SECURE HOME SURVELLIANCE SYSTEM

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Submitted to the Faculty of Computer Software Engineering Department,
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Rawalpindi in partial fulfillment for the requirements of a
B.E Degree in Computer Software Engineering

JUNE 2018

ABSTRACT

Secure home surveillance system is a new project built for sensitive homes and offices to provide foolproof security. Other products available in market are all being in news for possible breach or backdoor. It is built for users who do not want intruders to be able to disable the system and do any damage. Secure home surveillance shall provide a system that would be used in homes and offices for security services. The two basic things of interests in our IoT project are intrusion detection and live feed. In order to ensure safety, easily deployable and easy to afford solutions are required. This project is developed as a surveillance system through which user can monitor their homes on any android device using a dedicated app. The system will be user friendly and easy to operate. Different levels of security are implemented to make the system secure. A smart home surveillance system will be developed using the concept of IoT. System will use different sensors like Motion sensors, IP Cameras etc. to provide live feed and surveillance of your home on your mobile phone. The system is controlled by the android application. During locked state, if any intrusion is detected an alert will be sent on the mobile phone. An android application is developed to graphically represent the gathered information from different sensors. This application generates visual and notification based alerts to notify the end user in case of any critical event.

CERTIFICATE OF CORRECTNESS AND APPROVAL

Certified that work contained in this thesis “Secure Home Surveillance System” carried out by Wajeeh Sajid, Taimoor Akhtar, Bilal Rafique and Nouman Nasir under the supervision of Asst. Prof. Bilal Rauf for partial fulfillment of Degree of Bachelor of Software Engineering is correct and approved.

Approved by

_____

Asst. Prof Bilal Rauf

Department of Computer Software Engineering

Military College of Signals, NUST

Dated: _____

DEDICATION

In the name of Allah, the Most Merciful, The Most Beneficent

This project is dedicated to our parents and supervisor, who tried.

ACKNOWLEDGEMENT

We are eternally grateful to Almighty Allah for bestowing us with the strength and resolve to undertake and complete the project.

We gratefully recognize the continuous supervision and motivation provided to us by our supervisor, Assistant Professor Bilal Rauf for his continuous and valuable suggestions, guidance, and commitment towards provision for the undue support throughout our thesis work. It is because of the help and guidance that we were able to complete this project and thesis work in time.

We would like to offer our admiration to all out class mates and seniors who have been supporting, helping and encouraging us throughout our project.

Last but not the least we are deeply obliged to our families for their never ending patience and support for our mental peace and to our parents for the strength through their prayers.

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Introduction to Secure Home Surveillance System

1.1 Introduction

Secure home surveillance provides a system that would be used in homes and offices for security services. The two basic things of interests in our IoT project are intrusion detection and live feed. In order to ensure safety, easily deployable and easy to afford solutions are required. This project is developed as a surveillance system through which user can monitor their homes on any android device using a dedicated app. The system will be user friendly and easy to operate. Different levels of security are implemented to make the system secure. A smart home surveillance system will be developed using the concept of IoT. System will use different sensors like Motion sensors, IP Cameras etc. to provide live feed and surveillance of your home on your mobile phone. The system is controlled by the android application. During locked state, if any intrusion is detected an alert will be sent on the mobile phone.

1.2 Background

A rising concern in all aspects of life is security and no compromises can be made here. Human error is not something that can be tolerated in this case and if such error occurs the effects can be disastrous.

A well designed and tested surveillance system which reduces the chance of error is the solution to these problems. A Secure Home Surveillance System

is the solution. One which can sense and notify its users in time to take corrective action, in case of any anomaly in the sensed environment.

Smart environments is a technological concept that, according to Mark Weiser is "a physical world that is richly and invisibly interwoven with sensors, actuators, displays, and computational elements, embedded seamlessly in the everyday objects of our lives, and connected through a continuous network"

1.3 Problem Addressed

The problem of security in houses as well as in small organizations housed in a single home or small buildings is a major concern. Despite the availability of state of the art solutions, the problem persists. Not because these solutions don’t provide the required functionality but due to the cost that makes these solutions unaffordable for the common man and small organizations. Some of the solutions use wired approach and consumes a lot of space and is dependent on electricity i.e. a power failure means automated security is down.

The above stated problems are addressed by the Secure Home Surveillance System. The Secure Home Surveillance System is for those users who want security to protect their environment intrusion.

1.4 Goals and Objectives

Secure Home Surveillance System is developed to provide the security from intrusion. This system is well suited for environments like small buildings, laboratories and storage places etc. The objective of the Secure Home Surveillance System is to provide an application that monitors intrusion

detection and alerts the user in case of intrusion. The goal is the development of an android application. The android application has two main components. The first will enable us to get notifications in case there is a breach in security. Major concern in this regard is that the sensing devices (sensor) are resource constrained i.e. battery powered, low computational capability and few kilobytes of memory. The second will be the application will provide us live feed of cameras on the android device. This live feed will be streamed on the device through a streaming server. In this component, a user friendly GUI and capability to inform remote user regarding sensed data is important. This component provides visual and notification alerts to the user.

1.5 Deliverables

The project deliverable is an application and hardware system for the monitoring of intrusion with the ability to generate alerts based on the values sensed from the environment.

In its entirety it should be a wireless sensor network for sensing and transmitting information detected by the sensors to a common sink. This data will serve as input for the functioning of the above mentioned application.

1.6 Document Organization

The document includes the basic knowledge of the Secure Home Surveillance System. The first chapter describes what project is and explains the basic idea, background, goals and objectives. In second chapter related work has been discussed that has been done in this field. Requirements and design specifications are discussed in the chapter 3 and 4. Implementation of the

Secure Home Surveillance System is elaborated in chapter 5. Testing strategies and results are discussed in Chapter 6 and 7 respectively. The project work is concluded in the last chapter along with the future directions.

1.7 Summary

This chapter starts with a brief introduction and background to the Secure Home Surveillance System project. Initial sections are followed by an explanation of the problems that the project addresses and what the Secure Home Surveillance System project aims to achieve. It then touches upon the final product the project will deliver. In the last section document organization is elaborated. In a nutshell the Secure Home Surveillance System project aims at the development of an automated system for the monitoring of detecting intrusion.

Chapter 2

2 Related Work

2.1 Introduction

In this chapter existing technologies and solutions which address problems similar to the one the Secure Home Surveillance System project aims to solve are discussed in length. Also a comparison is done between these and the Secure Home Surveillance System which is presented at the end of this chapter.

2.2 Burglar Alarm

Burglar or intrusion alarms are electronic alarms to alert user form the intrusion. It has been observed that these types of alarms are commonly connected to some control unit via wiring but in very rear cases radio frequency signals are used for communication. There alarm systems most of the time only detect the opening of the window or door. Few new burglar alarms systems are now using the PIR (Passive Infrared) [17] for detection purpose. PIR sensor detects the motion and generates the intrusion alert. Secure Home Surveillance System also uses PIR sensors to detect the motion and generate alert for intrusion.

Conventional Alarms have a major drawback that the user has very little control over it and in most of the systems users can only turn it on or off [15], manually. Moreover, information regarding the intrusion is not provided to remote user who is outside the audible range of the alarm.

The figure 2-1 shows a wired burglar alarm which are commonly used in many places.

Figure 2.1 Burglar Alarm

2.3 Hold up and Panic Button System

This system is another type of intrusion detection system which has wired/wireless hold up and panic buttons which incorporate silent alarms. This system requires a person who presses the button to send the indication to the control room. These types of systems can only be used in retail and banking, commercial areas or any place where a company's employee is face to face to the customers or people from outside the company. The system is for some limited environments and also requires a person to generate the alert, thus informing the control room that something has gone wrong.

The figure 2-2 shows few hold up and panic button which are often used in banks and offices.

Figure 2.2 Hold up and Panic Button System

2.4 IP Cameras

IP cameras are widely used for monitoring and for security purposes. This system only provides streaming of video and does not have any mechanism to generate any kind of notification in case an intrusion occurs. They are attached with a DVR box which controls these cameras.

Figure 2.3 IP Camera

2.5 Summary

The existing technologies and systems that are providing similar solutions as Secure Home Surveillance System have discussed in this chapter. Burglar alarms, Hold up and Panic button, Fire alarms with smoke detector and pull station are discussed. Although, considerable amount of work has been in the field of home/office security and environmental monitoring, however on this project the Secure Home Surveillance System is developed with very resource constrained and cheap devices. But at the same time, the developed system is not only comparable but also affective than numerous existing solutions.

Chapter 3

3 Requirement Specification

3.1 Introduction

The requirement specifications of the Secure Home Surveillance System project are documented in this chapter. This chapter is aimed to eliminate ambiguities and misunderstandings that may exist. For the user, the SRS will explain all functions that the software should perform. For the developer, it will be a reference point during software design, implementation and maintenance.

This chapter encompasses the requirements for secure home surveillance Software. The main purpose of this project is the development of a system that would allow the users to secure their home using this system and they will be able to monitor the home on their android phone.

3.2 Project Scope

Secure home surveillance shall provide a system that would be used in homes and offices for security services. The scope of this project is to develop encrypted surveillance system through which user can monitor their homes on any android device using dedicated app. The system will be user friendly and easy to operate. Different levels of security are implemented to make the system secure.

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3.3 Overall Description

The overall descriptions of the system including the product features, perspective and network perspective are elaborated in this section.

3.3.1 Product Features

The final product is intended to have a number of features. These features are provided using different modules in a way to achieve the overall functionality. The basic product features are elaborated in the remaining of this section.

