

**SMART HOME SECURITY SYSTEM**

**BY**

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering.



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**5 MAY 2018**

## **APPROVAL**

This Project/Internship titled “**IOT Based Smart Home Security System**”, submitted by Md. Mezbah Uddin and Taspia Umma Tamanna to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of Bachelor of Science in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 5<sup>th</sup> May, 2018.

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## DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Most. Hasna Hena, Senior Lecturer, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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Finally, we must acknowledge with due respect the constant support and patients of our parents.

## **ABSTRACT**

Home security is becoming necessary nowadays as the possibilities of intrusion are increasing day by day. Only PIR sensor or Ultrasonic Sensor integrated with WIFI, there is good possibility of false intruder detection based on line of sight cut by any entity and not necessarily an intruder. Currently homes in Bangladesh still rely on security service personnel and no home security system been employed so far. So taking the above mentioned aspects into consideration, we here have developed an economical and affordable Home security system which have integrated the security component by making use of sensors like PIR, sensor camera. PIR observe Temperature, humidity etc to sense the motion, change in temperature and humidity in room from normalcy rather relying on PIR sensor for change in motion only. The owner of the house is informed about any intruder by sending a notification by using of WIFI module. Owner find the image in the android app which is created for system. All these activities are controlled by Arduino Uno microcontroller. This system would help all the users at any level of income to have one at their home and secure home from any vandalizing.

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# **Chapter 1**

## **Introduction**

### **1.1 Introduction**

Security is a prime concern in our daily life. Everyone wants to be as much secure as possible. Automated security system plays an important role of providing an extra layer of security. So many security systems are employed to protect ourselves from burglary and robberies. The main reason for providing home security is for our property.

In the project we are implementing the PIR (motion sensor) based HOME SECURITY SYSTEM. As a further security we have introduced a sensor camera capable of capturing the Images. The images are saved in SD card using SD card module and every hardware sensors and modules are connected and working through the Arduino Uno microcontroller. In order to aware the owner about the problem we have used a WIFI module which sends the signal in the Database and the Android App take the image from database and then owner can see the message when problem occurred.

## **1.2 Motivation**

Home security is the top concern for anyone who is serious about protecting their property and belongings. The crime statistics have increased in recent days, as improper security at homes encourages theft and burglaries easily. To avoid such rising scenario, home security industry is booming with many new technology and safety alarm systems that can be easily afforded and installed in every home. “The tasks of a modern security system include identifying an intruder trying to gain access to the home, alerting the home owner about the intrusion or intrusion attempt, preventing the intruder from gaining access to the home, and gathering or collecting evidence regarding the intrusion so that the perpetrators can be brought to justice.”

The advancement of technology has contributed to the changing concept of security in modern homes. Security is also a big factor in the emergence of smart home security systems. With a sophisticated enough system, home security becomes a powerful tool that gives piece of mind and power to the user. Security systems are also a large deterrent for crime. The mere presence of a camera will put doubt in any criminals mind about committing a crime. There are already many security systems on the market available and in use today, however integrating the security system into the smart home gives the user a one stop access to everything in their home. If the smart home security system integrates the smart phone into the system then this means that the user will always know the status of the security of their home.

### **1.3 Objectives**

Our objective is to build a smart home security system which is control through Android mobile device application. Our aim is to give maximize security a optimize Convenience in order to provide a safe and comfortable home security. The main objective of the project is to provide security of the home, by detecting the motion, capturing images and also send messages to the respective owner. WIFI module provides the communication mechanism between user and microcontroller.

Develop Wi-Fi appliance controller. The WIFI will interface with the microcontroller to perform the desired automation. The microcontroller will get the signals from the WIFI enabled mobile phone and it will be processed. An android application needs to be developed for the mobile phone, which needs to communicate with the WIFI receiver.

The primary objective of this study is to create a security-based system which is more affordable and flexible for the ordinary people of our country.

## 1.4 Expected Outcome

The project here is all about a security system. In this project we had planned to develop a smart home security system. We create a home security system which is based on motion sensor (PIR). A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. When the system are running then PIR sensor takes a snapshot of that place. If anything is moved from that place it give a signal to Arduino Uno microcontroller. Mainly PIR sense the temperature of human or animal body. We also use camera module (OV7670) which is attached with the microcontroller. The OV7670 camera is a low voltage CMOS image sensor that provides the full functionality of a single-chip VGA camera and image processor in a small footprint package. When PIR gives signal then camera module capture image of that place and the taken image are saved on the SD card using SD card Adapter. We will also make an Android App for controlling this system. This system is connected with WIFI module (ESP-8266). Signal also sent on the database through the WIFI module. The Android App collects the messages from database and shows the messages to owner of the house.

## **1.5 Report Layout**

**Chapter 1** is all about Introduction of this project. In this chapter introduction, motivation, objective, expected outcomes and report layout are described.

**Chapter 2** is all about background of this project. In this chapter related works, comparative studies, scope of the problem and challenges are described.

**Chapter 3** is about requirement of the project. It includes with requirement collection and analysis, use case modeling and description, logical data model and design requirements.

**Chapter 4** will all about designs of the project. It includes with Front-end design, Back-end design, Interaction design and UX and Implementation requirements.

