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**INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH
TECHNOLOGY****IOT BASED HOME SECURITY SYSTEM****Akruti Khurana¹, Shiva Karpe² & Dr. Gaurav Sharma^{*3}**¹B.Tech Student, ECE Department, CVR College of Engineering, Hyderabad²B.Tech Student, CSE Department, CVR College of Engineering, Hyderabad^{*3}Assistant Professor, ECE Department, CVR College of Engineering, Hyderabad

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ABSTRACT

In recent years embedded systems have gained more importance. These systems are especially dedicated to specific tasks which are handled by highly optimized solutions. One of the interesting areas of embedded systems use is multi-media. Producing, processing, streaming various multimedia types and interacting with the physical environment is very common today. Similar to these studies, controlling and observing the specified area by multi-media tools are the necessities for many reasons such as security. This project presents a method of video and photo recording of any moving object by using open source operation system (Raspbian- a distribution of Linux) and software (Python – a high-level programming language). The system finds motion and it collects visual data the collected data is saved in local server in our prototype project in real-time we can publish on internet via dedicated web site.

KEYWORDS: Raspberrypi , Pi Cam , GSM module , Adaptor.**1. INTRODUCTION**

Internet of things (IOT) platform based smart device/system has entered into a golden era of rapid growing technology in the field of home security. The Internet of Things is a concept to make every device/system such as Internet TV's, smart phones and sensors connected with the Internet can be controlled and monitored from anywhere and anytime. There are various existing systems that are used for home security purposes such as Microcontrollers- based wired and wireless security systems, CCTV system etc., but they are much expensive and having limitation in range and accessibility to the user [1]. In this research work, cost effective Raspberry Pi based home security system using pi cam and motion sensing feature.

In this project, an IoT platform-based home security system is developed. Whenever motion is detected in front of home door then system save image/video. It will contain image of the Intruder/video clip of the Intruder which is captured by Pi-camera. Raspberry Pi-3 is used to control the whole home security system with Python programming [2]. This system can be installed at the main door of user home or office, then user can access from his/her Smartphone from anywhere in the world over internet and control also like start/stop camera, enable/disable motion sensing, view the recorded images/videos, change camera settings and edit schedule settings.

Introduction to embedded systems

Embedded systems are electronic devices that incorporate microprocessors with in their implementations. The main purposes of the microprocessors are to simplify the system design and provide flexibility. Having a microprocessor in the device helps in removing the bugs, making modifications, or adding new features are only matter of rewriting the software that controls the device [1,3].

Embedded systems are self-contained programs that are embedded within a piece of hardware. Whereas a regular computer has many different applications and software that can be applied to various tasks, embedded systems are usually set to a specific task that cannot be altered without physically manipulating the circuitry. Embedded systems designers usually have a significant grasp of hardware technologies [2]. They use specific programming languages and software to develop embedded systems and manipulate the equipment.



Embedded systems technologies are usually fairly expensive due to the necessary development time and built in efficiencies, but they are also highly valued in specific industries.

Classification of Embedded Systems

- Stand Alone Embedded Systems
- Real Time Embedded Systems
- Network Information Appliances
- Mobile Devices

Characteristics of an Embedded System

- 1) Single-functioned – An embedded system usually performs a specialized operation and does the same repeatedly. For example: A pager always functions as a pager.
- 2) Tightly constrained – All computing systems have constraints on design metrics, but those on an embedded system can be especially tight. Design metrics is a measure of an implementation's features such as its cost, size, power, and performance. It must be of a size to fit on a single chip, must perform fast enough to process data in real time and consume minimum power to extend battery life [4].
- 3) Reactive and Real time – Many embedded systems must continually react to changes in the system's environment and must compute certain results in real time without any delay. Consider an example of a car cruise controller; it continually monitors and reacts to speed and brake sensors. It must compute acceleration or de-accelerations repeatedly within a limited time; a delayed computation can result in failure to control of the car [5].
- 4) Microprocessors based – It must be microprocessor or microcontroller based.
- 5) Memory – It must have a memory, as its software usually embeds in ROM. It does not need any secondary memories in the computer.
- 6) Connected – It must have connected peripherals to connect input and output devices. HW-SW systems – Software is used for more features and flexibility. Hardware is used for performance and security.

