DEPARTMENT OF INFORMATION SCIENCE AND ENGINEERING

A PROJECT REPORT ON

"Theft Prevention System using IoT"

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CERTIFICATE

Certified that the project work entitled "Theft Prevention System using IoT", carried out by Mr. Ayush Thapa, 1NH16IS127, Mr. Pramish Shrestha, 1NH16IS135, Mr. Shailesh Pokharel, 1NH16IS138 bonafide students of NEW HORIZON COLLEGE OF ENGINEERING, Bengaluru, in partial fulfillment for the award of Bachelor of Engineering in Information Science and Engineering of the Visvesvaraya Technological University, Belgaum during the year 2019-20. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

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DECLARATION

We hereby declare that we have followed the guidelines provided by the Institution in preparing the project report and presented report of project titled "**Theft Prevention System using IoT",** and is uniquely prepared by us after the completion of the project work. We also confirm that the report is only prepared for my academic requirement and the results embodied in this report have not been submitted to any other University or Institution for the award of any degree.

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ABSTRACT

In today's world, security and safety have always become a basic necessity for the urban population. With the rapid urbanization and development of big cities and towns, the graph of crimes is also on the rise. The basic anti-theft security systems that use sensors on walls or motion detection sensors can be avoided by using IR blocking clothes or hiding behind objects or simply identifying and disabling them. To secure and guard our house in our absence, we propose the IOT based Theft Prevention System using Raspberry Pi. This system monitors the entire floor for movement. One single step anywhere on the floor is tracked and user is alarmed over IOT. This system is secure flooring tile connected with IOT when we go out of house, the system is to be turned on, then whoever comes inside the house it passes the information over IOT. This system powered is by Raspberry pi it includes, two tiles for demonstration purpose, Piezo sensor, camera, wi-fi modem. Whenever the thief enters in the house, and steps on the floor immediately it is sensed by the sensor which passes on the signal to raspberry pi controller. The controller in turn processes it to be valid signal and then moves the camera to the area where movement was detected and then transmits it over the Internet for the home owner to check the image.

ACKNOWLEDGEMENT

Any achievement, be it scholastic or otherwise does not depend solely on the individual efforts but on the guidance, encouragement and cooperation of intellectuals, elders and friends. A number of personalities, in their own capacities have helped me in carrying out this project. We would like to take an opportunity to thank them all.

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Chapter 1

PREAMBLE

1.1 Introduction

Theft Prevention System is an Intelligent Monitoring system which is an application developed from the security point of view. The main aim of this project is to develop a system that monitors the area in which it is implemented. This system is applicable in the area where no one is permissible to enter, also in area where we need to detect any kind of misdeed activity. In this system, camera and different types of sensors have been used. The camera is used to catch the live images of crime happening, in different direction through the presence of servomotor. The captured images are stored in particular folder in raspberry-pi which can be viewed from the mobile application. The images will be then useful to work on. As soon as sensors detect motion, captured images are sent to mobile through IoT. So that the owner(user) will get aware of crime taking place and will get real time image of what is happening. Through this system owner can get real time image of area anytime in different direction.

Security and Safety have always become a basic necessity for the urban population in today's world. To monitor and to detect we use CCTV cameras. In surveillance, CCTV camera is costly because of the use of computer. It reserves too much space for continues recording and also requires manpower to detect the unauthorized activity. To overcome, we came across with Raspberry PI using IOT. Compare to Existing System Raspberry Pi is much cheaper with better resolution and low power consumption features. This Project "Theft prevention system using IoT" where we use image processing on live video to detect theft using motion and also highlight the area where motion occurred. In this system, we use a camera along with raspberry pi along with a circuit with LCD display IR for night vision and USB drive for storage. As soon as motion is detected in camera, the system uses image processing to detect an exact area of motion occurrence and highlights

it accordingly. The system now transmits the images of the occurrence over IOT to be viewed by the user online [1].

Also, it stores the footage in a USB drive for further reference. The user can now decode the data sent online using IoT, IoT system to view the images of the motion occurrence live remotely over the internet. Thus, the system provides an innovative approach to Theft Detection using IoT.

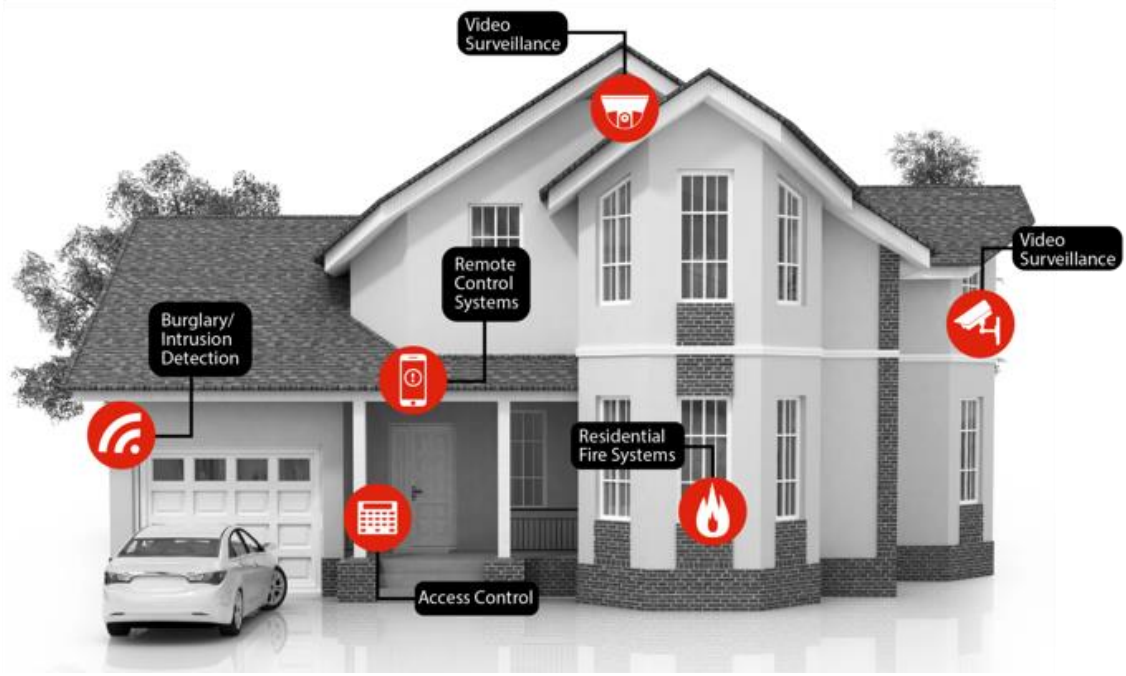

Fig 1.1- Home Security Systems

The above figure 1.1 shows the layout of Home Security Systems. There are CCTV attached all over the house for surveillance. There's an access control system in the main door so that only owner (members) can enter the house.

The main theme of this paper is to illustrate the technology used for security purpose. This paper presents the development process in security system that uses CCTV for security purpose. This security system is implemented using Raspberry Pi B. By combining the software's and camera this system is used as an intelligent monitoring system. Total security is provided to owner in a face of image at any instant in which area it is implemented. Image is sent through IoT (Over an application). Technology has reached a stage where mounting cameras to capture video imagery is cheap, but finding

available human resources to sit and watch is imagery. Like other systems it doesn't require continuous surveillance of human resources, machine will do the whole work.

1.2 Relevance of the Project

Now a days most of the crimes occurs in jewelry shop. Secondly in such areas, CCTV is used. But work of normal CCTV camera is continuous surveillance of that area under the human resource. And crimes are usually found out after it is being committed. By observing all these parameters, we decided to make an intelligent security system which will detect crime or any kind of misdeed action and required action will be taken at that instant only. Owner will have to no worry even in his absence due to real time image feedback used in this system [2].

This project is based on the increasing burglary and theft due to the failure of anti-theft or security systems in the victim's residence to recognize and report the threats. Although the burglary and theft cases have reduced by a significant amount in the past ten years, the need for security keeps increasing day by day. The current data of robbery and theft shows that in the past ten years the robbery at a residential infrastructure is significantly high.

Of the more than two hundred thousand robberies reported in the past 10 years by Federal Bureau of Investigations in the USA, robberies in residential areas are still around twenty percent. Also, from the produced report of the FBI it is found out that the residential buildings are at more risks during the day than in the night time.