**Chapter 5** will describe about the implementation of the project.

**Chapter 6** is having conclusion, limitation and scope for further developments of the project.

## **Chapter 2**

### **Background**

#### **2.1 Background**

Before starting this project we had to study a lot about home security systems of our country, its necessity, existing systems and a lot of marketing analysis as well as the challenges of our project. As we think, home security system is needed for convenience and safety. This system is invented to keep home safe. So we have to prepare our self first for this project and that's why we need background studies for successfully complete our project.

#### **2.2 Related Works**

Before starting this project we are searching the security systems which exist in market and how that systems are work is that reliable or not. After all those market research we were very disappointed about our result. Because of those existing systems is not enough for the security. Those systems work process are slow which is a very big issue. When owner is far away from home then using the existing systems they can't know about their home if any occurs done and it can create a big problem of owners life and loss of his property. Though we get some most renowned existing systems process but those systems also have a lot of limitations and those systems also can't resolve these issues. So here we came with our plan which can be safer than those existing systems.

## 2.3 Comparative Studies

According to our marketing studies in our country security systems are very poor and still backdated in different types of security issues. As a result, we can't find any other systems like our system. So that, we can say we are different from other security systems which are available in market. We can provide better security from other existing systems. We are very confident about our project platform and there is no existing system like our system. We are different in many ways and come with lots of features.

For this security system we think about present situation of our country and country people. Smart phones are available in our country more than 50% phone user use smart phone and now-a-days in our country people are become more educated from the first and they have enough knowledge about automated system so it will become a user friendly system for the users. This system work fully automatically.

Our features include:

1. When sensor found problem and give signal only then images are taken.
2. Images are saved on SD card.
3. Messages are also saved on the database.
4. Owner details are saved on Android App.
5. Owner can see images on the storage.
6. Owner can see images with the images capturing time.
7. Owner had a user id for the Android App.

Images are saved on the different place so that it's not being easy to destroy. These are the main features of our system and these features make our system different from others system.



## 2.4 Scope of the Problem

We think about our scope of working, problem that occurs people think every security systems are same in working method. They don't trust in the automated security systems. Some automated security systems in the market are run away for giving false system to customer. There are many security systems in the market which don't have smart features and suitable interface designs. So people think every automated security systems are same. In order to remove this think our system will provide appropriate levels of security while occupants are away from their residence. This system will especially helpful for those who put in irregular hours at their place of employment, those who vacation on a regular basis.

Finally bad home security system is harmful for the people asset; it's become a play with people trust. So we are created a scope for working on this platform.

## 2.5 Challenges

While working on this project we face many challenges which is too tough to solve but we solve those challenges. Because without solve those challenges we can't reach to our goal. We took those challenges very seriously and solve those challenges.

There are some major challenges:

1. Making whole system user friendly.
2. Arduino Uno R3 has not enough pin.
3. Communication setup with Arduino Uno and camera module (ov-7670).
4. Take image byte perfectly.
5. Use I2C bus like as SPI bus.
6. Communication setup with SD card module.
7. Communication setup with WIFI module (esp-8266).
8. Communication setup with WIFI module (esp-8266) and server.
9. Change image format .BMP to .JPEG.

# Chapter 3

## Requirement Specification

### 3.1 Business Process Modeling

Business process modeling is the graphical representation of a company's business processes or workflows, as a means of identifying potential improvements. This is usually done through different graphing methods, such as the flowchart, data-flow diagram etc [1].

For this security system a flow chart has been build which is given bellow:

#### 3.1.1 Flow chart of the proposed system

A flow chart is a graphical representation of a logical sequence or organization chart. It shows the working steps as boxes of various kinds and connecting them with arrows.

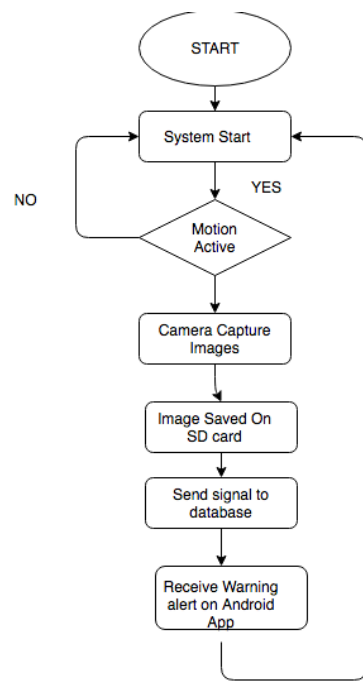


Figure 3.1.1: Flow chart of the system.

## **3.2 Requirement Collection and Analysis**

After analyzing existing system in market we understand people want security systems along with user-friendly system which enabled by wireless technology. Simplicity is one of the main factors. After online survey of existing system we find many requirements from those requirement we collect some requirement which is similar to our project.

Our system requirements are given below:

### **External Interface Requirement:**

1. User interfaces.
2. Customer application should be ported to customer mobile.

### **Hardware Interface Requirement:**

1. System should accept input from motion sensor.
2. System should accept output from camera sensor.

### **Software Interface Requirement:**

1. Customer mobile should be WIFI capable.

### **Communication Interface Requirement:**

1. System should be connected with internet.
2. Workstation should be internet capable.

### 3.3 Use Case Modeling and Description

A use case diagram represents the communication of a user's with the system that shows the relationship between the user and the different use cases in which the user is involved.