- Provides live feed on mobile phone using an IP camera
- Supports enabled and disabled state through mobile phone
- Notifies in case of any intrusion
- Uses motion sensor to detect unwanted activities
- Provides a secure and encrypted system

3.3.1.1 Live Surveillance

One of the basic functionalities of the system is to provide live feed from the home through IP cameras installed in the home. Video from the cameras will be sent to main system and will be encrypted and then sent through Wi-Fi to android device. Where the user will see the feed on provided app.

3.3.1.2 Intrusion detection

Another basic functionality of the system is to provide notification alerts in case of any intrusion. Whenever someone breaks into the house through a window or door, intrusion will be detected through installed sensors and a message will be sent on the app, notifying the user about the point of intrusion. .

3.3.1.3 System Android Application

The Secure Home Surveillance System is an android application. The application should be able to visually display the sensor motes data which they are sending from their observed environment. The data representative should be made on the device running the application.

This application will also generate alerts in the form of visual alerts, and notification alerts.

3.3.2 Product Perspective

Secure home surveillance is new project built for sensitive homes and offices to provide foolproof security. Other products available in market are all being in news for possible breach or backdoor. It is built for users who do not want the intruders to be able to disable the system and do any damage.

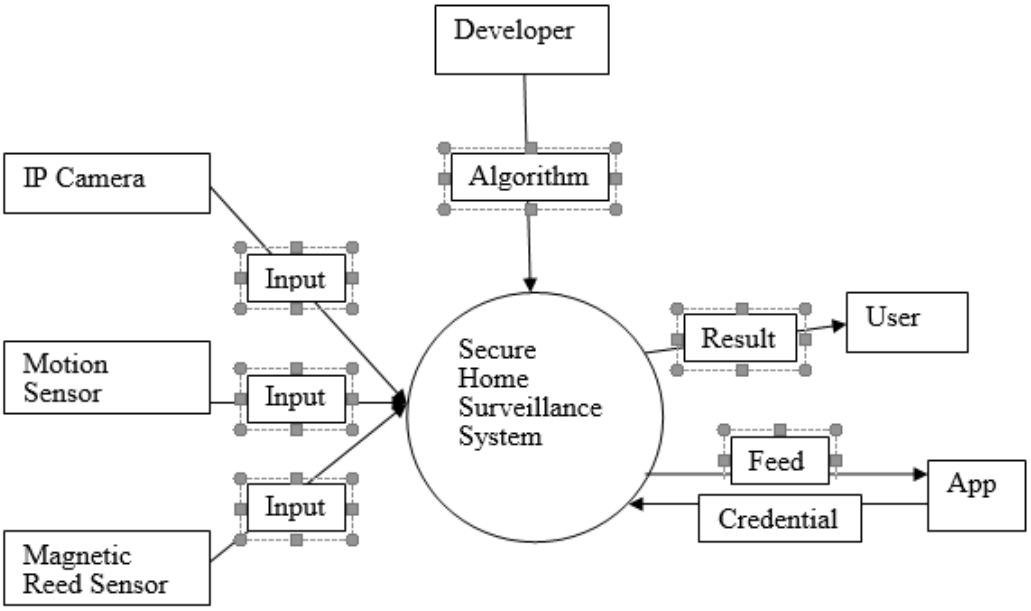


Figure 3.1 Working

3.4 Assumption and Dependencies

- Secure home surveillance will run with these minimum hardware specifications:
    - Android Version 4.1 (Jelly Bean)
    - 1GB RAM or higher
- Secure home surveillance app will run on Android devices only.

3.5 Design and Implementation Constraints

- For Secure home surveillance to operate successfully there must be no power failure otherwise the whole system will shut-down.
- All communication will be encrypted between system and android device.
- Secure home surveillance uses an android device therefore it should always be available for feed view.

3.6 User Classes and Characteristics

Defining system users for Secure Home Surveillance System:

3.6.1 UCC-1 System Buyers

Buyers will be general users who will use the system. They will be interacting with android app as well as the system.

3.6.2 UCC-2 Developers (Project group)

Software and source code will be provided to them for general development or future possible maintenance.

3.6.3 UCC-3 Software Testers (MCS, Project group)

Software will be used for Alpha Testing by our project group and Beta Testing for MCS team.

3.7 Operating Environment

This included all the specifics required for software to be built.

3.7.1 Hardware

Android Devices

3.7.2 Software

Android OS

3.7.3 Operating Conditions

The Secure Home Surveillance System hardware sensor are powered by an adopter. Based on the operation of the sensors these adaptors will work on electricity only. The range of sensors is severally effected by the length of the wires connecting them. The Wi-Fi system is also required for the proper functioning of the system which is limited by the range of the Wi-Fi.

The Secure Home Surveillance System project is intended for small closed environments such as houses and small buildings. However it can be used outdoors as well, with possibly a little deterioration in communication.

The targeted operating system for base station application i.e. Android OS. Android was selected as the first choice for the operating system because it is the most common OS now-a-days and easy to use.

3.8 System Features

This section gives details of the system features as documented in the functional requirements. All the functional requirements have been met and transformed into system features. Common system features includes the following:

3.8.1 Live surveillance

System will provide live camera feed on android device.

3.8.1.1 Description

One of the basic functionalities of the system is to provide live feed from the home through IP cameras installed in the home. Video from the cameras will be sent to main system and will be encrypted and then sent through wifi to android device. Where the user will see the feed on provided app.

3.8.1.2 Stimulus/Response Sequences

- User is provide with the system app
- User will click the live feed option available on home screen
- User will be able to see live camera feed

3.8.1.3 Functional Requirements

REQ-1. The system shall provide the option to view live feed

REQ-2. The system shall provide list of cameras to view

REQ-3. The system shall allow the user to select any specific camera from the list

REQ-4. The system shall provide live view from the selected camera

REQ-5. The system shall enable the user to switch to any other camera

3.8.2 Intrusion detection

3.8.2.1 Description

Another basic functionality of the system is to provide notification alerts in case of any intrusion. Whenever someone breaks into the house through a window or door, intrusion will be detected through installed sensors and a message will be sent on the app, notifying the user about the point of intrusion.

3.8.2.2 Stimulus/Response Sequences

- User is provide with the system app
- An intrusion is detected by the sensors
- User is given an alert through the app
- User will open the app to see the point of intrusion
- User will also be able to see intruder through cameras

3.8.2.3 Functional Requirements

REQ-1. The system shall be able to detect the intrusion

REQ-2. The system shall be able to detect location of intrusion through triggered sensor

REQ-3. The system shall notify the user through app

REQ-4. The system shall enable the user to switch to camera view by clicking on the generated notification

.

3.9 Non-Functional Requirements

Requirements that are required by the Secure Home Surveillance System project to ensure smooth functioning and to achieve best performance are explained in this section. These are requirements that are not tangible but necessary for the proper operation of Secure Home Surveillance System.

3.10 Security Requirements

REQ-1. The app shall allow the user to activate/deactivate the system only after password verification.

REQ-2. The system shall allow the user to recover forgotten password through a recovery key.

REQ-3. The system shall be needing power backup in order to avoid system shutdown.

REQ-4. Unavailability or poor network connection can cause the system to stop working properly

REQ-5. In case of system crash, no data will be lost

3.11 Safety Requirements

The use of the software app has no harms whatsoever; nor does it have any possibility of loss or damage that might be inflicted during the use of the product

3.11.1 Performance Requirement

Secure Home Surveillance System should be efficient with respect to response time, performance and operation. As the product deals with safety and security issues, which are both critical in nature, it is important for the system to be efficient and accurate. The minimalistic approach should be adopted to preserve limited amount of memory. Therefore, the size of the program must not exceed the memory limit of the devices. Since the network topology can change with the addition and deletion of sensors the system should respond to any change within appropriate amount of time.

3.12 Software Quality Attributes

Secure Home Surveillance System project has to follow some important quality requirements that should cause positive impact on the quality. The quality requirements are discussed in this section.

3.12.1 Runtime System Qualities

The Secure Home Surveillance System is a product which performs its functionalities in real time. So on runtime some function are adopted in order to fulfill the user required functionalities. The runtime quality attributes are as follow.

3.12.1.1 Functionality

Secure Home Surveillance System must have to perform the functionalities like measuring the temperature, detecting the intrusion no matter wherever the devices are placed within the network.

3.12.1.2 Availability

The availability of the Secure Home Surveillance System is very important because in case of intrusion all this have to be informed to the user by generating alerts which can only be possible if the system is available.

3.12.1.3 Usability

The Secure Home Surveillance System has to be user friendly and easy to install for the user. The user should understand right away how it will work after the system has been installed. The help menu option is available on the desktop application which guides user to all the details of the SHSS.

3.12.2 Non-Runtime System Qualities

Non-Runtime qualities of Secure Home Surveillance Systems are those requirements which can benefits other developers to enhance the code and improve any functionality of the system according to the environment.

3.12.2.1 Modifiability

Secure Home Surveillance System should also have the ability to accommodate the changes and modifications. The product has the ability to incorporate both the hardware and software functionality if anyone wants to modify it. New sensors like pressure or presence of any toxic gas can be attached with the sensor device. Likewise, some changes can be incorporated in the software.

3.12.2.2 Reusability

The modules to be developed in Secure Home Surveillance System should be reusable. Therefore, the implementation and working of the Secure Home Surveillance System should be understandable so that it can be reused.