1.3 Purpose of Study

Nowadays, intruders have become more technologically aware and have carried out burglaries using smart gadgets like gas-cutters, smart anti-lock systems, and many other equipment. For such intruders, it is straightforward to disconnect CCTV camera surveillance, which has an indirect connection to the digital video recorder and a database server residing at home. Therefore, there is a need to modify existing systems and propose an intelligent approach which will provide unsupervised human activity monitoring and stop an ongoing theft by notifying the house-owner at the earliest

opportunity. All legacy systems work on the premise of object detection, object motion detection, and tracking. Such systems are prone to false alerts or notifications, which might result in sending false emergency notifications to the house owner/member, the escape of the intruder after the theft, and unnecessary disruptions to the residents. To resolve these issues, a novel human activity monitoring detection, recognition, and home security approach is presented in the remaining sections [3].

The overall arrangement of the sensing units is as follows. The smart home monitoring and control framework is applied on two unique levels: equipment and programming. The equipment framework contains the sensor arrangements. This equipment framework is further classified into four areas: body sensor setup (BSS), ambient sensor setup (ASS), crisis sensor setup (CSS), and other sensors setup (OSS). The BSS is enabled with an impact sensor. A remote BSS provides observations of inhabitants in different physiological states. The BSS framework incorporates physiological checking gadgets that are capable of recording the daily activities of the smart home residents without disturbing their daily routine. The second equipment system, ASS, contains a temperature sensing unit, motion sensing unit, and pressure sensing unit. The CSS is equipped with numerous manual push buttons, for example there is a panic push button for emergency situations such as a house fire which activates security and alarm systems. The final setup, OSS, offers the utilization checking and control of electrical home devices through the electrical and electronic sensing unit. OSS additionally incorporates the contact sensing unit. The OSS framework is in charge of information accumulation, mining, and storage into the database server. Finally, server information is collected and handled by information mining models to deliver helpful data for application and output action.

1.4 Scope of the Project

This project is focused on developing a surveillance system that detects motion and to respond speedily by capturing an image and relaying it to an administrator device through the internet platform. The system will require Raspberry Pi module, motion detection sensor, camera and internet connection. It will come up with an implementation of a surveillance system which presents the idea of monitoring a particular place in remote areas. The system can be monitored by the user form anywhere

in the world. However, this project will not attempt to design the motion detection device, camera or the Raspberry PI. It will therefore use these systems together with a suitable program script to accomplish a real time surveillance system as desired [4].

1.5 Problem Definition

The issue of owners not being able to know what is going on in their house when they are not at home, besides that, problems such as theft and fires in the home while the user is at home can be overcome by this system [5].

• The system is able to provide 24 hours CCTV view for the user/owner of what is happening in the home, the User can view the CCTV system remotely from the computer or hand phone using valid ID and Password.

• The system can allow user to control electrical appliances at home from a remote location, the user may be able to control the light and fan as well as air conditions for the home in case they are not at home, any disturbances will also be notified to the user.

• The system also can deter theft and burglary in the house by certain measures such as vibration detector, pressure mat, magnetic contact and alarm system, in case of theft, the house will lockdown and the public authorities and owner will be notified.

• The security system using conventional pin number for security can be replaced with the more modern and secure biometrics system.

1.6 Significance of Project

Traditional home alarm systems started appearing on the consumer market in the 1980s-1990s. At that time, they were an advance in security technology. They had motion detection, cameras and very little visible wires. They made homeowners feel more secure. But fast forward to today. Compared to newer 'Smart' counterparts, traditional security systems are quickly becoming very outdated, costly and inefficient – and even worse – they aren't even that great at preventing burglaries. It's important to realize the common pitfalls of older security systems when making informed decisions about how to protect your valuables – and loved ones. Home security systems are reactive. In the 1970's they may have been a security innovation, but they are quickly becoming old and ineffective.

They often don't even stop crime, putting your family and valuables at risk. They allow complete strangers to get into your home, putting your privacy at major risk.

Significance of project is to provide better home security and home monitoring from any location provided there is secure internet access. This system also allows better control against unwanted problems that may occur while we are not at home such as fires and theft. Users can also monitor the situation of the home from remote location and be able to take note of what is happening such as what the maid is doing, what the children are doing and others. Users can also control the electrical appliances at home remotely as well, this can be used for security measures as well as for power saving. The public service departments are also actively involved in this system to ensure user safety against unwanted problems. The use of pin number to access the security system when entering the home is also not safe and very outdated, people can hack the system or access the pin number by other means and be able to enter the home. Biometrics system is a latest and more reliable system that uses specific features from the user to access the security system and is more secure [6].

To enable user to build an efficient and cheap home security and home monitoring which can be located in different places, in a building and can be monitor and manipulate remotely via internet and SMS. This project also can help Small and medium enterprises to reduce their cost in in terms of security for those who runs Cyber Cafés and mini markets.

1.7 Objective of the study

The main objective of study in this project is:

- To design and model Security System that will have the capability to alarm / notify the user via SMS or instant messaging notification through internet if the security system is triggered by external factors such as theft or fire.
- To design and model the Home Monitoring and Security System that will give full access to the user to be able to monitor the home remotely as well as control certain electrical appliances present in the home.

1.8 Existing System

In current scenario, all the houses use traditional home alarms in identifying and alerting the owners if any doors or windows are temped with. The monitoring of ins and outs of different personnel is also manually done by security professionals. In this case, there is little to no interaction between security person and the owner of the house [3].

The current security systems at home can be identified from automatic security systems to the human form of security services. Moreover, in these scenarios even animals like dogs are kept for the security of the residences. Although, humans and dogs are widely used for security, they cannot be relied on as much as the automated security systems. The automated systems can also be nullified by the burglars in today's scenario. With the help of various technologies such as signal jammers anti IR clothes etc. The burglars take advantages of these security systems.

1.8.1 Limitations

There are significant number of limitations for automated systems too which are explained below:

- **False Alarm**

These security systems are prone to false alarms that involve the alarm ringing when anyone from your family enters the restricted area. Or there are instances when the alarm is triggered by itself without any reason

- **Expensive**

Both, wireless and hardwired alarm systems are expensive to install. They require an initial investment, which includes equipment cost, installation, and subscription of security monitoring service.

- **Can be Stolen**

Irrespective of the type of burglar alarm you have, it can be stolen from the site where it is installed. Wireless systems are comparatively easier to disconnect. Some burglars can easily disconnect the wired alarm systems.

1.9 Proposed System

In early 1700s, English inventor Tildesley is credited with the first creation of an intrusion, door alarm by using a set of chimes mechanically linked to the door lock.

In 1853, The first electro-magnetic alarm system was patented on June 21 by Augustus Russell Pope in Boston, MA. Up until this point, most people had relied on noise from startled animals and guard dogs or mechanical ringing to catch any intruders.

In 1962, A team of Canadian researchers published a study about the life-saving potential of heat and smoke detectors. This led to the development of new policies and standards for smoke detectors in new and existing residences. This study and subsequent safety code enforcement is credited with a resulting 50% decrease in U.S. fire deaths between 1975 and 1980. [17]

In the 1970s, Video surveillance began to be used in home security systems. These early models included a large motorized camera that moved down a track to view the exterior of a home. The camera transmitted grainy images of visitors to a stationary television monitor that served as the camera's control panel. The panel was often equipped with security features like an intercom, a door lock switch and an alarm button. The approach we are taking is necessarily avoiding the traditional security of motion sensing and alarm buzzing, and adding some necessities which doesn't wholly change the complexity of the security system. However, it changes the approach in the security and anti-theft. The changed approach gives the system more flexibility and versatility for future. The purposed system clearly is more advantageous than the generic systems. The new anti-theft flooring system has the facility to detect any pressure or strain on the floor to identify the possible threat. The use of piezo sensors on the floors will help detect any foot stepped on that position for identification of the object that is causing the pressure on the sensors. [17]