2. REVIEW OF LITERATURE

In the IoT platform-based home security system, the main emphasis on protecting our loved ones and our belongings at home. Today numbers of IoT based home security systems are available in market. According to the literature and market survey, the common parameters of IoT enabled home security system are 24 hours monitoring and detection of the intruder, real time, cost effective and precise notification system suggested by various researchers. Following are the contributions of various researcher done in IoT domain [6].

Rani et al. (2018) explains the IoT based home security using Raspberry Pi which give SMS alert to authorize person through WAY2SMS and image of the unauthorized person via g-mail.

Dinakar et al. (2018) proposed IoT based automated home security system using Raspberry Pi which gives intruder detection alarm and notification to the owner.

Ghodke et al. (2017) explains in their paper how the IoT network-based system send the information of any person image coming close to the door for home security to the owner.

Anwar et al. (2016) explains the IoT based door accessibility and voice alerting through smart phone for home security system.

Tanaya and Kishore (2016) explains the up-gradation of home security system with face detection technique using haar algorithm in open CV for the detection of authorized or design and build unauthorized person.

Chowdhury et al. (2013) describes IoT based remote access control system for authorized person at door using raspberry Pi.

In [1] the author has come up with the technology for home automation and security by using a Bluetooth based system. The home appliances that are to be controlled are connected to the input/output ports of the Arduino BT board via relays. Passwords are provided for the purpose of protection so that only the authorized users can

access the home appliances. The python script is used for programming purpose as it is portable and can run on any platform. A feedback circuit is used to indicate the status of the home appliances after receiving a command from the phone. The disadvantages include: Less Range (<50) for controlling Devices, Pairing Process, and Requires Human Involvement for control. No Remote Control or Monitoring.

In [2] the author's implements home automation system using Arduino board that comes along with various sensors such as PIR motion sensor etc. and uses a GSM technology. The status of all the devices connected is sensed by the Arduino board for further processing. This system ensures home automation and security. Arduino board is an advanced version of microcontroller. It has various disadvantages similar to microcontrollers: Less Friendly Environment for development, Less Flexible, Maintenance Overhead.

In [3] the author's has proposed a home automation system using Arduino board based on IOT domain. This particular system uses an internet protocol-based communication. This system makes use of three operating modes: manual mode, automated mode and security mode. The manual mode is based on web supporting device, automated mode is based on sensor reading and security mode is based on safety. The simple execution is provided by Arduino microcontrollers that are used in this project as compared to other controllers. This particular prototype also uses Wi-Fi routers. The shortcomings are: Less Friendly Environment for development, Less Flexible, Maintenance Overhead.

In [4] the author presents the implementation of WIFI based home automation system. Wi-Fi technology is used for connecting various parts of the infrastructure. The proposed system includes a server where the status of each connected device is updated anytime it changes so that the user or system administrator can remotely control as well as monitor the system. It also includes hardware interface modules for connecting various sensors and actuators. This system provides power management and security. The disadvantages are: since WIFI usage involves a range, it is not possible for remote monitoring. It is not much reliable since the WIFI may go down at any point of time.

In [5] the author has designed a PIC microcontroller using ZigBee technology. The home appliances are controlled by using two technologies namely GSM network technology and speech recognition. In case smoke is detected in the house the SMS is sent to the mobile by using a GSM modem which is connected to the PIC controller. The ZigBee and GSM technologies are used for wireless communication among various modules. The microcontroller senses the accidents. It has disadvantages such as: use of Microcontroller – Requires Burning of Code for every Changes, Interface Problems, Maintenance overheads, Low processing power, Less Flexible due to complex architecture.