3.12.2.3 Integrate-ability

The Secure Home Surveillance System has separately developed components which are required to collectively perform all the required functionalities at its best. These modules are integrated in such a way that all the requirements are fulfilled.

3.12.2.4 Testability

Secure Home Surveillance System must be able tested to remove all the faults and bugs from the final product. Different testing techniques can be applied for example integration testing and beta testing. These testing techniques make the system to work according to the requirements specified.

3.13 Other Requirements

The Secure Home Surveillance System is should be developed with available devices. Also the cost of modification required within devices (like PIR sensor) should be low. It should be well documented, understandable, fault free at the time of delivery. It must allow the interfacing of additional sensors if required in the future.

3.14 Summary

In this chapter the requirements of the Secure Home Surveillance System project are described. These requirements include the application, functional and non-functional requirements and also the important features of the system. These requirements will serve as a basis for checking back if we have completed all that was decided at the start and also for testing purposes.

Chapter 4

4 Software Design

4.1 Introduction

The design and architecture of the system which is to be developed is very important because whole system qualities are based upon the design. Secure home surveillance system is a security system which will use cameras and sensors to monitor the home and provide live feed and intrusion alerts on android application. Secure Home Surveillance System provides the users with more reliable security system with rapid reaction time.

4.2 System Overview

Secure Home Surveillance System project is based on the concept of sensing, processing and constructing. In other words, sensors like magnetic reed/ motion sensors are used to gather information while these sensors are attached to Raspberry pi 3 module which processes the data and sends it to the base station. The base station then notification in case of an intrusion which is the action portion of the system.

In more detailed overview, the sensors will sense the environment for intrusion. The values from sensors are transmitted to Raspberry pi module.

Once received the data is read by the application and processed to make further decisions. The data is also displayed to the user. Details of the application can be found in previous sections. Based on the values the application will generate alerts to notify the user.

4.3 Assumption and Dependencies

The basic assumption for Secure Home Surveillance System is that the system is for homes or one floor of a building. It should not be placed in open environments. The hardware will not be exposed to direct sun light or direct wind from a heater or air conditioner. The hardware will be placed in places where intrusion is expected within 5-7 meters of the placement.

4.4 System Architecture

This section provides a detailed and comprehensive architectural overview of the system, using different architectural views to depict different aspects of the Secure Home Surveillance System project. The significant architectural decisions which were made are also described herein.

4.4.1 Architectural Constraints and Goals

SHSS is an interactive system which requires server and clients to be integrated and remain in touch at all times. Developing such systems require thorough consideration on the availability as it might result in complexity problem. A poorly-designed system results in a system consuming more resources with very little efficiency and a slower response time which directly affects the experience of the target user besides this, poor designs make testing and maintenance activities difficult. Client-Server approach would be used to develop the system. Low cost devices are used in Secure Home Surveillance System for data collection and routing purposes. Software application that reads and display the information graphically for the purpose of monitoring and generating alerts.

4.4.2 Sensor Network Architecture

This section describes the architecture used for the wireless sensor network. This is shown below in figure 4-1.

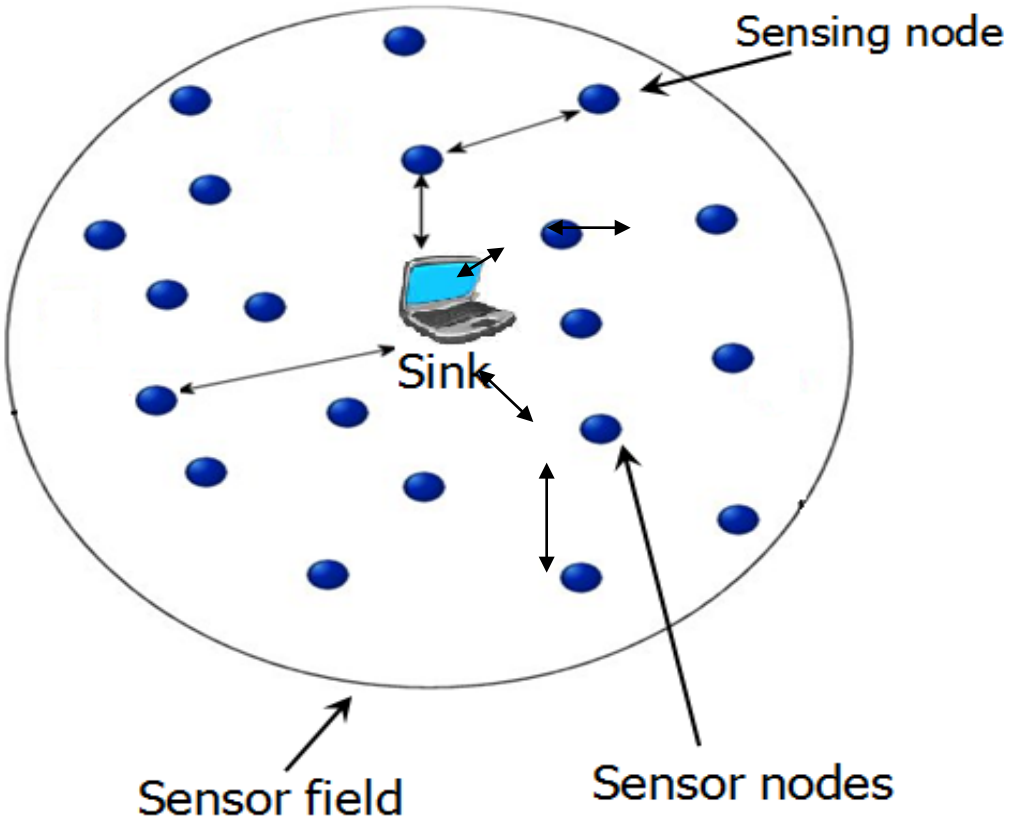


Figure 4.1 Communication System of Secure Home Surveillance System

4.4.2.1 Hardware

This represents the Node ESP32 which will host the sensors. The sensors will sense from the environment. This data is then transmitted. Once the packet has been transmitted it will be received by the Node ESP32. Similarly the IP cameras are connected to Raspberry pi 3 module.

4.5 System Design

The design of the Secure Home Surveillance System consists of two separate modules. The first is the Node ESP32 and Raspberry pi 3 module. And the second is the android application. These have been designed separately but in a fashion which will allow easy integration and to achieve the complete functionality of the Secure Home Surveillance System.

4.5.1 Smart Home Surveillance System (SHSS) Design

This section provides details overview of the design of the Secure Home Surveillance System, using UML diagrams such as Use case diagrams and Class diagrams. This will depict the different aspect of the Secure Home Surveillance System.

4.5.1.1 Use Case Diagram of the Smart Home Surveillance System

The use case diagram shown in figure 4-6 describes how the user and system will interact with each other. The diagram explains how a user can interact with the system and what types of functionality he/she can perform on the system. The use cases in the diagram show what the system can do and the relationship of different use cases with the user has been shown according to the requirements. A detailed description of the use cases is given below.

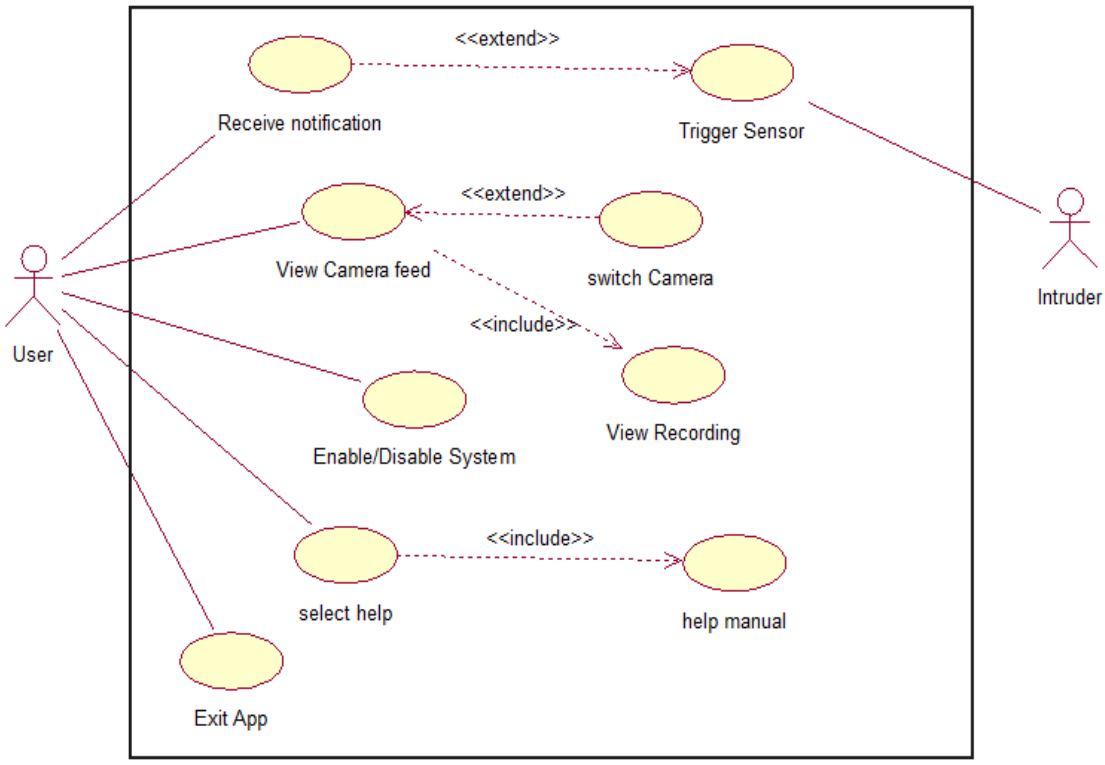


Figure 4.2 Use Case diagram

- **Alerts**

In the case that an intrusion is detected, the user is notified in the form of an alert. The alerts generated are displayed in the form of a notification.