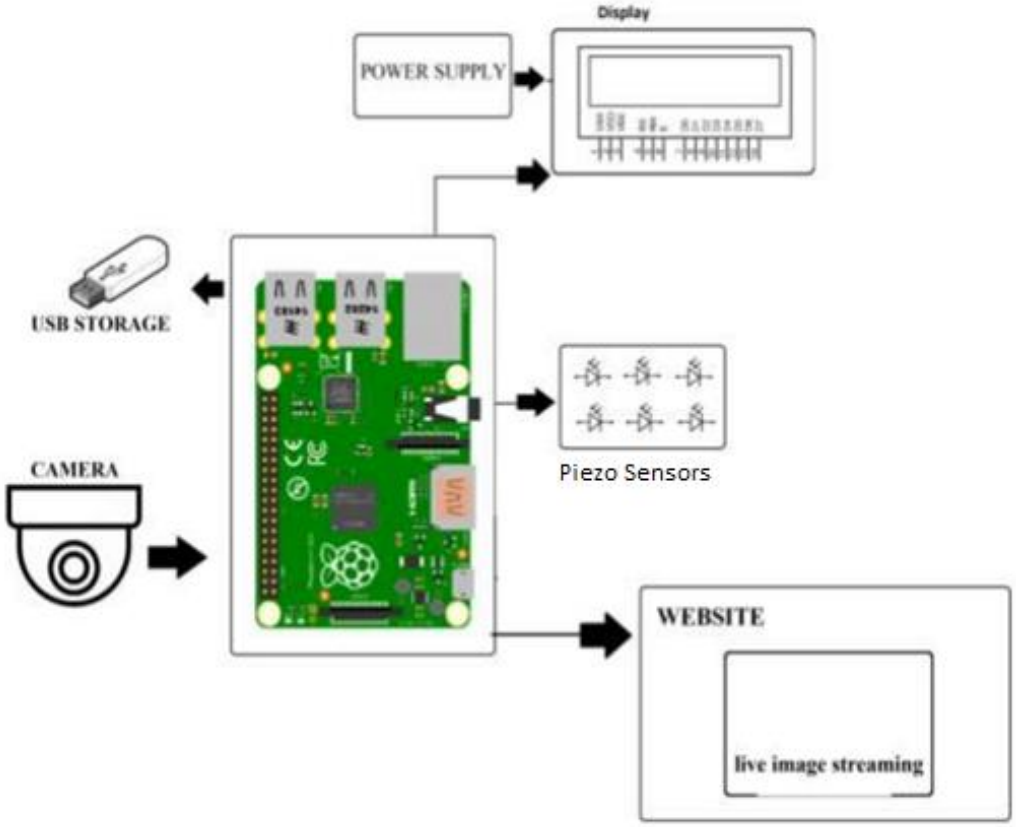

Fig 1.9- Block diagram of proposed work

The above figure 1.9 represents the block diagram of this project. Whenever piezo sensor senses motion and gives sensed signal to raspberry pi to take detected camera footage, the system uses image processing to detect an exact area of motion occurrence and highlights it accordingly. The system now transmits the images of the occurrence over IOT to be viewed by the user online [1].

1.9.1 Advantages

Theft prevention is a huge focus area for our systems. We are not satisfied with just recording robberies, so that you have evidence in court; we actually want your security system to prevent them altogether. The proposed system has a smart detection system that can actually identify possible threats. Once a threat has been detected there is no time to spare. Your system will send an automatic alert to local authorities, so that

law enforcement can arrive at the scene as quickly as possible [4]. This system is faster than a security guard could possibly process the situation and decide to dial 911. The system will also send an alert to your operations managers and whoever else you would like to be notified, so that you can have peace of mind knowing that you will know if ever someone or something threatens your building. Constant Protection Appointing security guards or personally being there to protect the property 24/7 is practically not possible. These security systems provide round-the-clock protection against burglars and break-ins.

- **Strong Deterrent**

Homes and commercial properties that have burglar alarm systems installed are at a lesser risk of being targeted by intruders and burglars. When infiltrators find out that you have an alarm system installed, they are persuaded to move away from your property. Even if they are not aware of its presence, the alarming sound will scare them off.

- **Uninterrupted Functionality**

There are two types of alarm systems. Wireless alarm systems work on batteries and not electricity. Which means they are effective during power-cuts as well. Hardwired systems do not use batteries and consume electricity from the source. So, there is no need of regular battery charging or replacement.

- **Can Relocate**

The alarm system devices can be disconnected and installed at different places. It is easy to relocate both, wireless as well has wired alarm security systems.

- **Special Alarm Systems**

Modern alarm security systems provide the ability to monitor the activities happening on your property when you are away. There are security systems that have an add-on feature of detecting fire or smoke. These systems will instantly notify you during emergencies like a fire breakout, gas leak, or a flood emergency.

- **Perimeter sensors for points of entry**

Surveillance systems also give you the ability to detect movement at all possible entry ways into your business, namely the windows and doors of your establishment. Perimeter sensors thus act as a surveillance tool because they alert you to any movement during a designated period, and they act as a security tool by deterring criminal activity by alerting the potential thief that their presence has been detected.

- **Interior motion sensors and alerting capabilities**

Similar to how a motion detecting light works on your driveway for example, the security interior motion sensors work by turning on at the immediate detection of movement. What's more important though is that security technology takes it one step further by notifying you and local authorities when there is movement inside your store when there shouldn't be, thus giving you the extra protection, your business needs to stay secure at all hours of the day.

Chapter 2

Literature Survey

This chapter reviews the project created to get idea about the project design, conception, specification and any information that related to this project. In later of this chapter, some review about the Home Monitoring and Security System is discussed that proposed to fulfil this project.

2.1 Review of Related Literature

2.1.1 Closed-Circuit Television

Closed-circuit television (CCTV) is the use of video cameras to transmit a signal to a specific place, on a limited set of monitors. It differs from broadcast television in that the signal is not openly transmitted, though it may employ point to point (P2P), point to multipoint, or mesh wireless links. Though almost all video cameras fit this definition, the term is most often applied to those used for surveillance in areas that may need monitoring such as banks, casinos, airports, military installations, and convenience stores. Video telephony is seldom called "CCTV" but the use of video in distance education, where it is an important tool, is often so called.

Fig 2.1.1: Closed-Circuit Television (CCTV) Camera

The above figure 2.1.1 represents CCTV Camera which will be used for surveillance. In industrial plants, CCTV equipment may be used to observe parts of a process from a central control room, for example when the environment is not suitable for humans. CCTV systems may operate continuously or only as required to monitor a particular event. A more advanced form of CCTV, utilizing digital video recorders (DVRs), provides recording for possibly many years, with a variety of quality and performance options and extra features (such as motion-detection and email alerts). More recently, decentralized IP-based CCTV cameras, some equipped with megapixel sensors, support recording directly to network-attached storage devices, or internal flash for completely stand-alone operation. Surveillance of the public using CCTV is particularly common in many areas around the world including the United Kingdom, where there are reportedly more cameras per person than in any other country in the world. There and elsewhere, its increasing use has triggered a debate about security versus privacy.

2.1.2 Security Alarm

A security alarm is a system designed to detect intrusion – unauthorized entry – into a building or area. Security alarms are used in residential, commercial, industrial, and military properties for protection against burglary (theft) or property damage, as well as personal protection against intruders. Car alarms likewise protect vehicles and their contents. Prisons also use security systems for control of inmates.

Some alarm systems serve a single purpose of burglary protection; combination systems provide both fire and intrusion protection. Intrusion alarm systems may also be combined with closed-circuit television surveillance systems to automatically record the activities of intruders, and may interface to access control systems for electrically locked doors. Systems range from small, self-contained noisemakers, to complicated, multi-area systems with computer monitoring and control.

Fig 2.1.2: Security Alarm System

The above figure 2.1.2 shows the basic security alarm system which are used in the houses or offices. The most basic alarm consists of one or more sensors to detect intruders, and an alerting device to indicate the intrusion. However, a typical premises security alarm employs the following components:

- **Premises control unit (PCU), or panel**

  The "brain" of the system, it reads sensor inputs, tracks arm/disarm status, and signals intrusions. In modern systems, this is typically one or more computer circuit boards inside a metal enclosure, along with a power supply.

- **Sensors**

  Devices which detect intrusions. Sensors may place at the perimeter of the protected area, within it, or both. Sensors can detect intruders by a variety of methods, such as monitoring doors and windows for opening, or by monitoring unoccupied interiors for motions, sound, vibration, or other disturbances.

- **Alerting devices**

  These indicate an alarm condition. Most commonly, these are bells, sirens, and/or flashing lights. Alerting devices serve the dual purposes of warning occupants of intrusion, and potentially scaring off burglars.