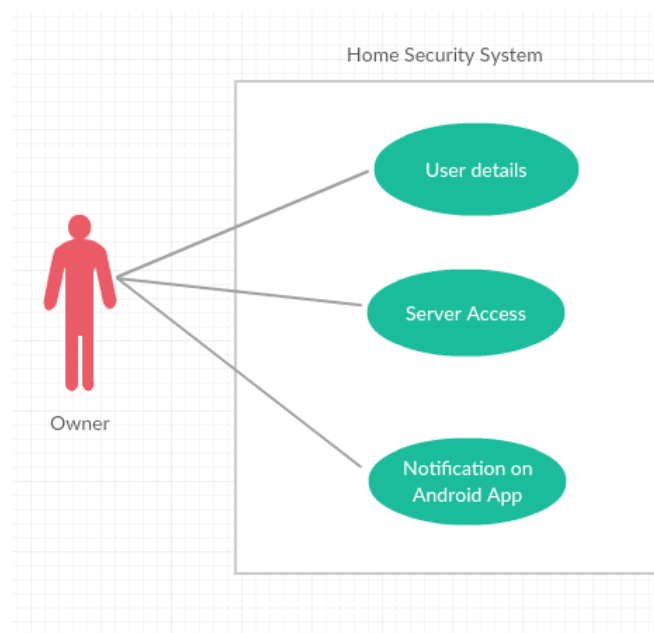
It has been said that "Use case diagrams are the blueprints for a system". Use case diagram is also a behavior diagram and structure diagram. It shows relationship between actor and the system. Actor is the main user of the system [9].

Causes of keep use case:

1. Organize functional requirements.
2. Actor interactions with the system.
3. Describe flow of using the system.

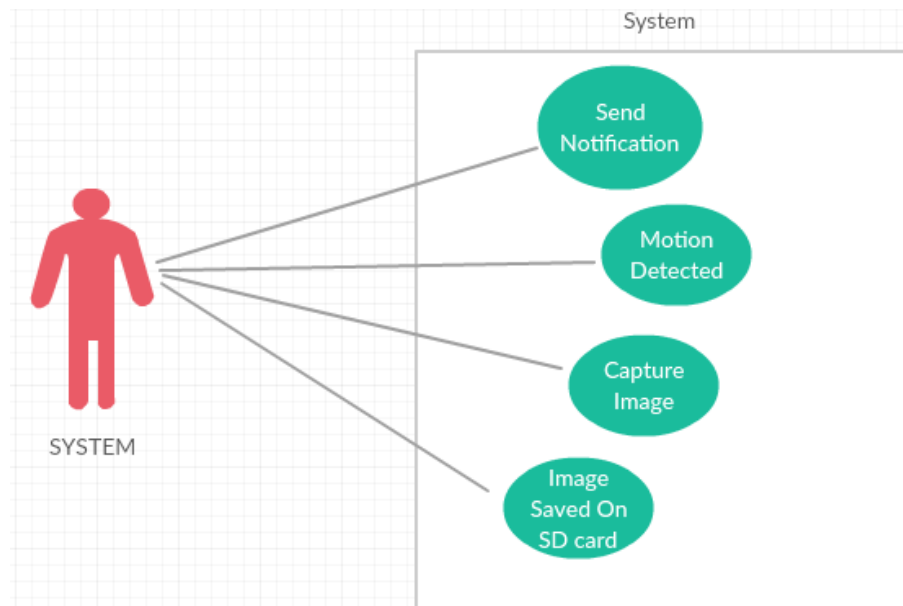
For our system we have two use case diagrams.

First one for Owner:



**Figure 3.3.1:- Use case diagram for Owner.**

Second one use case diagram for system:

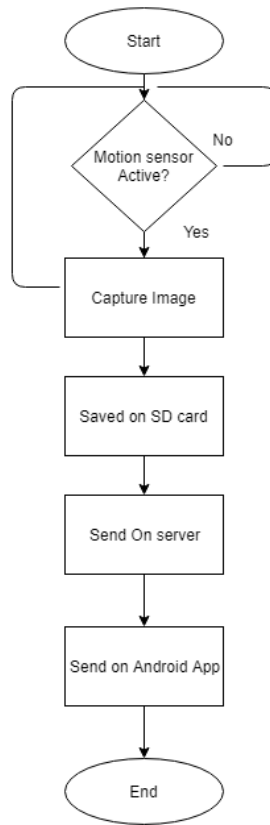


**Figure 3.3.2: System use case diagram.**

### 3.4 Activity Diagram

Activity diagram is one of the most important diagrams that describe the dynamic aspects of the system. Activity diagram is a kind of flow chart it represents the flow of activities of the system and shows the steps of activities. Activity diagram deals with all kind of flow. It captures the dynamic Behavior of the system [3].

In our system activity diagram shows the activities of whole system. It shows the sequence of our system from the activation of sensor to image send to Android App.



