGA analog signal. It enables the PC, Laptop DVD, PS3, Xbox360 Sky HD, Apple TV and other HD device to be connected to VGA monitor, projector or other display for education, business presentation, commercial promotion, conference, exhibition, etc. It supports the high-definition output of 720P or 1080P.

Fig. 12 HDMI to VGA Cable

VI. SOFTWARE TOOLS

A. Python v20.3

Python is a widely used high-level programming language for general-purpose programming, created by Guido van Rossum and first released in 1991. An interpreted language, Python has a design philosophy that emphasizes code readability (notably using whitespace indentation to delimit code blocks rather than curly brackets or keywords), and a syntax that allows programmers to express concepts in fewer lines of code than might be used in languages such as C++ or Java. The language provides constructs intended to enable writing clear programs on both a small and large scale. In this TDS the source code is written in python.

B. Raspbian OS v2.6

Raspbian is a Debian-based computer operating system for Raspberry Pi. Since 2015 it has been officially provided by the Raspberry Pi Foundation as the primary operating system for the family of Raspberry Pi single-board computers. Raspbian was created by Mike Thompson and Peter Green as an independent project. The initial build was completed in June 2012. The operating system is still under active development. Raspbian is highly optimized for the Raspberry Pi line's low-performance ARM CPUs.

C. Arduino IDE v1.8.13

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

VII. WORKFLOW

The Raspberry Pi3 is the heart of the system, it acts as the central processing unit of the system and this intelligent system consists of IR sensor, USB camera as input devices and Buzzer, Driver circuit with servo motor as output devices, respectively, that are connected to Raspberry Pi3. Raspberry Pi3 excels at processing large amount of data very quickly and it is connected to ATMEGA328P – Arduino based microcontroller that excels at controlling other hardware components like voice IC & GSM Module and is responsible of sending mail and performing bot calling. The ATMEGA328p will act as a subsystem that interfaces with the Raspberry Pi3.
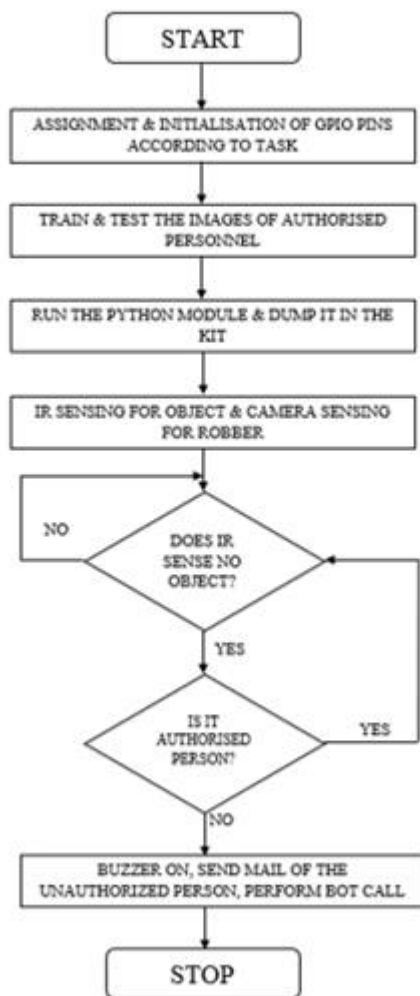
Fig.16 Flowchart of Proposed Work

Raspbian OS & Python module is used as Software tools. The GPIO pins of Raspberry Pi3 are assigned & initialised with Task. The USB camera is used to take pictures of authorised person and is trained through image processing techniques. IR sensor enables when the Object is taken away, thus enabling the Buzzer & thereby enabling the voice IC connected with speaker and the GSM module, a mail is sent to the owner highlighting the unrecognized activity or person and call is made with a pre-recorded voice reporting the theft.

VIII. ADVANTAGES AND APPLICATIONS

This Smart Theft Detection system is suitable for small personal area surveillance. i.e., personal office cabin, bank locker room, parking entrance, whenever the motion is detected through. It has a major advancement apart from the existing systems to detect the theft as soon as possible, using a bot calling feature which is a pre-recorded voice that alerts the owner through GSM call. In surveillance, CCTV camera is costly because of the use of a computer. It reserves too much space for continues recording and also requires manpower to

detect the unauthorized Activity. Compare to Existing System Raspberry Pi is much cheaper with better resolution and low power consumption features.