- **Keypads**

  Small devices, typically wall-mounted, which function as the human-machine interface to the system. In addition to buttons, keypads typically feature indicator lights, a small mulch-character display, or both.

- **Interconnections between components**

  This may consist of direct wiring to the control unit, or wireless links with local power supplies.

- **Security devices**

  Devices to detect thieves such as spotlights, cameras & lasers. In addition to the system itself, security alarms are often coupled with a monitoring service. In the event of an alarm, the premises control unit contacts a central monitoring station. Operators at the station see the signal and take appropriate action, such as contacting property owners, notifying police, or dispatching private security forces. Such signals may be transmitted via dedicated alarm circuits, telephone lines, or Internet.

2.2 IoT Embedded Systems

The Internet of Things (IoT) is defined as a process in which objects are equipped with sensors, actuators, and processors that involve hardware board design and development, software systems, web APIs, and protocols, which together create a connected environment of embedded systems. This connected environment allows technologies to get connected across multiple devices, platforms, and networks, creating a web of communication that is revolutionizing the way we interact digitally with the

world. This connected embedded systems are changing interactions and behavior with our environment, communities, and homes, and even with our own bodies. There are embedded systems around us in the form of commercial systems like vending machines, smart kiosks, AC controller, connected cars, hotel bill printers, etc., which are capable of performing a unique variety of operations. Hence, when it comes to designing of these embedded IoT systems, they need to be designed for specific functions, possessing qualities of a good product design like low power consumption, secured architecture, reliable processor, etc. However, designing an embedded IoT hardware system is not easy.

2.3 Linux for Embedded real-time applications

"Linux for Embedded and Real Time Applications", by Doug Abbott has been of great help in providing an introduction to the process of building embedded systems in Linux. It has helped us understand the process of configuring and building the Linux kernel and installing tool chains.

This book gave us the knowledge of:

- The basics of Open Source, Linux and the embedded space.
- How to set up a simple system and tool chain
- How to use simulation for initial application testing
- Network, graphics and Android programming
- How to use some of the many Linux components and tools
- How to configure and build the Linux kernel, BusyBox and U-Boot bootloader.

2.4 The ARM architecture

ARM, previously Advanced RISC Machine, originally Acorn RISC Machine, is a family of reduced instruction set computing (RISC) architectures for computer processors, configured for various environments. Arm Holdings develops the architecture and licenses it to other companies, who design their own products that implement one of those architectures—including systems-on-chips (SoC) and systems-on-modules (SoM) that incorporate memory, interfaces, radios, etc. It also designs cores that implement this

instruction set and licenses these designs to a number of companies that incorporate those core designs into their own products. [16]

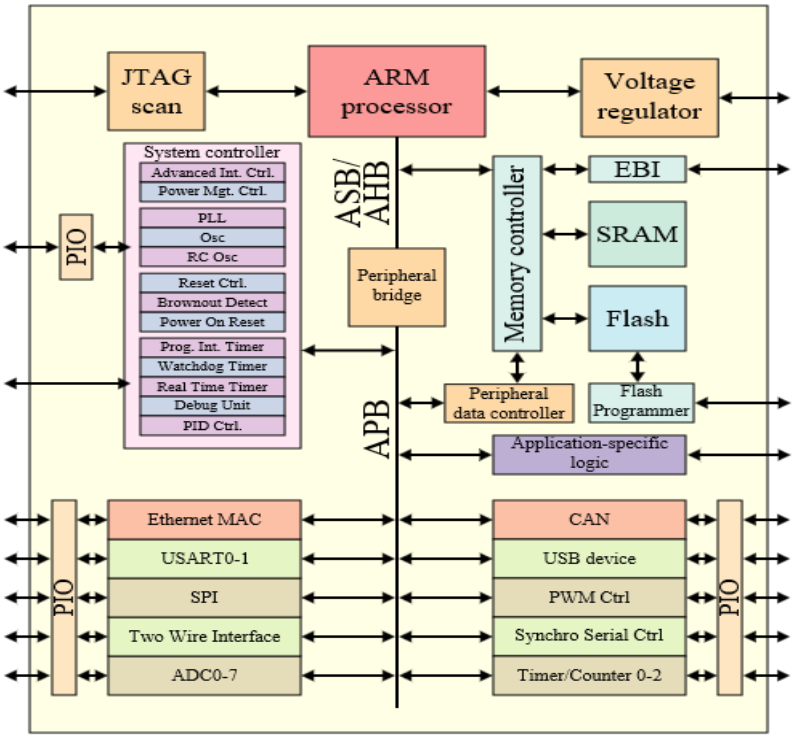

Fig 2.4: The ARM Architecture

As shown in the above Fig 2.4, there are different components and characteristics of an ARM processors. Processors that have a RISC architecture typically require fewer transistors than those with a complex instruction set computing (CISC) architecture (such as the x86 processors found in most personal computers), which improves cost, power consumption, and heat dissipation. These characteristics are desirable for light, portable, battery-powered devices—including smartphones, laptops and tablet computers, and other embedded systems but are also useful for servers and desktops to some degree. For supercomputers, which consume large amounts of electricity, ARM is also a power-efficient solution.

2.5 IoT integration with various Platforms

IoT can be integrated with different platforms or technologies, these technologies make interactions with the devices more feasible and easier. Thus, coming across this possibility gave us the idea for integration of IoT systems with different other platforms. Some of the cloud platforms for IoT are Thingworx 8 IoT Platform, Microsoft Azure IoT Suite, Google Cloud's IoT Platform, BM Watson IoT Platform, AWS IoT Platform etc. The above-mentioned platforms are the most popular platforms for IoT integration.

Android Things is an Android-based embedded operating system platform by Google, announced at Google I/O 2015. It is aimed to be used with low-power and memory constrained Internet of Things (IoT) devices, which are usually built from different MCU platforms. As an IoT OS it is designed to work as low as 32–64 MB of RAM. It will support Bluetooth Low Energy and Wi-Fi. Along with Brillo, Google also introduced the Weave protocol, which these devices can use to communicate with other compatible devices.

Chapter 3

System Requirement Specification

3.1 General Description of the System

The system we are basically trying to build works in the way that the piezo sensor when detects any movement on the floor, it activates the camera to its position and the servo motor which is used for the rotation of camera, points the camera to the activated position and a picture is captured and sent to the user through the internet. This is the basic description of the system.

3.1.1 Overview of the Functional Requirements

The functional requirement of this the theft prevention system using IOT are basically the user interfaces which notifies the user of any possible threats through the internet. This system also needs the configuration of piezo sensors to be identified manner i.e. every sensor should have its own identity through which the triggered sensor area can be identified so that the camera captures of the exact position where the sensor is triggered. Another functional requirement is the workstation or administration from where the security devices are managed, maintained and kept track. Another important requirement is the mobile device application through which the user is notified of the threat or the possible burglary.

3.1.2 Overview of Data Requirements

The IoT systems basically work on the signals and communicate with themselves during the flow of data in the system. They are basically intercommunicating Devices, therefore the data basically required is given by the sensors which are in the form of signals these signals circulate among the devices to solve the particular problem. The term solving of a particular problem is identifying the possible threat in the owner's residence. Therefore, the required data is produced by any interference in the sensor devices. The other data requirement is fulfilled by the camera which captures the image of the object

that's triggering the sensor. Therefore, this system is an intercommunicating system with the outflow of data to the user.

3.2 Technical Requirements of the System

This technical requirement specifies the requirements of the project. The information on technical design, development and procedures related to the requirements is outlined here. This section talks about the system requirement details, including functional, interface and design requirements.

3.2.1 Hardware Requirements

For the application to be built and used efficiently the hardware components required to run these below mentioned software resources on the computer. It gives a physical computer resource list accompanied by Hardware Compatibility List (HCL).

- Raspberry Pi Board
- Camera
- Piezo Sensors

1. Raspberry Pi 3 Board

The Raspberry Pi is an atm-card-sized single-board computer developed by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools. The Raspberry Pi has a Broadcom BCM2837 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, Video Core IV GPU, and was originally shipped with 256 MB of RAM, later upgraded (Model B & Model B+) to 512 MB. It does not include a built-in hard disk or solid-state drive but uses a memory card for booting and persistent storage [1].