3. PROJECT DESCRIPTION

Block diagram

In our project totally we have 4 main blocks those are

- 1) Power supply
- 2) Raspberry pi 3
- 3) Pi camera
- 4) GSM module

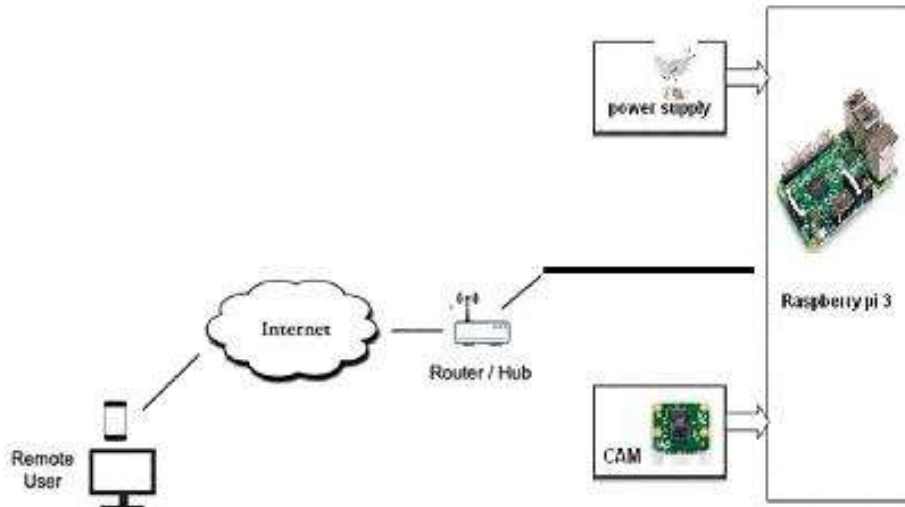


Fig. 1 Block diagram

(a) Power Supply

In-order to work with any components basic requirement is power supply. In this section there is a requirement of 5V regulated DC power supply. This block converts 230V AC in to 5V DC.

Circuit diagram and block diagram of power supply are shown in Fig. 2 and Fig. 3 respectively.

(b) Raspberry pi 3 Model

This blocked is used to control its interfacing devices (pi camera, WIFI) according to given code.

1. 85.6mm x 56mm x 21mm, the size of your student ID
2. ARM1176JZF-S Processor of Typical clock size is 700 MHz, performing at approximately 40 MFLOPS
 Can be over clocked to 1GHz without any issues
3. Includes Video Core IV graphics processor w/ 1 billion pixels per second
4. 512 MB of RAM is built into the board, not replaceable or upgradeable
5. Includes multiple built on I/O ports o 100 MB/s Ethernet port o HDMI port and RCA port audio Jack.