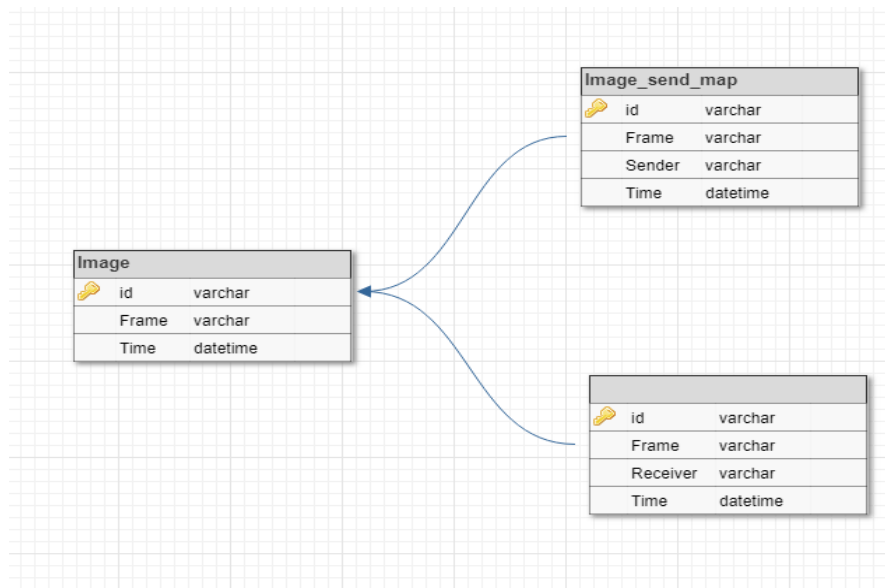
**Figure 3.4.1: Activity Diagram.**

### 3.5 Logical Data Model

Logical data models represent the abstract structure of a domain of information. logical data model can become the basis of a physical data model and form the design of a database [8].

Secure home provide a sense of security to its owner. Home security has two aspects, inside and outside.

In our Android App we use Firebase real-time database. It is a cloud-hosted database. Data is stored as JSON and synchronized in real-time to every connected client. When you build cross-platform apps with our iOS, Android, and JavaScript SDKs, all of your clients share one Real-time Database instance and automatically receive updates with the newest data [6].



**Figure 3.5.1: Database Schema of image sends and receives**

Messages send and receives database schema of our project.

### 3.6 Design Requirements

Home security becomes an important issue now a day. Smart homes security system offers a comfortable, convenient, and safe environment for Owners. This paper mainly focus on security of a home when owner away from home. This security system keeps owners property safe.

This system is based on WIFI technology to get notification on Android App. The first security of this system is motion sensor and camera. Second security of this system is WIFI technology and the Android App. By using this owner find the alert signal if anything is occurred.

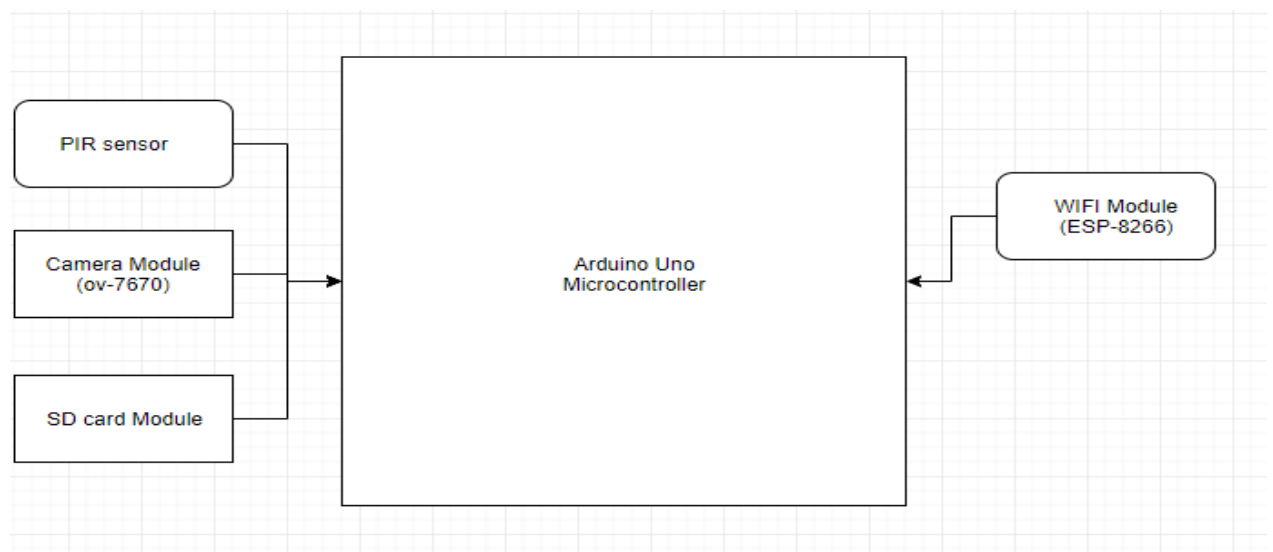
### Proposed System

A smart home security system has been designed using motion sensor and camera. When PIR (motion sensor) find any human or animal body temperature then it become active and then camera module capture an image and saved it in the SD card

then WIFI module send the warning message in database. We create an Android App for observing this system. Owner find notification on the App.

## Hardware Design

This system contains PIR sensor for detecting motion, Camera module (ov-7670) for capturing image, SD card module to save image on SD card, WIFI module (ESP-8266) for communication with user, Anduino uno microcontroller. Every sensor and modules are connected with microcontroller.