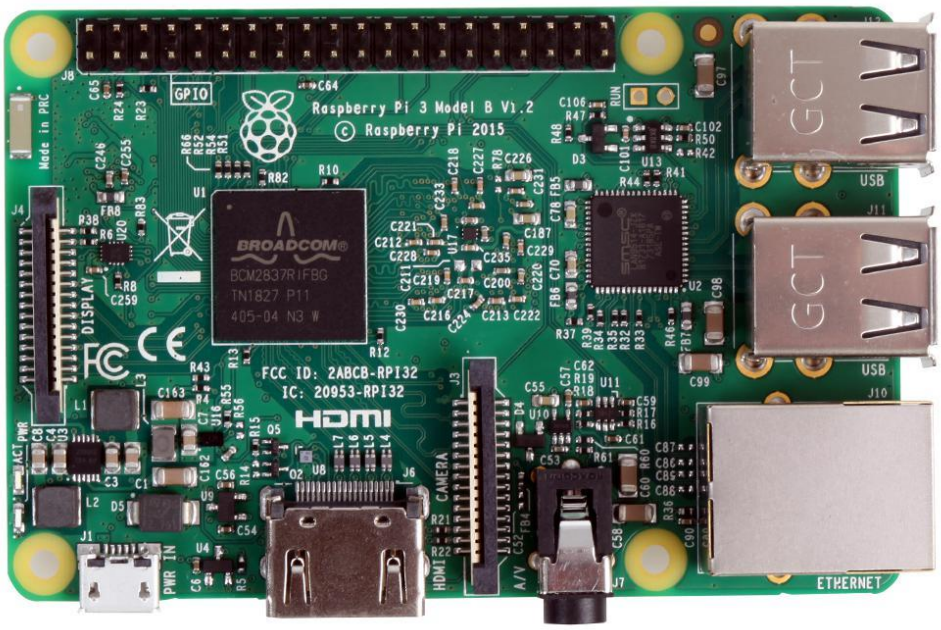

Fig 3.2.1.1: Raspberry Pi 3 Board

Above is the diagram of Raspberry Pi 3 Board. It contains a processor and graphics chip, program memory (RAM) and various interfaces and connectors for external devices. Some of these devices are essential, others are optional. It operates in the same way as a standard PC, requiring a keyboard for command entry, a display unit, and a power supply. Since raspberry Pi board operates like PC it requires 'mass storage', but a hard disk drive of the type found in a typical PC is not really in keeping with the miniature size of RPi. Instead, we will use an SD Flash memory card normally used in digital cameras, configured in such a way to 'look like' a hard drive to RPi's processor. RPi will 'boot' (load the Operating System into RAM) from this card in the same way as a PC 'boots up' into Windows from its hard disk.

2. Camera

Fig 3.2.1.2: Camera

Cameras are used to capture images of the objects that are have triggered the piezo sensors. These cameras are generally good enough to capture a HD image resolution for better identification of the burglars.

3. Piezo Sensors

A piezoelectric sensor is a device that uses the piezoelectric effect to measure changes in pressure, acceleration, temperature, strain, or force by converting them to an electrical charge [16].

Fig 3.2.1.3: Piezo Sensor

The above Fig 3.2.1.3 is a Piezoelectric Sensor, these sensors are versatile tools for the measurement of various processes. They are used for quality assurance, process control, and for research and development in many industries. Pierre Curie discovered the piezoelectric effect in 1880, but only in the 1950s did manufacturers begin to use the piezoelectric effect in industrial sensing applications. Since then, this measuring principle has been increasingly used, and has become a mature technology with excellent inherent reliability[17].

3.2.2 Software Requirements

- Linux Operating Systems
- Python for Embedded Linux
- Open CV

1. Linux Operating Systems

Linux is the best-known and most-used open source operating system. As an operating system, Linux is software that sits underneath all of the other software on a computer, receiving requests from those programs and relaying these requests to the computer's hardware.

Linux is one of the prevalent versions of UNIX Operating System. Linux or GNU/Linux is a free and open source software (FOSS) operating system for computers. Since Linux is free software it means that none of the software will put any license limitations on users [12].

2. Python

Python is an interpreted, high-level, general-purpose programming language. Python's design viewpoint underlines code readability with its notable use of important whitespace. Its language constructs and object-oriented method aim to help programmers write clear, logical code for small and large-scale projects. Python and its

APIs also can be used for the GUI designing. This programming language is more preferred as it is multipurpose.

The language of Python programming is freely available and makes it almost as easy to solve a computer problem as you write your thoughts on the solution. It is possible to write the code once and run on almost any computer without changing the program. It is a language of programming that is multiparadigm, general purpose, interpreted, high level. Python allows programmers to create simple or complex programs using different programming styles, get faster results, and write code almost as if they were speaking in a human language. Google Search, YouTube, BitTorrent, Google App Engine, Eve Online, Maya and iRobot machines are some of the popular systems and applications that Python used during development. Python has been around for over 20 years, so many codes written in Python has built up over the decades and, being an open source programming language, a lot has been released for use by others. You can install this software to use your own projects on your system. For example, if you want to use Python to build scripts with command line arguments, you would install and import the "click" library into your scripts.

3. Open CV

Open CV (Open Source Computer Vision) is a library of programming functions for real time computer vision. Open CV is an open source c/c++ library for Image processing and Computer Vision developed by Intel. The library is written in C and C++ and runs under Linux, Windows and Mac OS X. It now supported by Willow Garage, which is also the organization behind the famous Robot Operating System (ROS). It is free for both commercial and non-commercial use. your commercial applications, you can use the OpenCV library. It is a library that is primarily aimed at processing in real time. It now has several hundred built-in functions that implement image processing and computer vision algorithms that make it easy and efficient to develop advanced computer vision applications.

3.3 Input Requirements

The input is directly taken by the piezo sensor sue to the any change in pressure or strain in the position it is located. The intercommunication between the sensors and the connected devices count as the input to the devices. As, the sensor is triggered the sensor immediately signals the motor the position where it is triggered and motor turns the camera to that position and camera captures image. These series of communication are a fair example of the communication between the devices where the output signals from one device can work as the input signal to trigger another device.

3.4 Output Requirements

The sensors give out signals as output to other sensors devices thus the circulation of inputs and outputs occurs in the system. As, the output from the sensor is input for the motor and output from the motor are the input for the camera and finally the output from the camera is notification to the user. The system basically gives the information through output to the owner. Thus, the output at last is nothing but an image provided to the user through the internet. The output from the user's device again sends a signal whether the threat is just a false alarm or is unauthorized entry in the owner's premises.

3.5 Language Requirements

- **Python 3.8**

Python 3.8 was released on October 14th, 2019 which included different set of updating and changes than its former version. It has two sting types which are Unicode strings and non-Unicode strings. The xrange () function is added to be used to create iterate able objects. There are separate int and long types for non-floating-point numbers. It included the support for Tkinter and a backport of the memory view object. It has the added feature of dictionary view and new syntax for nested with statements. It has much

longer period time of maintenance when compared to the earlier version of 3.x which will be supported by the core development team which means that it will be receiving the security updates and other bug fixes until at least 2030 which almost 10 years from the date of initial release.

- **Java**

Java is a general-purpose programming language that is class-based, object-oriented, and designed to have as few implementation dependencies as possible. It is intended to let application developers write once, run anywhere (WORA), meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to bytecode that can run on any Java virtual machine (JVM) regardless of the underlying computer architecture. The syntax of Java is similar to C and C++, but it has fewer low-level facilities than either of them. As of 2019, Java was one of the most popular programming languages in use according to GitHub, particularly for client-server web applications, with a reported 9 million developers. Java was originally developed by James Gosling at Sun Microsystems (which has since been acquired by Oracle) and released in 1995 as a core component of Sun Microsystems' Java platform. The original and reference implementation Java compilers, virtual machines, and class libraries were originally released by Sun under proprietary licenses. As of May 2007, in compliance with the specifications of the Java Community Process, Sun had relicensed most of its Java technologies under the GNU General Public License. Meanwhile, others have developed alternative implementations of these Sun technologies, such as the GNU Compiler for Java (bytecode compiler), GNU Class path (standard libraries), and IcedTea-Web (browser plugin for applets).

Chapter 4

System Design and Analysis

4.1 Preliminary Design

The design of Security System is a basic operational of the circuit system and software system must be design first. The basic design of Security System to ensure it will able to interface with the input and output operation.