It has wide applications like Jewellery Shop, Army Surveillance, Bank Locker Room, Museum Security, Home Security, Safe locks, Office security, Industrial Surveillance, ATM surveillance. It is using Buzzer system which uses to alert the owner by making sound. A bot calling feature for faster alert to the owner. It is Easy to implement, available in low cost with high quality, convenient to use, relatively free from false alarms and does not require frequent user action to arm and disarm the system. It is durable, consumes less amount of electricity and very less chance of being hacked.

IX. FUTURE SCOPE

From improvement point of view, we can add new features to existing system such as, providing delay timer to the system so that owner can switch off the system. Using framing techniques video can also be captured as an evidence. We can also notify the nearest police station with location of intruder detection through GSM module. If we want to cover large area through the system, we can deploy multiple sensors using multiplexer. Piezo sensor can be added to the system to distinguish between Animal and Human intrusion using the temperature & pressure changes.

X. RESULTS AND DISCUSSIONS

As observed, the project mainly deals with security and alerting when robbery occurs in the absence of the owner. We have come across many cases in our country and all over the world regarding robbery in shops, malls, ATMs and in places that attract attention. This can be avoided with proper surveillance and security. But mankind is never reliable in today's scenario. So, we have proposed this anti-theft smart system that can be easily assembled in places that are in need of surveillance and protection. The IR sensor is placed beneath the object and is sensed continuously. When the object is removed, the sensor senses its absence and therefore the buzzer goes on and the motor sprays the anesthesia so that the thief becomes unable to move. Simultaneously the camera captures the picture of the robber and sends it to the owner's mail. Meanwhile, the owner gets a call for intimation. As a result, the object is saved from robbery and the thief would be arrested. Hence, we assure that our project can be relied on for safety, security, surveillance and protection.
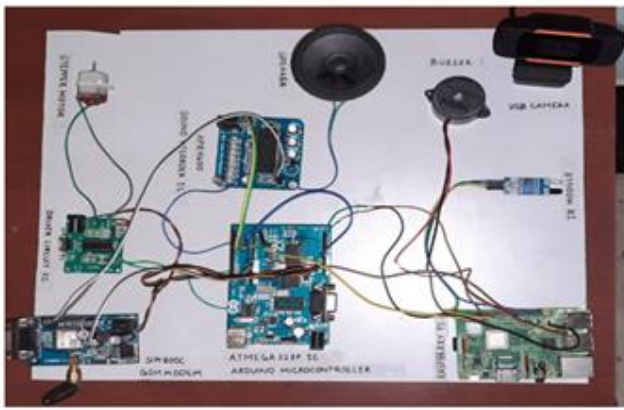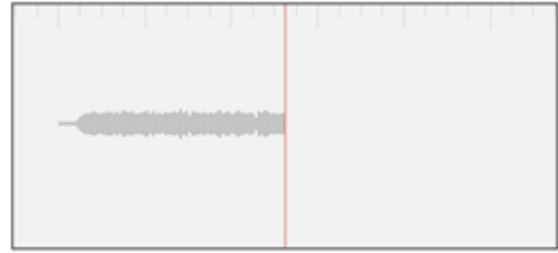
Fig. 17 Hardware Module of Smart Anti-Theft Device

A. Alert Call and Mail Output

Fig. 18 Alert Call Output

Fig. 19 Alert Mail Output

B. Buzzer Output in terms of Frequency Variations

When the IR Sensor is not enabled, then the Raspberry Pi 3 is not enabled, which in turn has no effect on Buzzer connected to it. This state of Buzzer is called Normal Mode, where the frequency variations are low, specifying Buzzer is OFF.

B

Fig. 20 Normal Mode

When the IR Sensor is enabled, the Raspberry Pi 3 turns on, this in turn switches on the Buzzer connected to it. This state of Buzzer is called Robber Alert Mode, where the frequency variations are high, specifying Buzzer is ON.
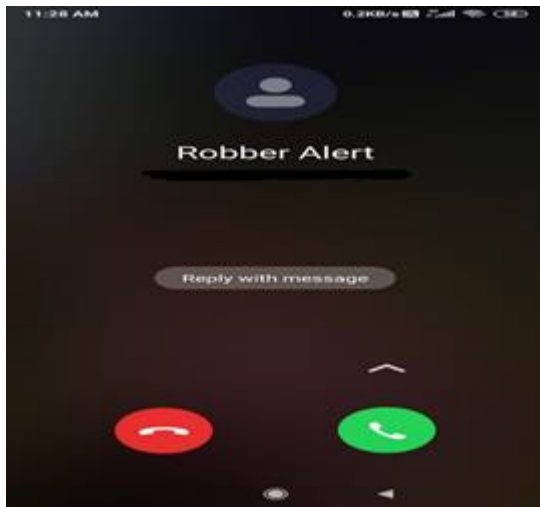