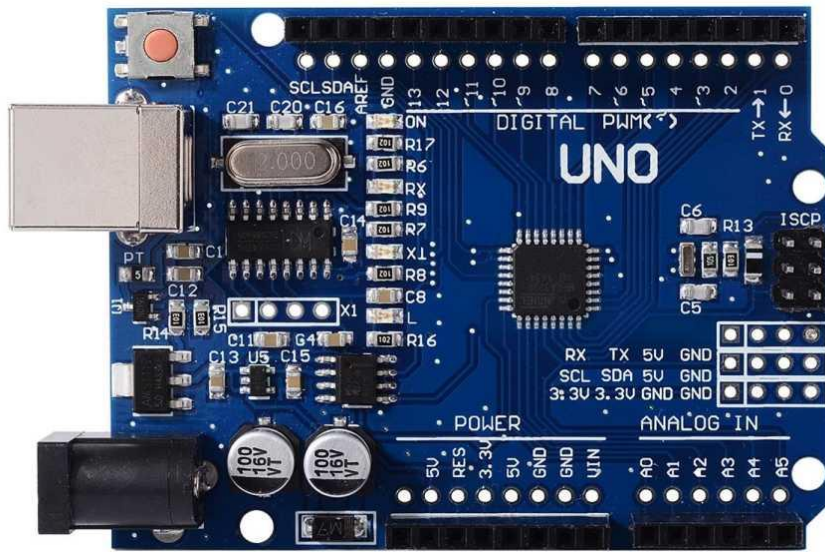
**Figure 3.6.1: Hardware Design of the system.**

Figure shows the hardware connection of proposed system.

## Microcontroller Unit

**Arduino Uno** is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started [4].





**Figure3.6.2: Arduino Uno R3.**

## **WIFI Module Unit**

ESP-8266 WIFI module features are given bellow:

- Processor: L106 32-bit RISC microprocessor.
- Memory:
  - 32 KB instruction RAM
  - 32 KB instruction cache RAM
  - 80 KB user data RAM
  - 16 KB ETS system data RAM
- External QSPI flash: up to 16 MB is supported.
- 16 GPIO pins
- SPI interface.
- I<sup>2</sup>C (software implementation)
- I<sup>2</sup>S interfaces with DMA (sharing pins with GPIO)
- UART on dedicated pins, plus a transmit-only UART can be enabled on GPIO2 for 10bit ADC [7].

## **Sensor Model Unit**

We use PIR sensor in our system. PIR is motion based sensor. Its slot is made with a special material that made it more sensitive from IR.

PIR features are given bellow:

- **Sensitivity range:** up to 20 feet (6 meters) 110° x 70° detection range.
- **Power supply:** 5V-12V input voltage for most modules [5].
- **Pins:** 3 pin (GND, 5V, and Digital I/o pin).

When a warm body likes a human or animal passes in the sensing area then PIR become active because a positive differential change between the two halves and when warm body passes through the sensing area then the reverse happen.

## **Storage Module Unit**

In our project we use SD card module for storage. After capturing image it should store somewhere and for this we use SD card module to store images on SD card.

Features of SD card module are given bellow:

- Break out board for standard SD card.
- Contains a switch to select the flash card slot
- Sits directly on a Arduino

Also be used with other microcontrollers.

## Camera Module Unit

The OV7670 CAMERACHIPTM is a low voltage CMOS image sensor that provides the full functionality of a single-chip VGA camera and image processor in a small footprint package. It has 16 I/O pin and it support 3.3v not 5v.

## Software requirements

For our project two types of software are required.

1. Hardware device communication.
2. Android Application

Hardware device communication features are given bellow:

**Software requirements:** Arduino Ide.

**File Extension:** .ino

Android Application features are given bellow:

**Software requirements:** Android Studio.

**Storage:** Firebase real-time database..

**Languages:** xml, java, JavaScript.

## Chapter 4

### Design Specification

#### 4.1 Front-end Design

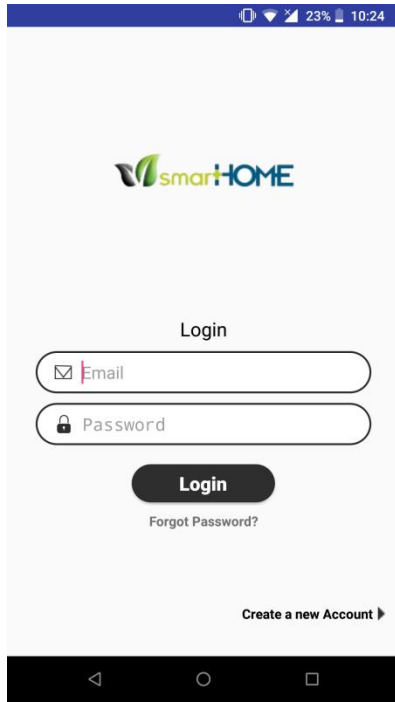
Front-end design means screen design.