Besides that, the system also aims to give user a better control over the situation at their home where they can view and control what is happening at their home effectively. This is done by the use of CCTV system to be able to monitor the situation at home.

4.2 System Architecture

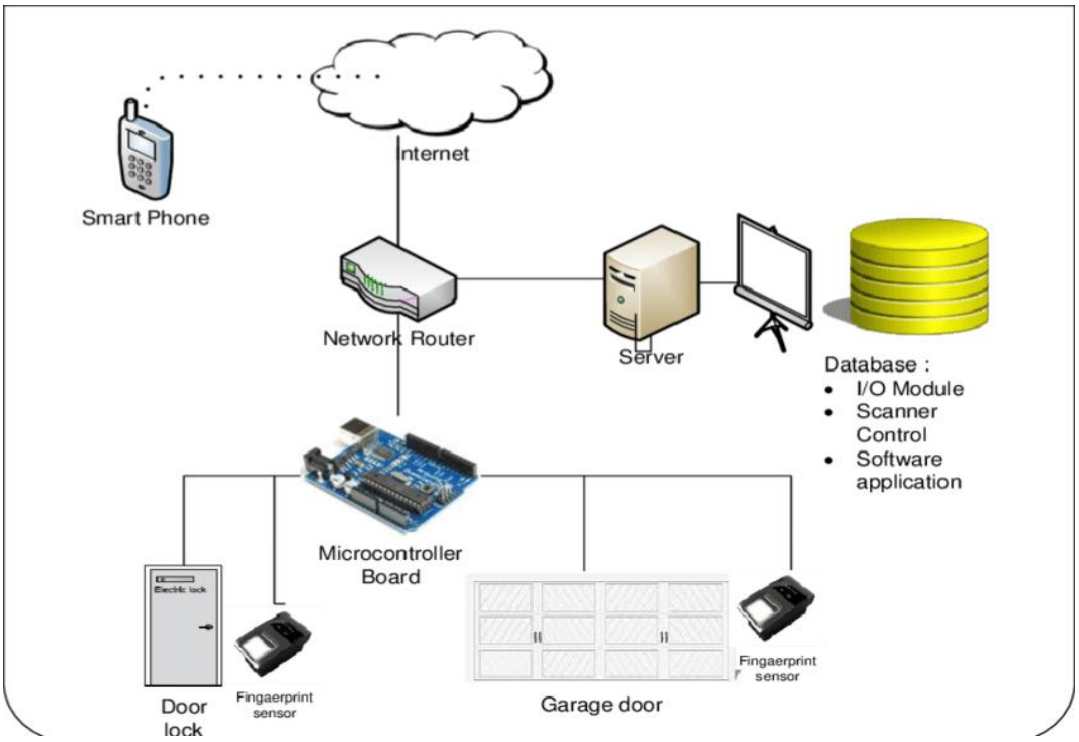

Fig 4.2: System Architecture Diagram

The above figure 4.2 shows the system architecture of the project. The system architecture shows Raspberry Pi as the microcontroller board and every component which are used in the system are connected to it. The RPi is connected to the internet through the network router and the user's device where they get the notification is also connected to the internet. The camera, PIR sensor, alarm buzzer etc. are connected to Raspberry Pi. The architecture works in such a way that, when the devices connected detect any movement, they send a signal to the central board and the central board triggers the alarm, captures the image from the area where the movement is detected and sends the notification to the user via internet to their registered devices.

4.3 Data Flow Diagram

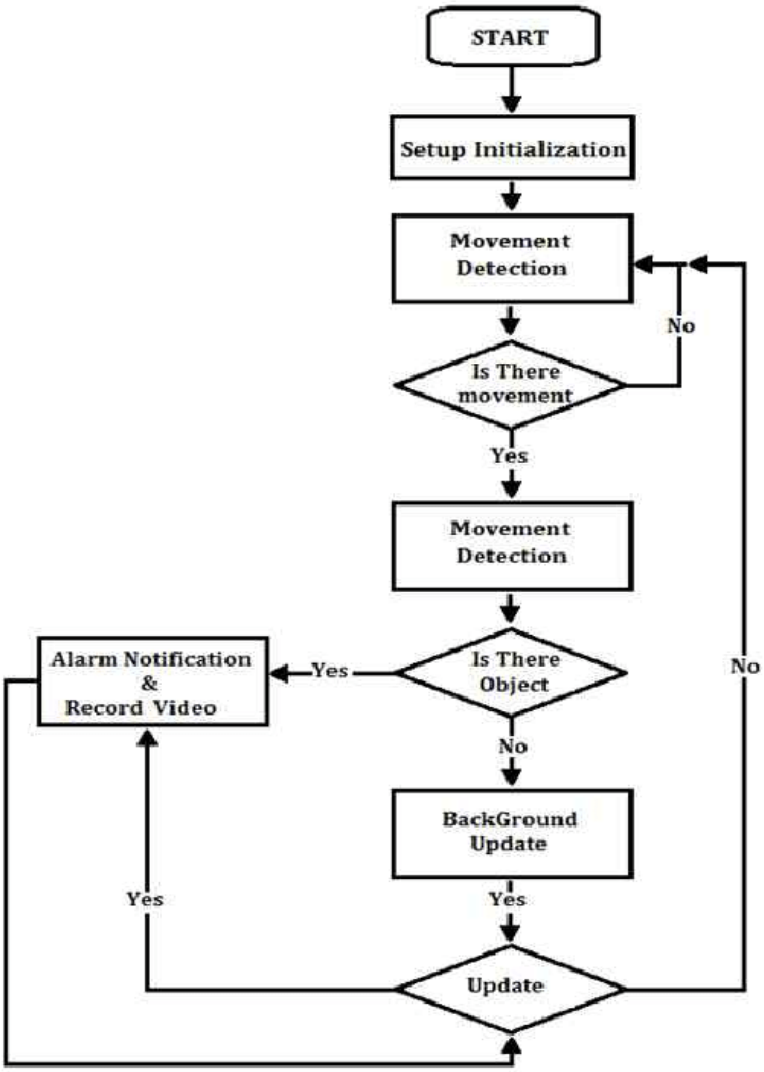

Fig. 4.3: Dataflow Diagram

The above figure 4.3 shows the data flow diagram of the project. The project setup consists of Piezoelectric sensor for movement detection, Raspberry Pi 3 board which is the main controller, camera and a buzzer for alarming the intruder. Whenever movement is detected by the sensor, alarm is buzzed and pictures are captured by the camera around the area where motion is detected. It will then send the captured images to the owner via mobile application through IoT.