- **Intrusion**

This explains that intrusion alert will only be generated when an intrusion occurs. The system sequence diagram explains this extended use case.

- **Notification**

The user will be notified as mentioned above. These notifications are in the form of alerts. One kind of alert is provided by the application.

4.5.2 Class Diagram

The class diagram of Secure Home Surveillance System has been shown in the figure 4-14 and the detail about the classes is discussed in this section.

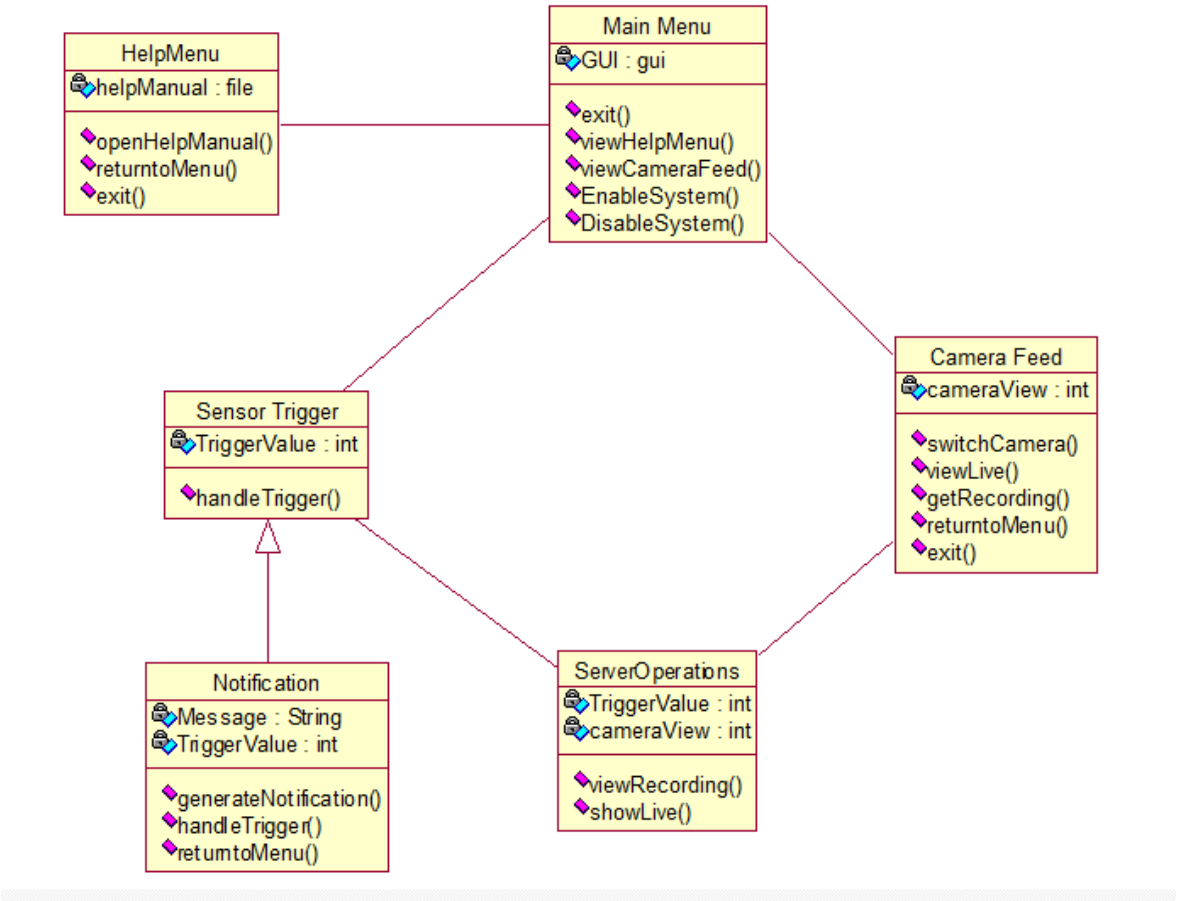
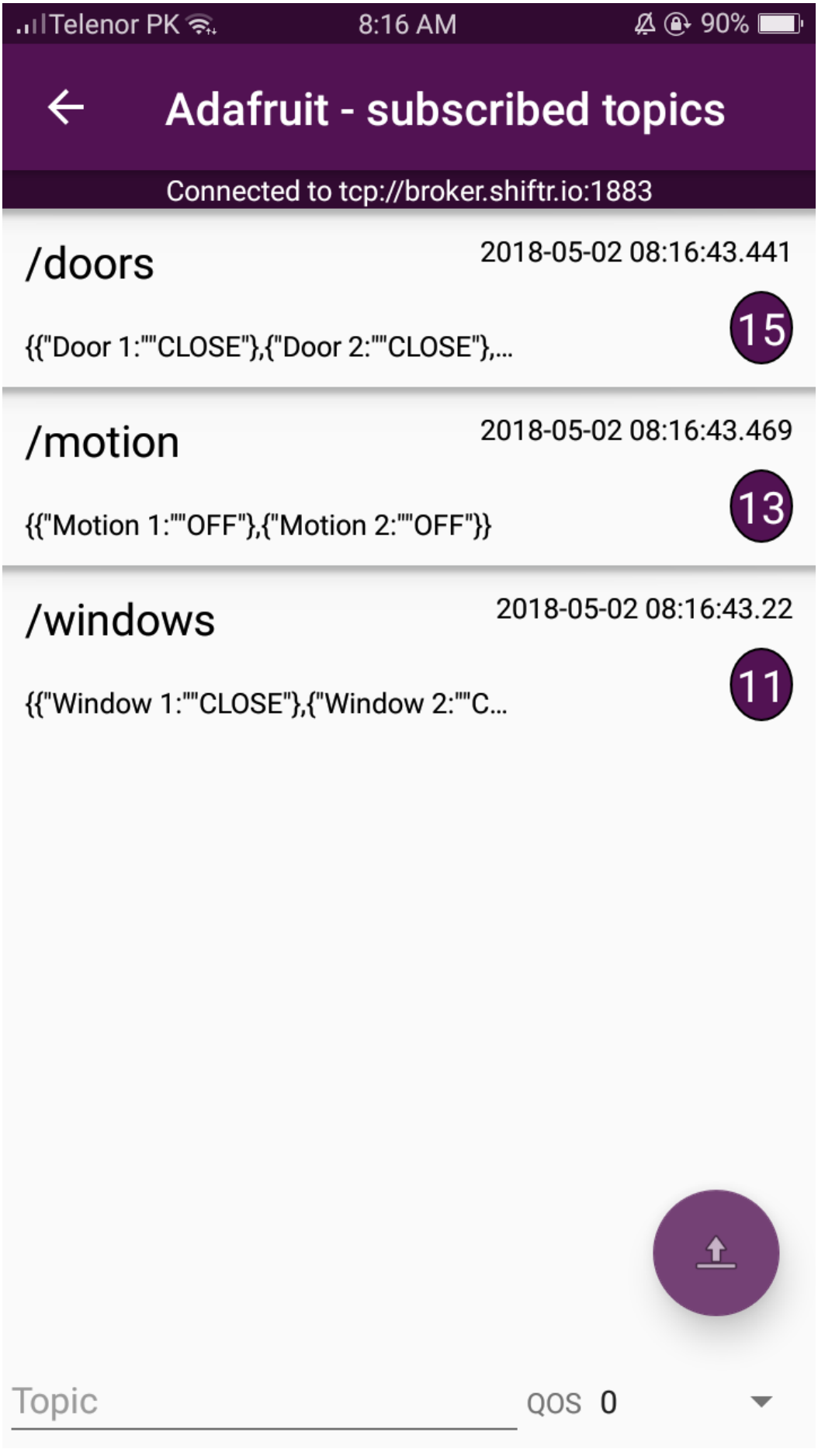
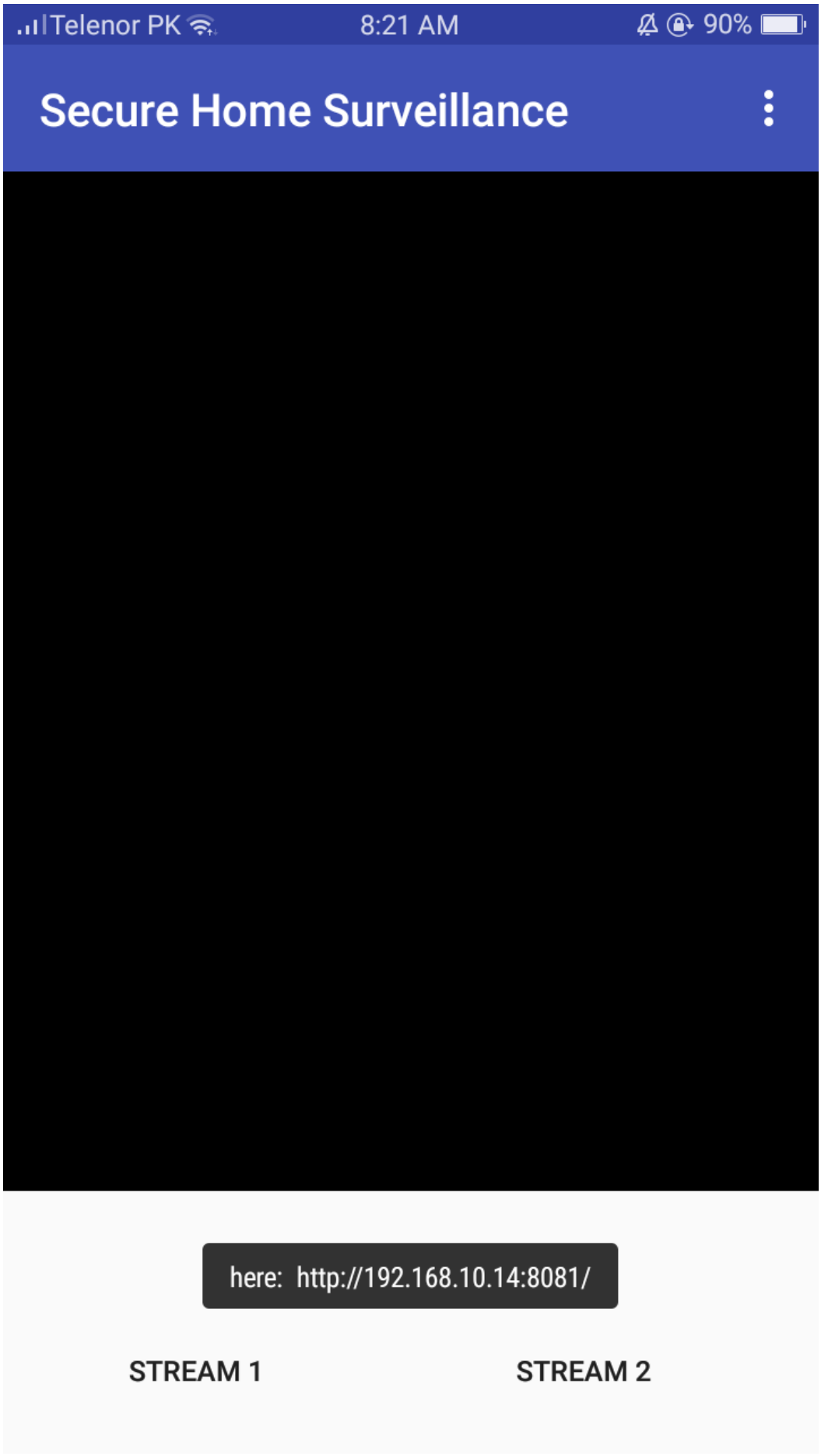