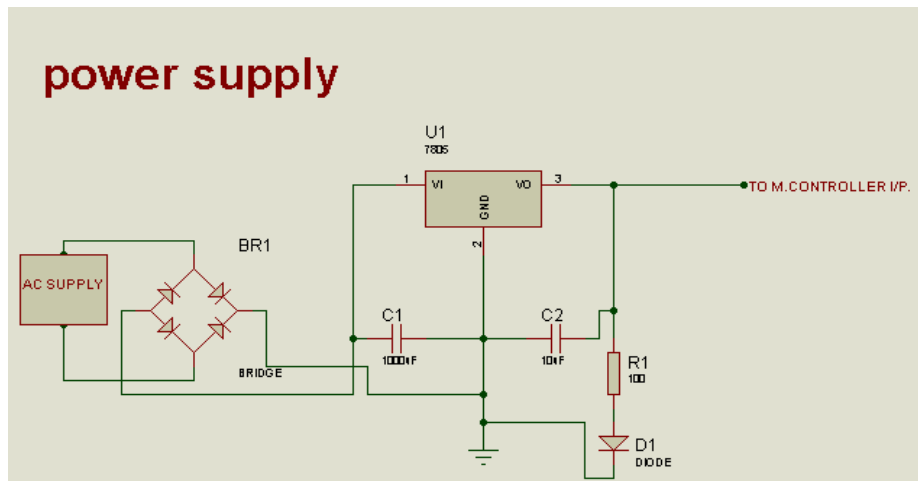


Fig. 2 Circuit diagram of power supply

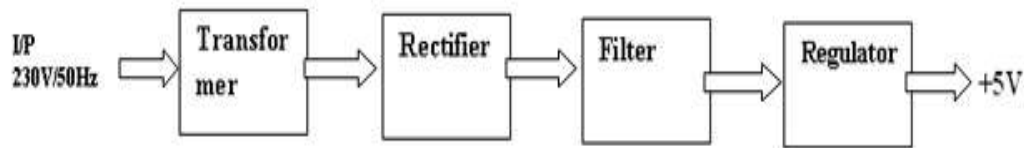


Fig. 3 Power Supply

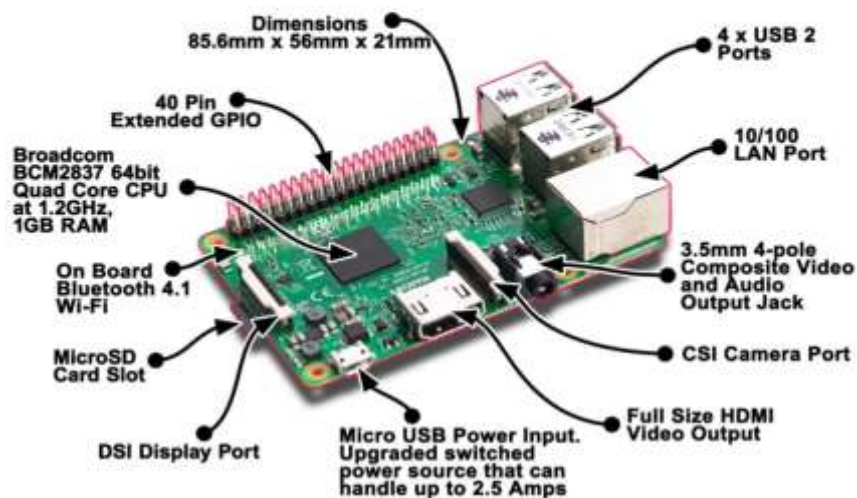
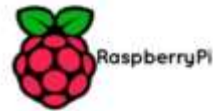


Fig. 4 Raspberry Pi

The processor at the heart of the Raspberry Pi system is a Broadcom BCM2835 system-on-chip (SoC) multimedia processor. It's not just this SoC design that makes the BCM2835 different to the processor found in your desktop or laptop, however. It also uses a different instruction set architecture (ISA), known as ARM [7]. The BCM2835 uses a generation of ARM's processor design known as ARM11, which in turn is designed around a version of the instruction set architecture known as ARMv6.

(c) GSM Module

A GSM module or a GPRS module is a chip or circuit that will be used to establish communication between a mobile device or a computing machine and a GSM or GPRS system. The modem (modulator-demodulator) is a critical part here.

These modules consist of a GSM module or GPRS modem powered by a power supply circuit and communication interfaces (like RS-232, USB 2.0, and others) for computer. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities [8].



Fig. 5 GSM module

GSM Module GSM Modem with Sim800 module is built with Dual band GSM/GPRS. It has a variable baud rate ranging from 9600 to 115200. Baud rate can be configurable using AT commands. It works on frequencies 900 / 1800 MHz It operates on 12V regulated power supply. It has a SIM card slot to insert SIM and a receiving antenna to receive network signals [9]. It has RS232 interface which allows it to connect de-vices like PC, Raspberry Pi, microcontroller etc. This module can perform the basic functions of a mobile phone like receiving and sending messages, voice calls, and TCP/IP communication over GPRS based on the various AT commands. These AT commands can send through the serial port on Raspberry Pi, thus functions such as dialing and answering calls, sending and receiving messages and surfing online can be done.

(d) PI NoIR CAMERA

- It is used to capture video or image
- This camera is used to compute the videos. This is directly connected CSI port
- The camera rating is 5mp.
- This camera module is capable of 1080p video and images and this module is capable of taking images and videos nut not sound.
- There are four models they are A, A+, B, B+

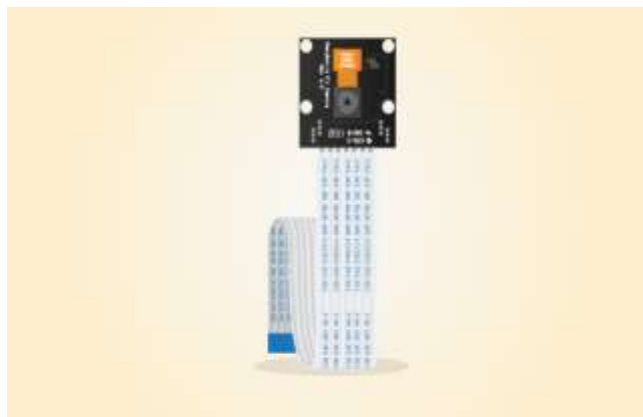


Fig. 6 Pi NoIR Camera

The Pi NoIR gives you everything the regular camera module offers, with one difference: it does not employ an infrared filter. (NoIR = No Infrared.) This means that pictures you take by daylight will look decidedly curious, but it gives you the ability to see in the dark with infrared lighting [8].

We bundle a little square of blue gel with the Pi NoIR, which you can use with the Pi NoIR to monitor the health of green plants. The Pi NoIR is very popular among wildlife hobbyists: with a few infra-red LEDs, you can monitor what nocturnal animals are doing in your garden without disturbing them [10].