4.4 Use Case Diagram

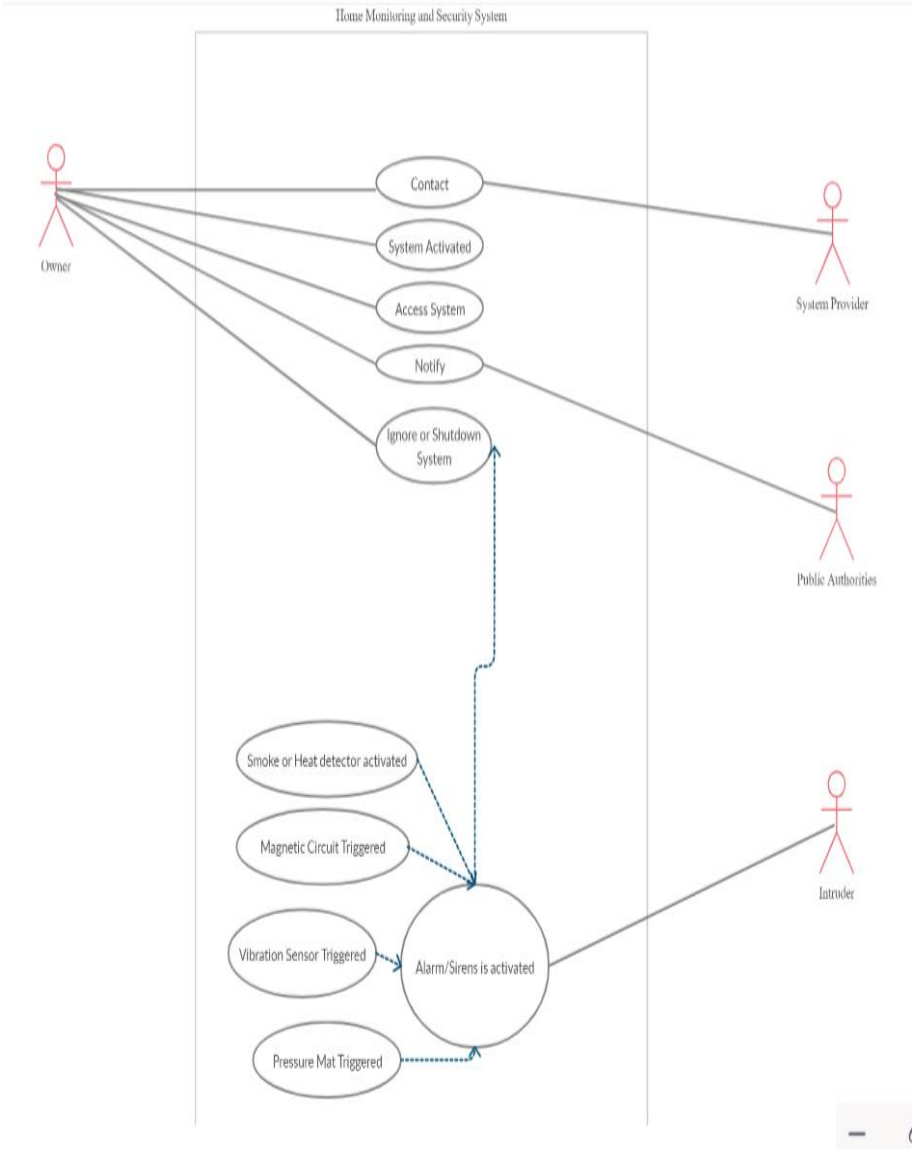

Fig 4.4: Use Case Diagram

The use case diagram shows the simplified and graphical representation of the system as shown above. There are four different actors in this system, owner, system provider, public authorities and intruder. Owner can activate the system, access the system and even shut down the system. Whereas, system provider can only contact the owner. Public authorities can notify the owner. The intruder triggers the sensors and alarm in case of burglary.

Chapter 5

Implementation

This chapter briefly explain about the overall of the application development and implementation. This chapter focus on the testing method being carried out and the final implementation of the entire system. Implementation of the project is explained elaborately module wise with the tools/applications used. While, there are alternatives to implement the same the module, the one that was cost-effective for us to implement it as a prototype is being explained in detail. [23]

5.1 The Different Modules of the Project

A project comprises of many modules. A module at a high-level is a component that can function independently. Many such modules are combined/integrated together as per the tasks rendered by them to form a full-fledged project [9]. These modules are listed below:

- **Detection of unusual pressure on the floor**

While the security system is activated, any unusual pressure on the floor which is covered by piezo sensors is detected and the signals or data are prepared with these detections. As, every sensor has its unique identification or the position it is deployed into therefore the signal is generated by only the sensor that has been activated. The position is sent to the board for further continuation of threat detection.

- **Rotation of the camera to the specific position**

As soon as the signal is received to the servo motor. The motor rotates in the direction of the triggered sensor. The motor which is well connected to the camera, also is rotated together and the position of the occurrence of the disturbance. Then the motor gives out the signal that the desired position is turned and camera can well and truly capture the object that caused the disturbance.

- **Capturing of picture and storing it for further processing**

After the camera is in the desired position, it then captures the image of the object and the image is stored in the raspberry pi board which also has SD Card deployment facility which ca store the images for further use. The raspberry pi board also facilitates the use of USB drive or even a portable hard drive for the storage purpose [10].

- **UI Application for user's end**

This is an application where user interacts with the security system and can use to maintain and get notifications from the system. This system is where the captured image is sent to the user and they can view it in near real-time. This application can also use to send commands to the system to activate or turn on any components of the connected system.

5.2 Functional Description of the Modules

Module functionalities and implementation details are included in the following sub-sections. As a prototype the above modules are implemented in a simpler and cost-effective way. These can be replaced in real use.

5.2.1 Raspberry Pi Model B+

This is the model that was chosen to implement the project. It has merits over other models in that it has increased number of USB ports and large number of GPIO pins. Moreover, this piece of hardware was available at the department.

5.2.1.1 Booting Up the Pi Model

Raspbian 'Wheezy' image was written into the 4GB Micro SD card. This was the operating system chosen to run on the Pi because the OS has been optimized and ported

to the Raspberry Pi ARM architecture. This OS has very good integration with the hardware and comes pre-loaded with a GUI and development tools.

After slotting in the Micro SD card and connecting RJ45 Ethernet cable to the Pi and the personal computer with Putty software (Putty is an SSH client used to remotely access and control the Pi from computer running on Windows platform) the system was powered. Putty was then started and the default static IP address of the Pi was typed into the host name field. While doing this, windows pc was set to manual IP configuration. This was to allow it communicate with the Raspberry Pi.

5.2.1.2 Setting Up internet connection on the Pi

Internet was necessary in so that the Pi can communicate over network protocols and thus allow for installation of necessary Python packages. The architecture below was used to achieve that.

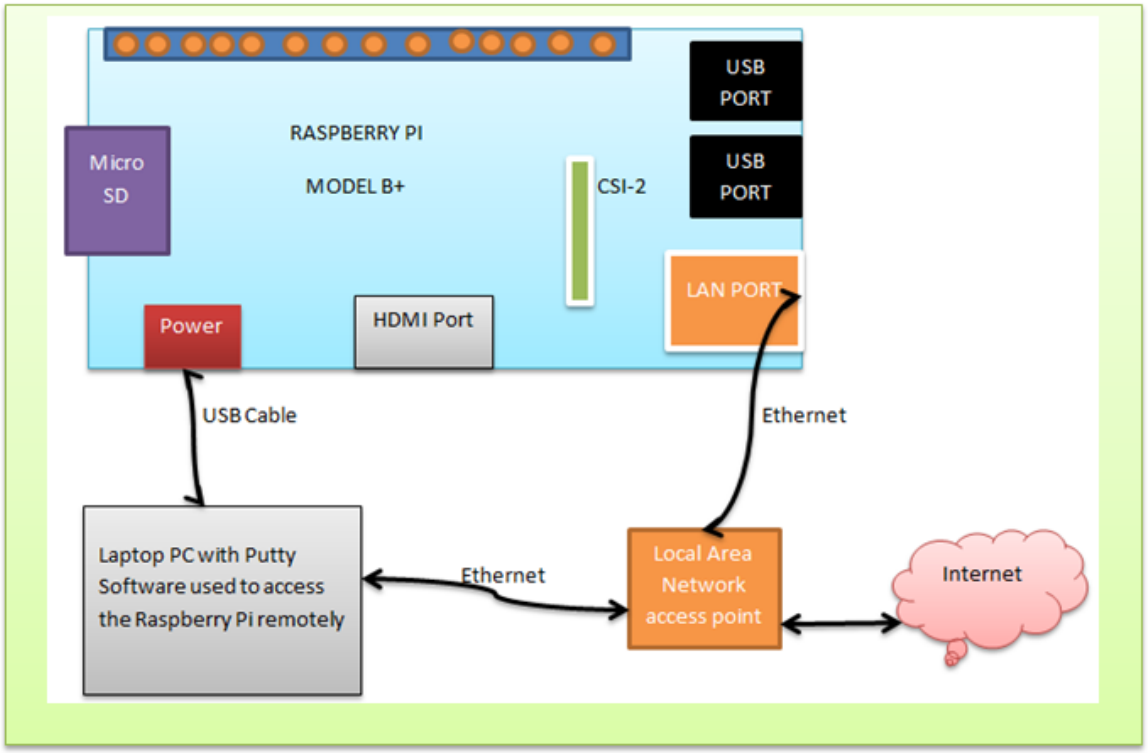

Fig 5.2.1.2: Internet Setup Architecture

Above fig 5.2.1.2 shows the architecture of Internet Connection. Since the broadcast router uses Dynamic Host Configuration Protocol (DHCP) to dish out IP

addresses to devices connected to it, it was necessary to change the IP address of the Pi from static to dynamic. This was done by editing the network interfaces file using the command;

```
Sudo nano /etc/network/interfaces
```

5.2.1.3 Enabling the Pi Camera

Fig 5.2.1.3: Raspberry Pi Camera Module

Above figure represents the Raspberry Pi Camera Module. This is the camera made specifically for the Raspberry Pi. It was hooked to the raspberry pi through CSI-2 electrical port which is an extremely fast port. To configure and enable the camera, the following commands were executed at the CLI of the raspberry pi:

```
sudo apt_get update
sudo apt_get upgrade
sudo raspi-config
```

After these configuration settings, the system was rebooted. This was done to ensure that the camera was allocated enough space in memory. The camera takes 5MP image and has a resolution of 1080 by 890. And to ensure that the camera was well configured and functional, the following command was executed.

```
sudo raspistill –o image.png
```

5.2.3 Setting Up the Passive Infrared Sensor

This is formed the prime motion sensor. It was used to control the entire system. The device used here was HC501SR passive infrared sensor. The detection range is 7 meters by 140(degrees) coning angles. It has a delay time of 16 seconds but adjustable. The ambient temperature is 253K-323K. It was powered directly from the Pi through the 5V dc supply pin. Its output was connected as the input to the programmable GPIO pin.