Figure 4.3 Class Secure Home Surveillance System

4.5.2.1 Main Menu

This class is the main class of the Secure Home Surveillance System which includes the maximum functionalities.


Telenor PK
8:16 AM
90%
Adafruit - subscribed topics
Connected to tcp://broker.shiftr.io:1883
/doors
2018-05-02 08:16:43.441
{{"Door 1:""CLOSE"},{"Door 2:""CLOSE"},...
15
/motion
2018-05-02 08:16:43.469
{{"Motion 1:""OFF"},{"Motion 2:""OFF"}}
13
/windows
2018-05-02 08:16:43.22
{{"Window 1:""CLOSE"},{"Window 2:""C...
11
Topic
QOS 0


Telenor PK
8:21 AM
90%
Secure Home Surveillance
here: http://192.168.10.14:8081/
STREAM 1
STREAM 2

4.5.2.2 Camera Feed

Camera feed provides live video streaming. User can switch between camera feeds. It records the video and saves it on the server.

4.5.2.3 Sensor Trigger

This class is responsible for serial port communication. It handles the reading of data from the serial port and making it available for use by Secure Home Surveillance System.

4.5.2.4 Server Operations

Live streaming from cameras will be uploaded to the server and displayed on the android app through this class.

4.5.2.5 Help Menu

It provides general navigation through the application and general user guidelines.

4.5.2.6 Notifications

Whenever a sensor is triggered it generates a notification on the user's android device. By clicking on the notification user can navigate to the relevant live stream.

4.6 Summary

Design details and some of the design decisions along with the reasons for selection of these design decisions have been provided in this chapter. The design of the complete system includes the design of the android application (Secure Home Surveillance System) which allows monitoring, settings for alerts and generation of alerts.

Chapter 5

5 Implementation

5.1 Introduction

The previous chapter discussed the design; inner details of the class attributes and methods, Use case diagram etc. Based on that design this chapter will concentrate on the implementation details of the system.

We have categorized implementation details into Intrusion detection and Secure Home Surveillance System (SHSS). Therefore, in the remaining of this section implementation details regarding these modules have been presented.

5.2 Intrusion Detection

There are a number of sensors available which can be sued for the purpose of intrusion detection. We have used sensors like motion and magnetic reed due to ease of availability and low price. Moreover, most of the motion detection sensors continuously emit radiation, such as light, radar, or ultrasonic waves and sense changes in the environment caused by a passing object.

When an intrusion is detected by the sensor, it sends a voltage signal at its output pin. When the PIN 3 of the node ESP32 detects a high signal, it triggers an interrupt. This informs the system that an intrusion has been detected.

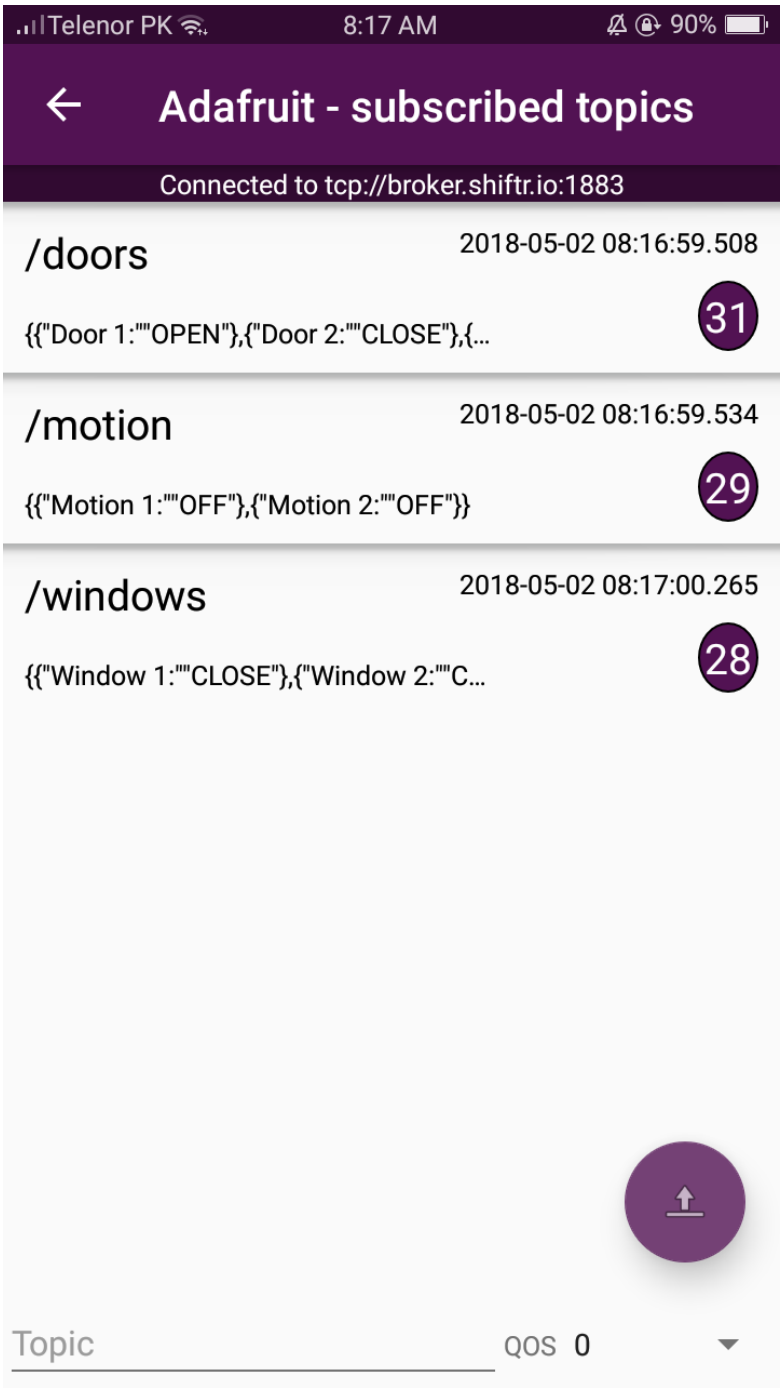
5.3 Secure Home Surveillance System (SHSS)