Fig. 21 Robber Alert Mode

XI. CONCLUSION

The security system described in this project is capable of detecting intruders. The system informs the authorized owner of an unauthorized intrusion via Mail & GSM call no matter where the person is, at the time of intrusion. The commonly available systems today are one, where the intrusion is detected via alarms making out sounds, which is not as much efficient. This system is very beneficial for people who wants to safeguard their properties and restrict access. This system is very affordable and easily operated, so that anybody whether rich or comfortable, young, or old can make use of this system. Thus, we have designed a home security alarm system using Arduino and Raspberry Pi3, which is handy, portable, cost-effective, and highly effective as well. Such alarm systems are hugely in demand for security purposes, and thus the given system can be proved useful and effective in view of the above features. It can be concluded that the proposed system presents the basic level of security, remote monitoring, theft detection and alerting while the required objectives of Anti-Theft secure system have been achieved.
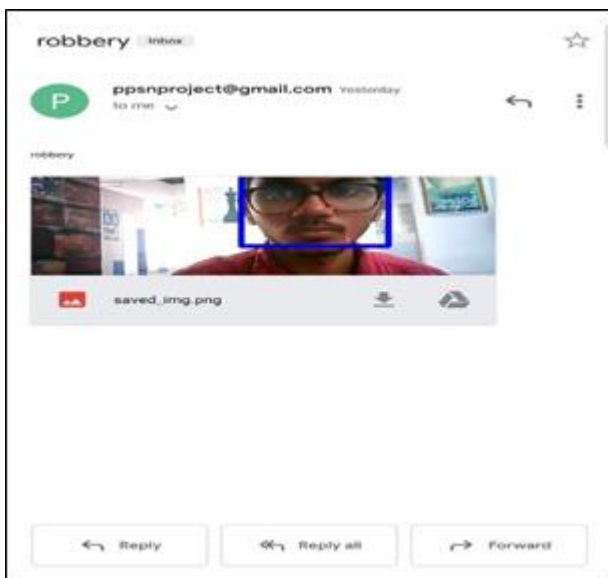
REFERENCES

[1] Ying-Wen Bai, Li-Sih Shen and Zong-Han Li, "Design and Implementation of an Embedded Home Surveillance System Use of Multiple Ultrasonic Sensors", IEEE Transactions on Consumer Electronics, Vol. 56. Issue No. 1, February 2010.

[2] Anbarasi and M. Ishwarya, "Design and Implementation of Smart Home using Sensor Network", International Conference on Optical Imaging Sensor and Security, pp. 1-6, 2013.

[3] Haipeng Chen, Xuanjing Shen, Fang Mei and Yingda Lv, "Embedded Remote Video Surveillance System Based on ARM", Vol.13, Issue No.3, pp. 51-57, 2011.

[4] Gayatri.P.Sonawane and Dr A.J. Patil, "A Survey on Different Digital Video Monitoring Systems", International Journal of Computer Science Trends and Technology, Volume 3 Issue 3, pp. 132-134, May-June 2015.

[5] O. Urfaliglu,Emin B. Soyer and B. Ugur Toreyin, "PIR-sensor based human motion event classification", Signal Processing, Communication and Applications Conference, April 2008.

[6] Luo Wei, Li Wei and Li Xin, "Design and Implement on Smart Home System", International Conference on Intelligent Systems Design and Engineering Applications, pp. 229-231, 2013.

[7] U.Ramakrishna and N. Swathi, "Design and Implementation of an IoT Based Smart Security Surveillance System", International Journal of Scientific Engineering and Technology Research, Vol. 5, Issue 4, pp 697-702, Feb-2016.

[8] Bing. Z, Yunhung. G, Bo. L, Guangwei. Z, Tian. T, 2001, "Home Video Security Surveillance", Info-Tech and Infonet, Proceedings, ICII Beijing. International Conference, vol 3, pp.202-208.