5.2.4 Automatic Light Simulation

An LED was used to simulate an automatic light control. This was designed to be controlled through the action of a PIR sensor. This device was connected to the GPIO pin through a 220Ω resistor.

Chapter 6

Experimental Results

Chapter 7

Testing

7.1 Testing and Validations

This system enables user to connect home security and appliance system with computer and mobile devices with limitation to quantity of devices by one user per system, as it connects from the system and the user device with the limitation of internet access. This device gives a lot of advantage in the sense of time and money saving for consumers. Moreover, this device will also reduce the cost of hiring expensive security solution which irritates most of the user, worst goes to those who run small business [13].

Important processes involved in this system is the manipulation of correct instruction which is happened in modulating input phase, which allows all the system parts (hardware and software) especially the web protocol and the mobile phone will able to share the output from the system which cannot be penetrated.

Software testing is the process whereby the circuit is tested in stimulation for the effectiveness and error detection, if everything is fine, we can proceed to the real environment test.

Software testing is performed to verify if any error happens in the circuit and this will enable us to re-correct the errors in the circuit. This testing will reduce the wastage happens during the construction of this project.

Hardware testing is the process whereby the circuit which is constructed on the PCB will be test using apparatus such as millimetre to ensure that the device will not malfunction and damaging another device which interoperate with each another.

7.2 Testing Levels

A level of software testing is a process where every unit or component of a software/system is tested. The main goal of system testing is to evaluate the system's compliance with the specified needs.

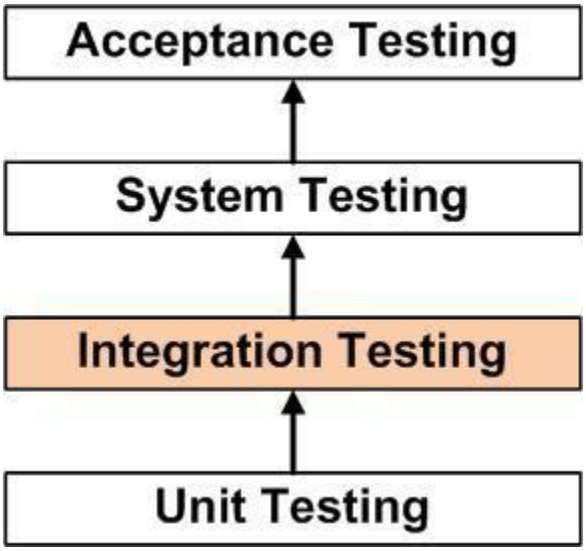

Fig 7.2: Different levels of testing

There are many different testing levels which help to check behavior and performance for software testing. These testing levels are designed to recognize missing areas and reconciliation between the development lifecycle states. In SDLC models there are characterized phases such as requirement gathering, analysis, design, coding or execution, testing, and deployment. All these phases go through the process of software testing levels [14].

7.2.1 Unit Testing

Unit Testing is the very first level of testing of the software where the minute testable parts of a newly finished software parts are tested. This is used to validate that each unit of the software performs as designed. PSpice and OrCAD has been used to

stimulate and create the circuit design, as this software can determine the errors occur in the circuit before proceed to the real circuit environment. With this software, some amount of money used in testing purpose can be reduced [11].

7.2.2 System Testing

This testing checks for operating system compatibility. It includes both functional and non-functional requirements. In system test, awareness about the PCB board design and the surface where it is laid is very important in trial, because sensitive board and surface can lead to short circuit and other errors. After the confirmation of error free, the actual system test is started [8].

7.2.3 Integration Testing

It is the process of testing the interface between two software units or module. It focuses on determining the correctness of the interface. The purpose of the integration testing is to expose faults in the interaction between integrated units. This process is done after all the modules have been unit tested. There are four types of integration testing approaches:

- **Big-Bang Integration Testing**

In this type of testing approach, all the modules are combined together and verified for the functionality after the completion of individual module testing. All the modules of the system are simply put together and tested. This approach is practicable only for very small systems. If once an error is found during this testing, it is very difficult to localize the error as the error may potentially belong to any of the modules being integrated. So, debugging errors reported during this integration testing are very expensive to fix. The main advantage of this type of testing is it is convenient for small systems. Beside the advantages, there are disadvantages too. In this approach, there will be quite a lot of delay because we have to wait for all the modules to be integrated. Also,

there will be high risk to critical modules which are not isolated and tested on priority since all the modules are tested at once.

- **Bottom-Up Integration Testing**

In this type of testing, each module at lower levels is tested with higher modules until all modules are tested. The purpose of this integration testing is, each subsystem is to test the interfaces among various modules making up the subsystem. It uses test drivers to drive and pass appropriate data to the lower level modules. The main advantage of this testing is no stubs are required and several disjoint subsystems can be tested simultaneously. Similarly, the disadvantage of this testing is driver modules must be produced here and the complexity that occurs when the system is made up of a large number of small sub-system.

- **Top-Down Integration Testing**

Top-down integration testing technique used to simulate the behavior of the lower-level modules that are not yet integrated. In this type of testing, testing takes place from top to bottom phase. First high-level modules are tested and then low-level modules. It is then finally integrated from low-level modules to a high level to ensure the system is working as intended.

Advantages:

- It uses separately debugged module.
- Few or no drivers are needed.
- It is more stable and accurate at the aggregate level.

Disadvantages:

- It needs many Stubs.
- The modules at lower level are tested inadequately.

- **Mixed Integration Testing**

It is also called sandwiched integration testing follows a combination of top down and bottom-up testing approaches. In top-down approach, testing can start only after the top-level module have been coded and unit tested. In bottom-up approach, testing can start only after the bottom level modules are ready. This sandwich or mixed approach overcomes this shortcoming of the top-down and bottom-up approaches.

Advantages:

- Mixed approach is useful for very large projects having several sub projects.
- This Sandwich approach overcomes this shortcoming of the top-down and bottom-up approaches.

Disadvantages:

- For mixed integration testing, require very high cost because one part has Top-down approach while another part has bottom-up approach.

This integration testing cannot be used for smaller system with huge interdependence between different modules.

Chapter 8

Conclusion and Future Enhancement

8.1 Conclusion

The main purpose of this project is to produce a system combination of Surveillance , alarm and home appliance monitoring system for the urban user and small and medium entrepreneurship (SME'S) in setting up a device which is capable to monitor, alarmed electrical appliances throughout the building, and this is a bumper jack for those who runs mini markets and Cybercafé this project will enables them to save cost, time, maintenances etc. in handling the device if compared to the expert security system.

As a conclusion, Theft Prevention System using IOT project is a simple project which gives a lot of benefits to those SME's in order to run a business in budget less than expected. The Home Monitoring And Security System gives a lot of benefit and advantages to the user whether a home user, small and medium enterprise, or even for the big enterprise such as Hypermarkets and resorts because this device will reduce the expert Surveillance cost to the company because of its feature which allows us to monitor, manipulate and alarm our home and premises. This will save their cost in installing expert Surveillance which is expensive [15].

By using this device, owners of the company can use the saved amount of money via using this device, to other important things, to enhance their business. Therefore, this Home Monitoring and Security System is a must for those who want to reduce the cost while having the optimum home security and monitoring equipment.

8.2 Future Enhancements

- Major improvements on the system processor speed are much needed in order to process large files.
- The quality of the camera (i.e. with higher Mega Pixels) is required for clear image or video.
- This system requires to be remotely controlled. Hence, future explorations should focus much more on the same.

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