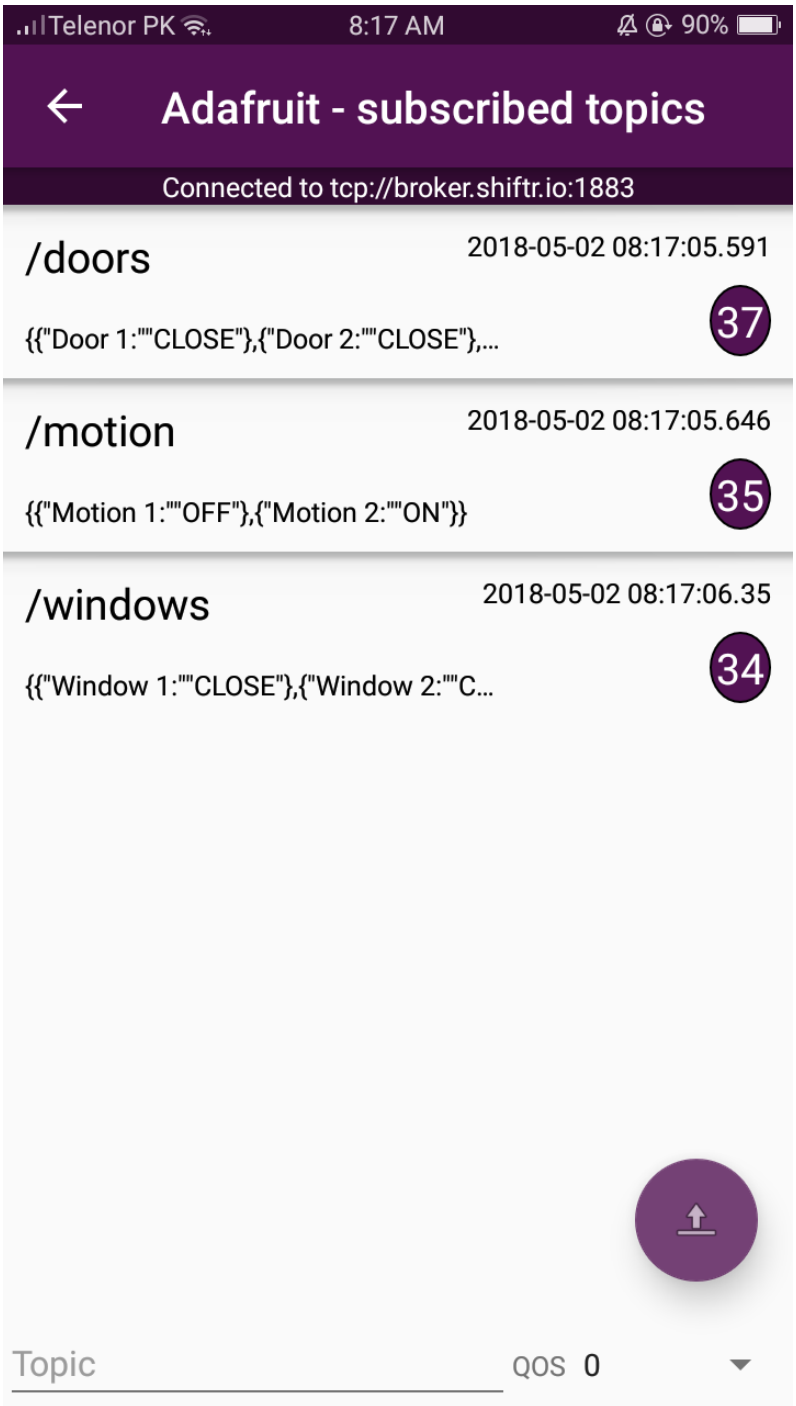
The communicating motes are not enough for the complete functioning of the Secure Home Surveillance System. The user will be provided alerts based on the information provided by the motes, via Secure Home Surveillance System. This is an application developed in android studio. This will assist the user in monitoring the system as well as customizing alert settings. Data from all the motes is communicated to the Node ESP32. The Secure Home Surveillance System continuously listens for data received at the sink. The Secure Home Surveillance System reads this information from the node as it arrives. Each time the message is received at the node, a software trigger is generated which informs the SHSS that data has arrived. In the next step SHSS reads this data and processes it. Different implementation details of SHSS components are explained in the remaining of this section.

5.3.1 Graphical User Interface

The Secure Home Surveillance System allows the user to view the received information as graphical objects. The alerts are pop up notifications.

In order to make the Secure Home Surveillance System user friendly and allow for easy monitoring, the user is allowed to name the sensors as they appear to identify where this motes is placed in the environment. e.g. if a sensor is placed in the bedroom, the user might want to name it as name “Door”.


Telenor PK
8:17 AM
90%
Adafruit - subscribed topics
Connected to tcp://broker.shiftr.io:1883
/doors
2018-05-02 08:16:59.508
{{"Door 1:""OPEN"},{"Door 2:""CLOSE"},{...
31
/motion
2018-05-02 08:16:59.534
{{"Motion 1:""OFF"},{"Motion 2:""OFF"}}
29
/windows
2018-05-02 08:17:00.265
{{"Window 1:""CLOSE"},{"Window 2:""C...
28
Topic
QOS 0



The text is to be read as: values indicate whether an intrusion has been detected, “CLOSE” means no intrusion and “OPEN” means an intrusion.

5.4 Summary

The implementation of final product has been explained in this chapter. Implementation of the sensors and the Secure Home Surveillance System application has been explained in detail.

Chapter 6

6 Testing

6.1 Introduction

This test plan document describes the appropriate strategies, process and methodologies used to plan, execute and manage testing of the "Secure Home Surveillance System". The test plan will ensure that Secure Home Surveillance System meets the customer requirements at an accredited level.

Manual Testing will be followed which includes testing a software and hardware manually, i.e., without using any automated tool or any script. In this type, the tester takes over the role of an end-user and tests the software to identify any unexpected behavior or bug. Each Unit will be tested separately and then will be integrated with other units; therefore, Unit Testing and Integration testing will be followed. For each unit, Black box Testing is done and for combined units Acceptance Testing is done.

The test scope includes the Testing of all functional, application performance and use cases requirements listed in the *requirement document.*

Software testing, depending on the testing method employed, can be implemented at any time in the development process. However, most of the test effort occurs after the requirements have been defined and the coding process has been completed.

This document includes the plan, scope, approach and procedure the testing of Secure Home Surveillance System. The pass/fail criteria of the test items are also defined. The document tracks the necessary information required to effectively define the approach to be used in the testing of the product.

6.2 Testing Techniques and Levels

Testing of the software projects involve different levels of testing to make sure that the software which is being developed is error and fault free. Secure Home Surveillance System has different modules which were developed separately depending up on the functionalities. Therefore testing of all the modules has to be done and testing while integrating all the modules. The different levels at which testing was done are discussed here.

6.2.1 Approach

Acceptance test will be executed based on this acceptance test plan. And after all test cases are executed, a test report will be summarized to show the quality of Secure Home Surveillance System. Following test approaches will be used in test execution:

6.2.1.1 Unit Test

Developers are responsible for unit testing. The implementation of each module and individual component will be verified separately.

6.2.1.2 Integration Test

After the unit test is passed above the defined quality threshold, testers will execute the integration test cases. After all the modules are integrated, it is

crucial to test the product as a black-box.

6.2.1.3 Regression test.

After developers fix the bug in one feature, regression test will be executed by testers to ensure that the other functions are not affected.

6.2.1.4 Positive and negative testing design technique.

This approach will be combined with unit test and integration test. Test cases are designed in obvious scenarios, which ensure that all functional requirements are satisfied. What's more, different test cases will also be covered to show how the system reacts with invalid operations.

6.2.1.5 Item pass\fail criteria

Details of the test cases are specified in section Test Deliverables. Following the principles outlined below, a test item would be judged as pass or fail.

- Preconditions are met
- Inputs are carried out as specified
- The result works as what specified in output => Pass
- The system doesn't work or not the same as output specification => Fail.

6.2.1.6 Suspension criteria and resumption requirements

Any bugs found can be fixed by developers quickly and no need to start the testing process from the beginning. However, when major bugs will block some test cases as they are interdependent and the testing has to be paused. The test will restart from the very beginning until the major error is solved.

6.2.1.7 Test Deliverables

Following are the Deliverables as per this Plan:

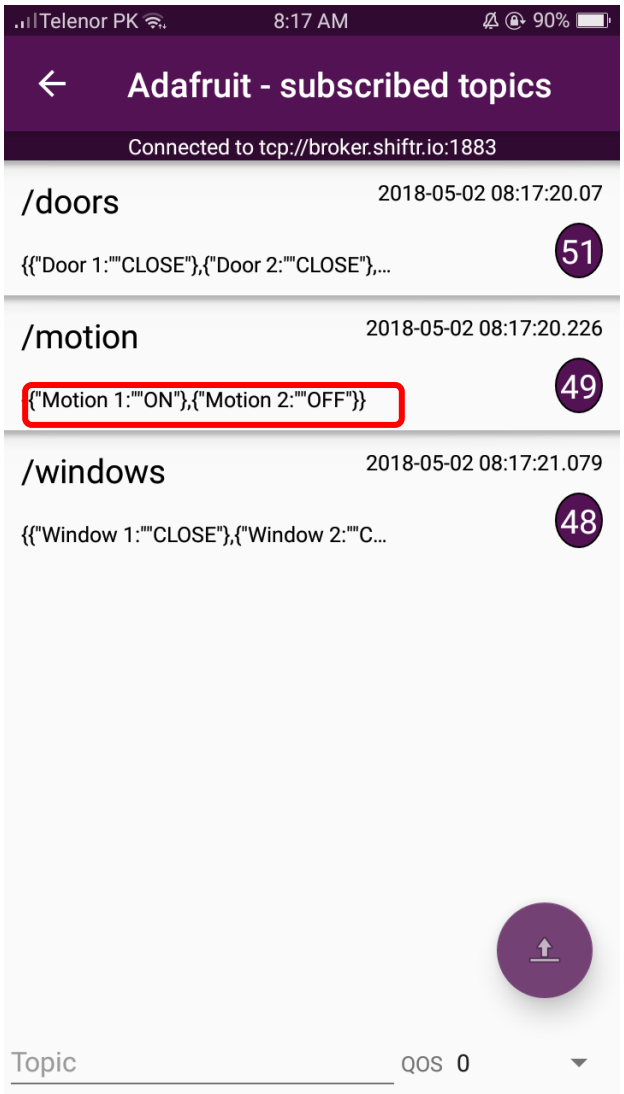
Test cases

Output from tools

6.3 Unit and Component level Testing

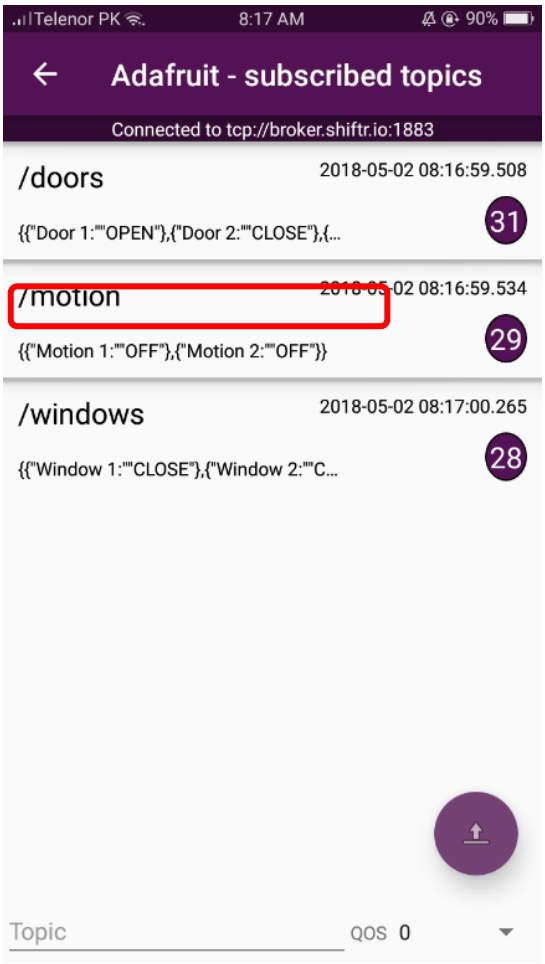
Test Case Number	01
Test Case Name	Visibility of camera feed
Description	Testing cameras feed. User will open the app and see, if he is able to see the feed.
Testing Technique	Component testing, Black Box Testing
Preconditions	Application should be open
Input Values	Feed from the installed cameras
Steps	Open the application Main Screen is open. Select the ‘Camera 1’ or ‘camera 2’ button. See if the feed is visible.

Expected output	Feed is streaming properly.
Actual output	Feed is streaming properly without any lag.
Status	Test case passed successfully.

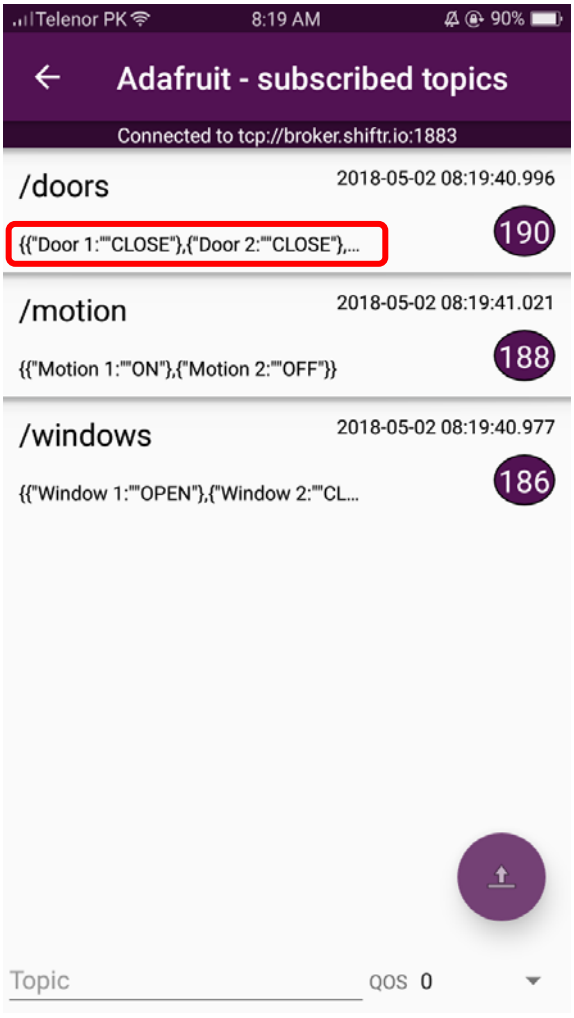


Test Case Number	02
Test Case Name	Motion is being detected
Description	Testing motion sensors. User will open the app and see, if he is able to see the motion being detected
Testing Technique	Component testing, Black Box Testing
Preconditions	Application should be open.
Input Values	Values from the motion sensors
Steps	Open the application Main Screen is open. Trigger the motion sensors.

	See if the motion is detected in the app.
Expected output	Motion sensors should detect the motion.
Actual output	Motion is detected by the sensor.
Status	Test case passed successfully.


Telenor PK
8:17 AM
90%
Adafruit - subscribed topics
Connected to tcp://broker.shiftr.io:1883
/doors
2018-05-02 08:16:59.508
{{"Door 1:""OPEN"},{"Door 2:""CLOSE"},{...
31
/motion
2018-05-02 08:16:59.534
{{"Motion 1:""OFF"},{"Motion 2:""OFF"}}
29
/windows
2018-05-02 08:17:00.265
{{"Window 1:""CLOSE"},{"Window 2:""C...
28
Topic
QOS 0


Telenor PK
8:16 AM
90%
Adafruit - subscribed topics
Connected to tcp://broker.shiftr.io:1883
/doors
2018-05-02 08:16:43.441
{{"Door 1:""CLOSE"},{"Door 2:""CLOSE"},...
15
/motion
2018-05-02 08:16:43.469
{{"Motion 1:""OFF"},{"Motion 2:""OFF"}}
13
/windows
2018-05-02 08:16:43.22
{{"Window 1:""CLOSE"},{"Window 2:""C...
11
Topic
QOS 0


Telenor PK
8:19 AM
90%
Adafruit - subscribed topics
Connected to tcp://broker.shiftr.io:1883
/doors
2018-05-02 08:19:40.996
{{"Door 1:""CLOSE"},{"Door 2:""CLOSE"},...
190
/motion
2018-05-02 08:19:41.021
{{"Motion 1:""ON"},{"Motion 2:""OFF"}}
188
/windows
2018-05-02 08:19:40.977
{{"Window 1:""OPEN"},{"Window 2:""CL...
186
Topic
QOS 0

Test Case Number	03
Test Case Name	Opening/closing of door/window
Description	Testing Magnetic reed switches. User will open the app and see, if he is able to see the doors/windows, opening/closing being detected
Testing Technique	Component testing, Black Box Testing
Preconditions	Application should be open.
Input Values	Values from the magnetic reed switches

Steps	Open the application Main Screen is open. Open/close any door/window See if the change is being detected in the app.
Expected output	Opening/Closing of doors/windows is detected.
Actual output	All the openings/closings are detected properly.
Status	Test case passed successfully.

Test Case Number	04
Test Case Name	App Notifications
Description	If any sensor is triggered by the intruder, app should notify the user.
Testing Technique	Component testing, Black Box Testing
Preconditions	App has the permission to generate notifications and

	sensors are working properly.
Input Values	Values from any sensor being triggered
Steps	• Allow notifications on the device. • Trigger any sensor • Check notifications. • Click the notification to open the app
Expected output	Notification will be generated on the device.
Actual output	Notification was generated on triggering sensor.
Status	Test case passed successfully.

Test Case Number	05
Test Case Name	Feed Storage
Description	User will check if the feed is being stored properly and can be accessed by the app.
Testing Technique	Component Testing, Black Box Testing

Preconditions	Cameras are in working condition.
Input Values	Feed from the cameras will be the input.
Steps	Open the app and click on ‘View storage’ Select ‘Camera 1’ or ‘Camera 2’ View the stored feed.
Expected output	Feed will be stored and available to watch at any time.
Actual output	Feed is stored and available.
Status	Test case passed successfully.

Test Case Number	06
Test Case Name	Switching cameras
Description	Testing the ‘Camera 1’ and ‘Camera 2’ button and if the feed is switching.

Testing Technique	Regression Testing, Black Box Testing
Preconditions	App should be opened.
Input Values	Click on ‘Camera 1’ or ‘Camera 2’ Button
Steps	Select the ‘Camera 1’ button. Observe the feed Click on ‘Camera 2’ button Screen should shift to camera 2 feed
Expected output	Camera feed should change.
Actual output	Camera feed is switching properly.
Status	Test case passed successfully.

Test Case Number	07

Test Case Name	Raspberry Pi Stream
Description	Testing if the raspberry pi will take the feed from the cameras and stream it to the app
Testing Technique	Integration Testing, Black Box Testing
Preconditions	Wi-Fi internet should be available.
Input Values	Feed from the cameras
Steps	Turn on the raspberry pi module Connect the cameras Open the app Check if the feed is active.
Expected output	Camera feed will be active in the app.
Actual output	Feed is live and available without any lag.
Status	Test case passed successfully.