List of screen of our Android App are given below:

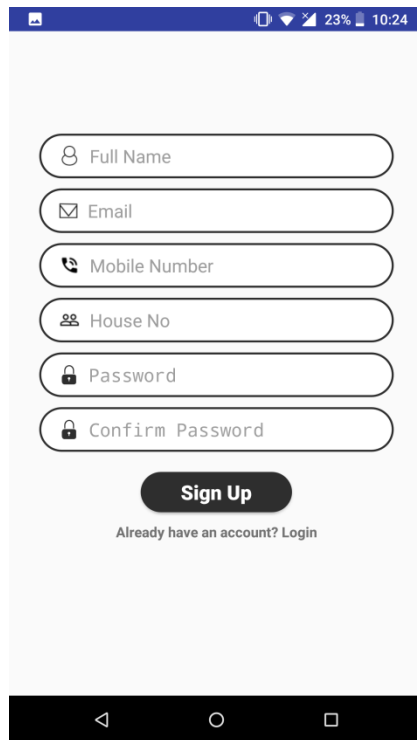
1	User Profile Screen
2	Registration Screen
3	Message seen screen
4	Log-in Screen

**Table 4.1.1: List of Android App screen designs.**

We use xml language for front-end design. Xml is a markup language just like HTML. It's an extensible markup language. Xml was designed to store and transport data and it was designed to self-descriptive data.



**Figure 4.1.1: Home Page**



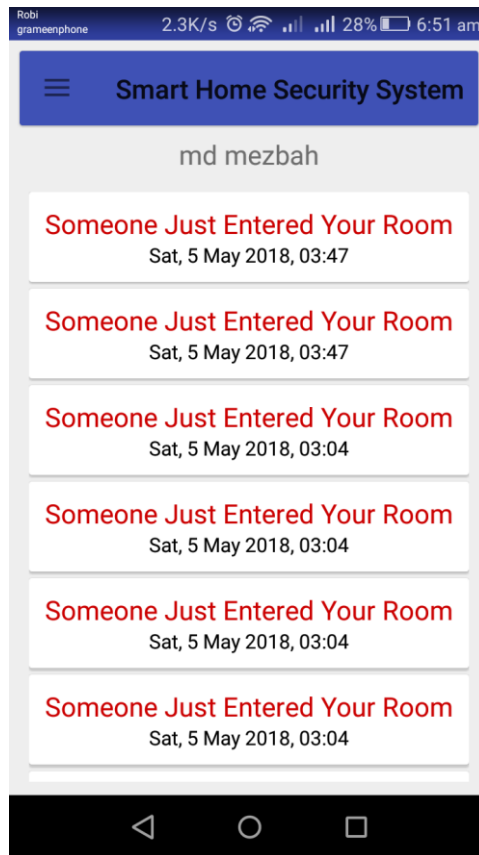
**Figure 4.1.2: Registration Page**

## 4.2 Back-end Design

For back-end design we use java for android side. Java is most popular language for Android. For Android part that means working process of this App is created by java. For collect data from database we use JavaScript because we use firebase real- time database. If we use local database then we collect data from local database by using of php script. Data are shown in the App is the work of back-end design.



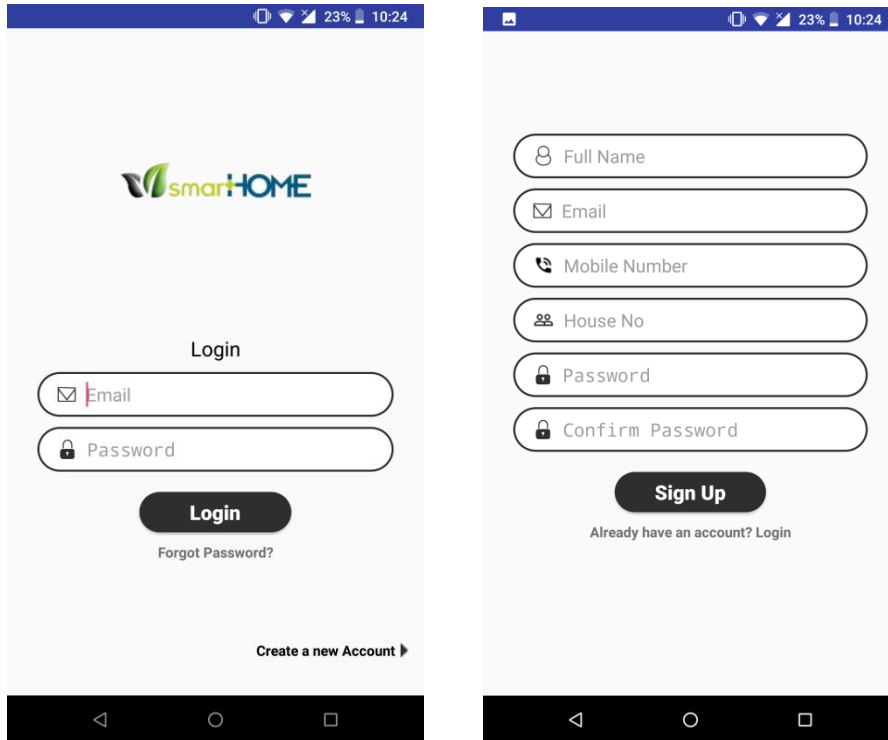
**Figure 4.2.1: User profile screen.**



**Figure 4.2.2: Screenshot of message seen part.**

### **4.3 Interaction Design and UX**

It is the design of the interaction between users and products. The goal of interaction design is to create products that enable the user to achieve their objectives in the best way possible. In every application there are some interaction is design for the user. Normally buttons are the interaction design which is creates interaction between user and product. UX is the shape of interaction design. To create interaction between user and product UX is one of the important issues.



**Figure 4.3.1: Interaction design and UX**

## 4.4 Implementation Requirements

There are many types of requirement to implement this system.