The camera works with all models of Raspberry Pi 1 and 2. It can be accessed through the MMAL and V4L APIs, and there are numerous third-party libraries built for it, including the Picamera Python library.

4. WORKING AND ALGORITHM

Raspberry Pi board uses Linux-Kernel operating systems supporting programming languages like C, Python etc., Python language is used in ARS system makes easy to communicate with a serial port, GSM modules. GSM module responds to AT commands through serial communication. AT means attention. Set of AT commands perform different functions [11]. By following below steps the system is implemented:

- 1) Import all the required modules for serial communication
- 2) Initialize serial port for communicating with GSM module.
- 3) Communicate with a camera to read the images of the surrounding.
- 4) Camera image frames are captured when PIR sensor detects the motion of the object.
- 5) If motion is detected, then notification is sent.
- 6) If a motion detection fails, then surveillance continues.
- 7) Message is sent by GSM module which sends the notification to the user via message.
- 8) Raspberry Pi then clears off the message sent from GSM Module's temporary memory.

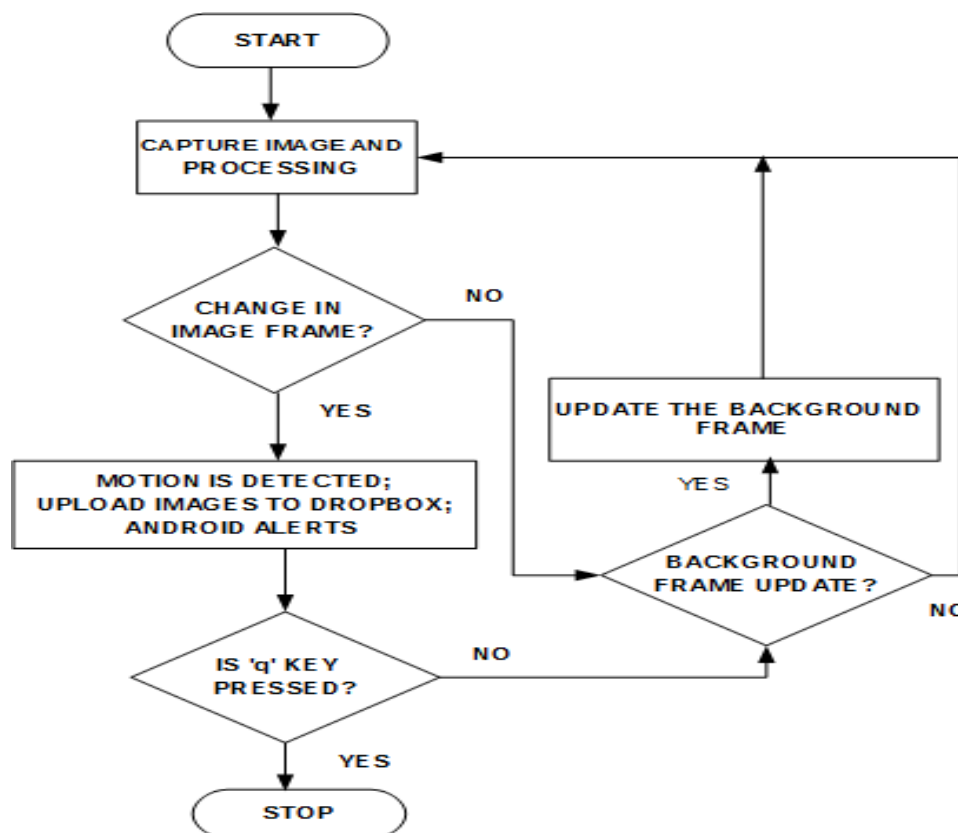


Fig. 7 Flowchart

5. ADVANTAGE DISADVANTAGE AND APPLICATION

Advantages

- Very Small Space Required as Compared to Existing Available Surveillance Systems in Market;
- Cost Efficient Than Other Surveillance Systems;
- Wireless Transmission, So There Is Minimum Data Loss or Minimum Data Delay;
- There is no any fixed Surveillance Centre or Room, we can observe it from anywhere at any time.
- Can Control Start/Stop Camera from Remote Location
- Enable/Disable Motion Sensing from Remote Location
- View the Recorded Images/Videos from Remote Location
- Change Camera Settings and Edit Schedule Settings from Remote Location

Disadvantages

- If the system crashes this application will be corrupted.
- This system is depending on internet
- Its required high-resolution camera
- This system requires more ram space for fast operations

Applications

- In hospital for patient surveillance.
- In city buses or in Wi-Fi enabled trains to reduce the crime.
- In any big housing apartments, in big organizations or in big institutes.
- In the companies where surveillance is needed.