Test Case Number	08
Test Case Name	Password verification
Description	Testing the verification method on opening of app.
Testing Technique	component testing, Black Box Testing
Preconditions	Password protection should be active
Input Values	Click on the app icon
Steps	App will open and ask for the password Enter the correct password On entering the correct password, app will open the home page.
Expected output	Entering the correct password will open the home page.
Actual output	Correct password opened the home page
Status	Test case passed successfully.

Test Case Number	09
Test Case Name	Password change
Description	User will change the password from the settings. After entering the current password, user will enter the new password.
Testing Technique	Black Box Testing
Preconditions	Current password should be known
Input Values	Current password and new password
Steps	Select ‘Change Password’ in the settings Enter the current password Enter the new password
Expected output	Password should be changed.
Actual output	Old password is changed to new password
Status	Test case passed successfully.

Test Case Number	10
Test Case Name	Server connection
Description	As soon as the main system is turned on, the main system should make a connection with the server immediately.
Testing Technique	Component testing, White Box Testing
Preconditions	System should be on and sensors should be connected to the main system.
Input Values	Values from the sensors
Steps	Turn system on Trigger any sensor Check notification on app Note the time in which notification is being sent
Expected output	Server connection should be made within 1 minute
Actual output	Server connection is made within 1 minute and notification is received

Status	Test case passed successfully.

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6.3.1.1 Secure Home Surveillance System

This is the software application of the system which displays the data coming from different sensors. It also process data to generate alerts depending upon the incoming data.

In order to test the application the network was set up and then it was tested for different events. The application was tested for intrusion. Moreover, notifications were tested and revealed that the notifications are successfully appearing to the user. Visual alerts were tested in case of different events.

6.3.2 Integration Testing

Integration testing is the type of testing which is performed when different modules of the system are combined to form a whole system. This testing level ensures that the system is stable and performs as expected after integrating the individually tested modules. The modules as mentioned above and in the previous chapters were integrated and tested. The results produced were satisfactory. All modules communicated with each other as expected. The sensors successfully measured values from the environment.

6.3.3 System Testing

System testing is the level of testing which comes when the whole system has been developed and integrated. The complete system was tested in different

places with different conditions to verify that those conditions do not disrupt the performance of the system.

6.4 Summary

Testing is one of the most important phases of software development life cycle because by testing one can ensure the quality and performance of the product as expected. Different testing approaches were applied on the Secure Home Surveillance System to make system which lead to a more stable and correct version of the system.

Chapter 7

7 Result and Analysis

7.1 Introduction

Secure Home Surveillance System is a real time application to provide safety and security. It detects intrusion and alerts the user. The system provides all these services by using different sensors integrated together which communicate to a central device where the Secure Home Surveillance System is deployed.

7.2 Result

Secure Home Surveillance System deals with security issues which makes this system sensitive and important. The basic concept of the project is to facilitate people with provide safety against intrusion detection to alert user about the intrusion in restricted or protected area. The main objective of the project was achieved which is discussed in this section.

The main objectives of project was to develop an intrusion detection system and generation of alerts.

Each of the modules has been tested and results gathered. These are documented below

7.2.1 Intrusion detection

Intrusion detection is the first objective of Secure Home Surveillance System which was very important to be achieved. The intrusion is detected by the help of motion sensor and magnetic reed switches placed in specific locations

in the model home. The sensors detect the intrusion and generate the signals which alert the user on the SHSS.

7.2.2 Alerts

The alerts are generated in case of intrusion to inform the user about the occurrence of undesired event.

7.3 Analysis

The analysis of the results of Secure Home Surveillance System can be made by comparing it with those systems which are also providing similar functionalities. One of the major advantages of the Secure Home Surveillance System is its ability of providing a complete system with IP cameras and sensors. There is no need for lengthy installations. Just turn on the devices and install the application.

Based on the results, analysis has been carried out to discover the bounds of the software. Also to detect and resolve conflicts if any with the requirements. Also this will help to establish certain things that must be avoided and others that are necessary while using the software and the underlying hardware.

7.4 Summary

The Secure Home Surveillance System is an important system providing two essential functionalities in a single unit i.e. live surveillance and intrusion detection. An application has been developed to assist in monitoring i.e. Secure Home Surveillance System which responds to different events. The

sensor used to monitor the environment is cost effective as it uses low cost and low power hardware.

Chapter 8

8 Conclusion and Future Work

8.1 Introduction

This chapter describes the future scope of the project and the overall conclusion of the project. The project can be extended and few ideas are given in the chapter for the up gradation of the concept.

8.2 Conclusion

Security and safety are critical in all aspects of today's world, irrespective of whether human lives are involved or not. Even though stakes are higher if human life is at risk. Whatever the case compromise is not an option. In order to ensure safety easily deployable and easy to afford solutions are required. The Secure Home Surveillance System Project is just one of those solutions. What makes this solution an effective one is that it is easily deployable with low cost. It can be used as a basic tool for the detection of intrusion in homes and offices along with the provision to get live feed of cameras as well. The developed solution has been rigorously tested and the end results are satisfactory.

8.3 Future work

A true Secure Home Surveillance System is one that not only detects intrusion but also automates and controls the whole environment. Therefore, this project is the foundation for a big and more practical solution.

For this purpose, more sensors can be attached with the existing nodes to monitor the environment effectively. These sensors may include humidity sensors, occupancy sensors, light sensors, carbon monoxide sensors, glass-breakage detectors, Smoke detectors, automatic meter reading: gas meters, water meters, e-meters, Active RFID applications etc.

Another extension of this project is that the current coverage area of developed solution is limited to homes or a single office floor. In order to enhance the coverage area of the network more base stations can be incorporated within the network which can be at different floors of the buildings.

8.4 Summary

This chapter documents the conclusions drawn after the completion of the Secure Home Surveillance System Project. A section has also been dedicated to some of the future plans.

APPENDIX

SECURE HOME SURVEILLANCE SYSTEM

USER'S MANUAL

WELCOME

Thank you for using the Secure Home Surveillance System.

This user's manual is designed to be a reference for the operation of the Secure Home Surveillance System (SHSS).

Here you can find detailed operation information related to the SHSS.

Overview and Environment

The following sections give a brief overview of the Secure Home Surveillance System and the minimum requirements needed to run the software

Overview

It is a software that comes with hardware required for the monitoring of intrusion.

It provides the user with a way to monitor the environment's changes. It shows intrusion information for each node that is added to the network. It can display this information in simple text format using the console mode. SHSS can notify the user of an anomaly in the environment using different types of alerts. Visual which require the user to be at the android device and SHSS notifications if the user wants to be alerted via a notification generated on the android device.

Environment

OS: Android v 4.0 or higher

Processor: 1 GHz or higher.

Memory: 1 GB or higher.

Displayer: 1024*768 or higher.

Installations

This section documents the installation process.

Installation

Download the application from Google PlayStore.

Tap download to install the SHSS.apk on your device.

At the login screen please input user name and password to create your account.

Figure 9.1 Customer Information

How to Use Software

This section describes the various features offered by the software and how to use these.

Menu

The figure 3-1 shows the dropdown menu button which includes the option of IP settings, how to, start service and stop service.

Figure 9.2 Dropdown Menu

Camera Switch Buttons

This feature helps to switch the live feed from camera 1 to camera 2. By clicking stream 1 it will start showing feed from camera 1 on the android device and similarly same procedure is followed for displaying live feed from camera 2.

Notification Settings

This will enable/disable SHSS notifications. User can set the notification from settings and allow it to be displayed on the home screen.

Disconnect

The disconnect tab is for disconnecting the software from all the sensors in the system.

Exit

Exit tab is to close the Secure Home Surveillance System.

How to Menu

This will help the user in understanding the application and give instructions.

Intrusion

Each sensor detects the intrusion using the sensors mounted on the model. The sensed intrusion is shown on the screen by displaying a notification on the android device.

Sensor Name

Each sensor can be named as it joins the network. This name is displayed in with each device. This will assist the user to identify the location of the sensors.

REFERENCES

[1] Raspberry Pi Technical documentations from elinux.org.

[2] Vinay Sagar K N, Kusuma S M, "Home Automation Using Internet OF things", International Research Journal of Engineering and Technology (IRJET), Volume: 2, Issue :03 June -2015, pp 1965 - 1970.

[3] Ahmed Elshafee, Karim AlaaHamed, "Design and Implementation of a Wi-Fi based Home Automation System",International Journal of Computer, Electrical Automation,Control and Information Engineering Vol:6,No:8,2012,pp 1074 - 1080.

[4] Shaijupaul, Ashlin Anthony, Aswathy B, "Android based Home Automation Using Raspberry Pi, IJCAT - International Journal of Computing and Technology, Volume 1,Issue 1, February 2014, pp 143 - 147.

[5] Pawansingh,Krupachotalia,SanketPingle, " Review paper on SmartGSM based Home Automation System".International Research Journal of Engineering and Technology (IRJET), Volume: 3, Issue :04 April - 2016, pp 1838 - 1843.

[6] https://www.hackster.io/AnuragVasanwala/

[7] https://www.techopedia.com/definition/27747/raspberrypi

[8] http://www.extremetech.com/computing/124317-whatis-raspberry-pi-2.

[9] Monika M Patel, Mehul A Jajal, Dixita B vataliya,

"Home automation using Raspberry Pi, "International

Journal of Innovative and Emerging Research in

Engineering Volume 2, Issue 3, 2015.

[10] Raspberry Pi latest kit from raspberrypi.org

[11] Debian linux command line from debian.org

[12] PuTTy a free telnet/ssh client from putty.org

[13] Python application development sources for python.org

[14] Android application development references from developer.android.com