### Network Requirements

To implement this smart home security system WIFI connection is mandatory and the connection of user and system should be same network. Because of we use WIFI module to transfer data. Without connection of WIFI network module doesn't work and local host also should connect with same network to upload data from WIFI server to database.



## **Android App Requirements**

For using this application user must be registration first for create a user id. Without user id, user can't find any data.

### **Power**

For working the hardware devices power connection is mandatory things.

## Chapter 5

### Implementation and Testing

#### 5.1 Implementation of Database

We are using firebase real-time database for our system. Because when anything is update on the database from cross matching platform then firebase updates automatically which user found in active without permission. For our system continuous update is mandatory. Our database implementation is successfully complete. We found our expected result.

Here is the screenshot of Dashboard of our database:

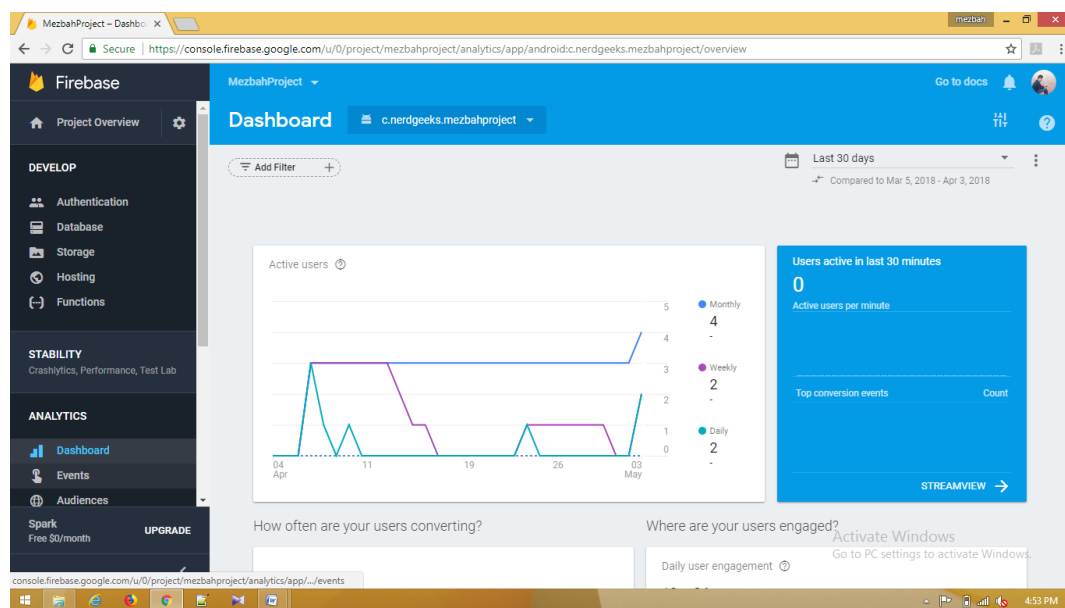
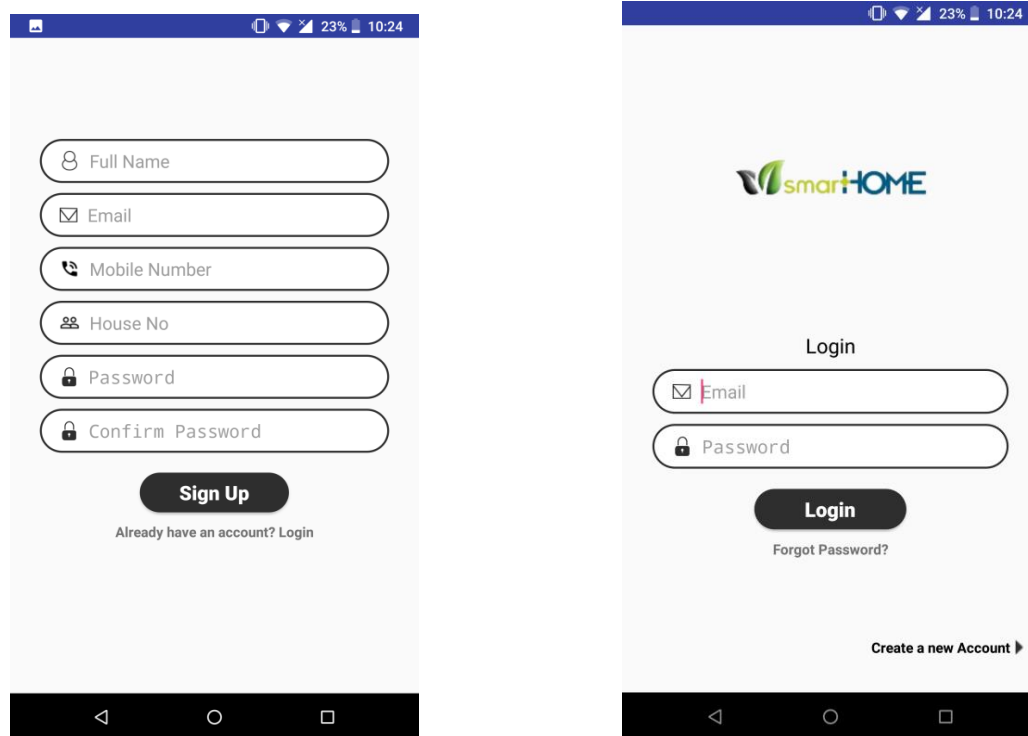


Figure 5.1.1: Dashboard of Database

#### 5.2 Implementation of Front-end Design

We are successfully implementing our front-end design. We use xml language for front-end design. It's markup language just like html. Xml can transport data.