6. RESULTS

In this section, we can see the results of IoT based home security system which is implemented in prototype with all the system components as shown in below figure.



Fig. 8 Home Security System Using Raspberry Pi

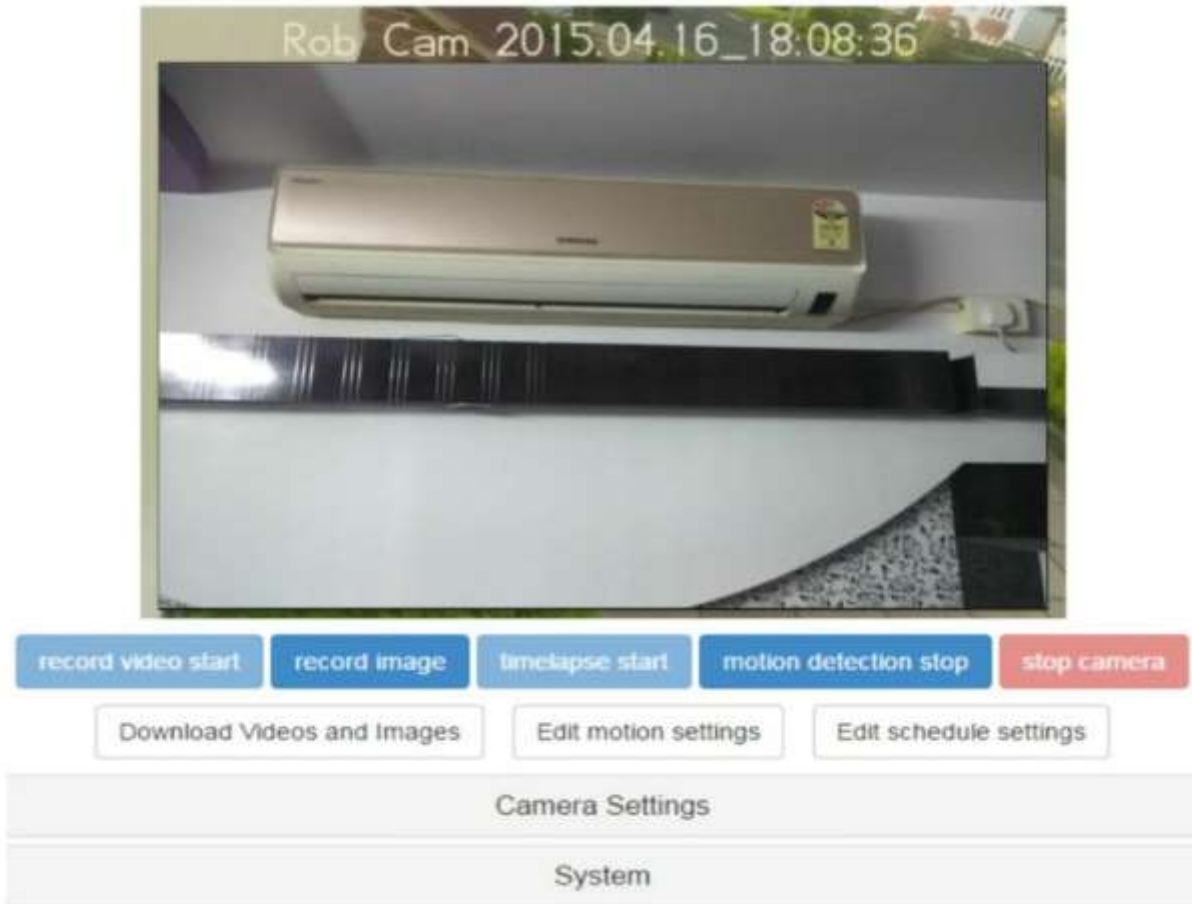


Fig. 9 Output during recording

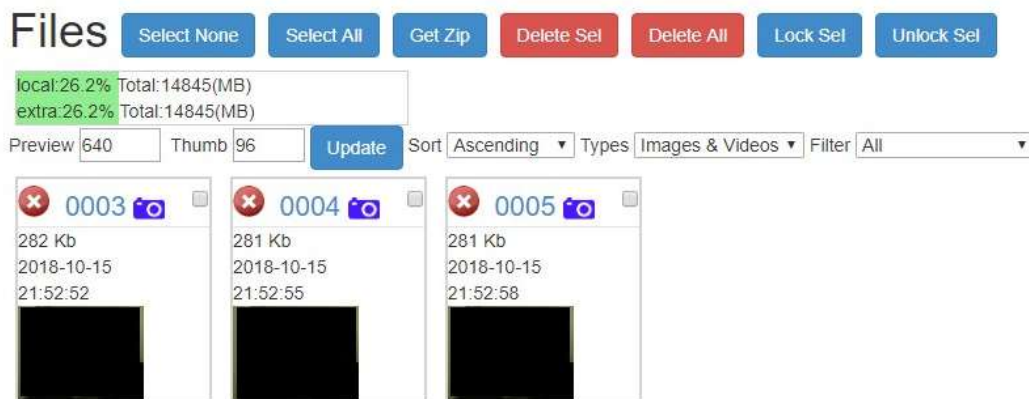


Fig. 10 Stored Video Recordings

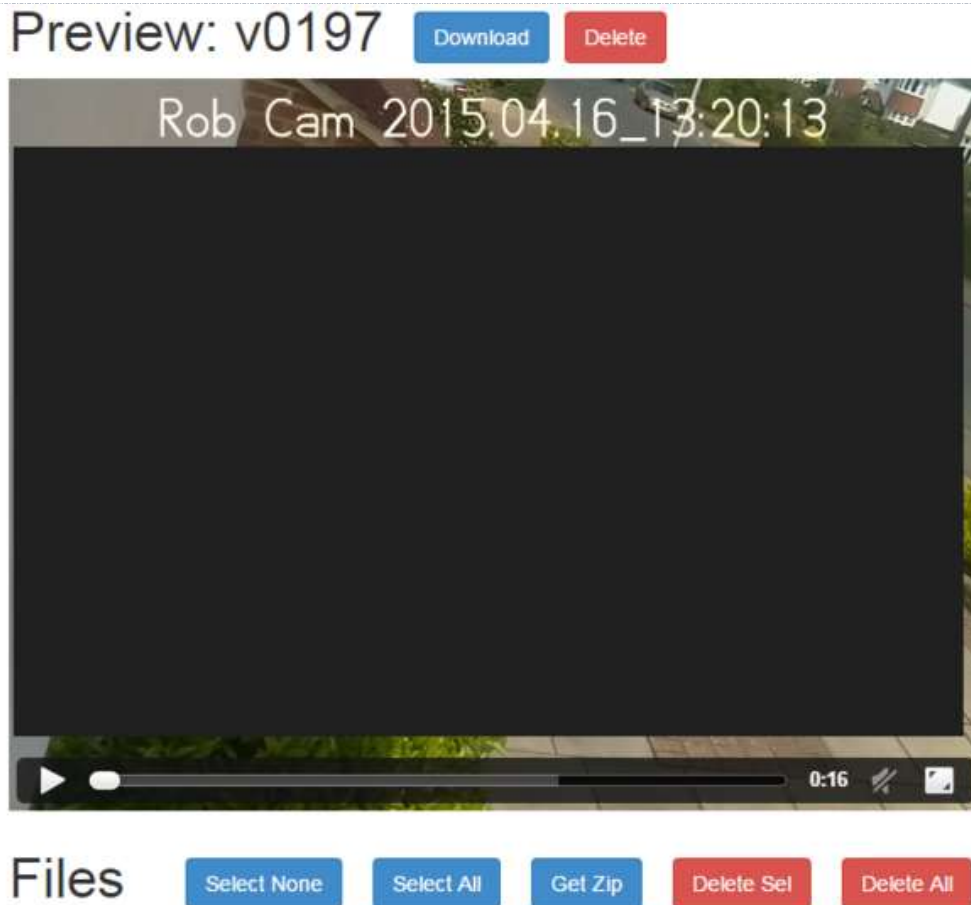


Fig. 11 Preview of the recording

7. CONCLUSIONS AND FUTURE SCOPE

The IoT based home security system has been designed and developed with RaspberryPi-3 and Pi-camera. The user can access anytime and anywhere through smart phones or Laptop. Whenever any movement is detected, its capture that that video and images. Hence, the designed system working successfully. The further extension of this paper is real time surveillance and Artificial Intelligence. To record direct videos and send to nearest police stations and also send alert voice messages to authorized persons.

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