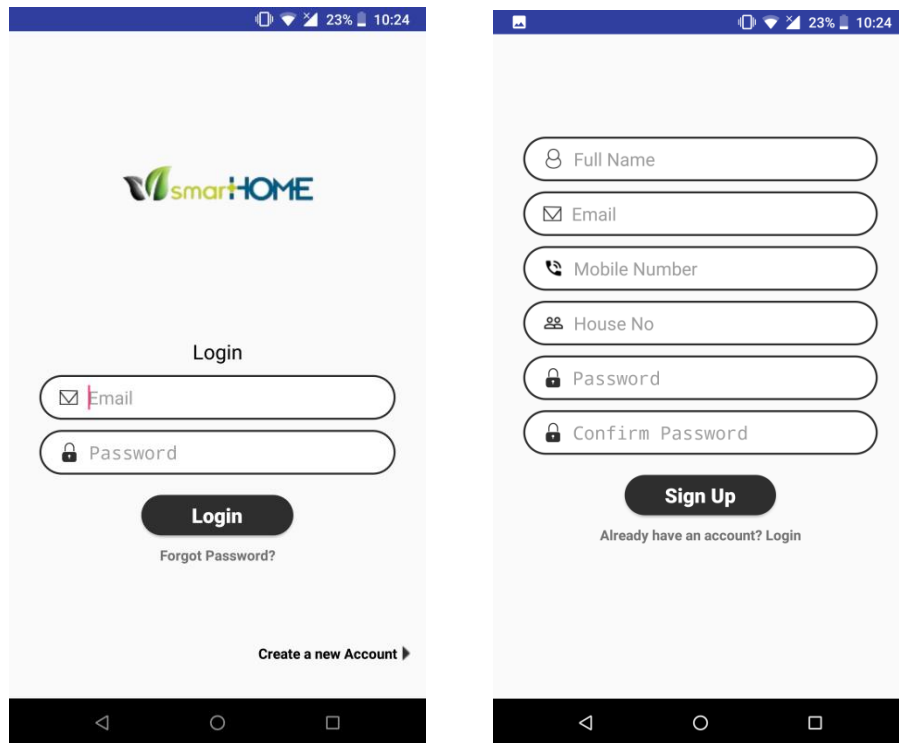
Now we show the screenshots of front-end design of our system:



**Figure 5.2.1: Front-end Design**

### 5.3 Implementation of Interactions

An Android App typically has several activities. Each activity displays a user interface that allows the user to perform a specific task to take the user from one activity to another. We also add some interaction for the user and this interaction are user friendly. In our application when user completes their registration it automatically login to the Message seen page. Implementation of our interaction is shown is below:



**Figure5.3.1: Interaction in Login and Registration.**

## Chapter 6

### Conclusion and Future Scope

#### 6.1 Conclusion

Through study and analysis home security system is very useful. In this project we implement smart home security system. We implement all the topic of this book. It's a WIFI based security system and the main components are used in Arduino mega 2560 microcontroller. Using this microcontroller can create very functional and flexible systems. Smart home security systems are driven by a WIFI network', which wirelessly connects to and communicates with a Smartphone app and the other components of the system. Using the app in Smartphone or tablet, owner can monitor his home by receiving alerts, viewing photos taken by camera module.

In our system we serve three main benefits: security, accessibility and most of all, simplicity.

In our project, Hardware equipment and Android App tested and obtained result and we find our desire result. This system can play a vital role in security system sector. When owner is away from home our system give full security by detecting of motion. When sensor found any motion in sensing area owner found the update instantly via Android App.

## 6.2 Limitations

We are successfully complete our project but there are also some limitations here.

The limitations are given below:

1. Image quality is very low.
2. WIFI module communication with Microcontroller is too week.
3. Low data speed.
4. Few no. of I/O pins on Arduino Uno board.
5. Small amount of memory (32Kb) on Uno board.
6. 8 MHz of maximum generated clock speed by the Uno board which is less than the specified operating range of OV7670 camera.
7. Slow writing speed to the SD card.

In future we add more features on this system and overcome all of this limitation.

## 6.3 Scope for Further Developments

Home Security System has a broad future ahead. We have some plan about future development of this system which engages general people with this system. In future we overcome all the limitations of our system after that we add more features with this system.

Some of our planning about this system is given below:-

### Camera issues

We will solve the camera issues and we will be use better camera module for clear images.

### Sensor

Add more security sensor in the system then home will be more secure. We will be use fire sensor, Door lock sensor, laser light sensor etc.

## **Security**

We will be provide more security in data so that without owner anyone can't access on data.

## **The Internet of Things**

It refers to the wireless connection of devices and their abilities to send data. With the further development, we will work for how our devices can connect to each other remotely. Then distance will not become a issue.

## **Motion sensors that know you**

There are already pet-immune motion sensors that can tell the difference between an Intruder and owner pet, based on the amount of heat each entity radiates [2].

## **Smartphone device application**

Now we create Smartphone device applications for the owner but our desire is to create another application for police so that they can take action instantly. Owner and Police both applications will work on same time.