Abstract

In today's world Automatic systems are being preferred over manual system. With the rapid increase in the number of users of internet over the past decade has made Internet a part and parcel of life, and IOT is the latest and emerging internet technology. With advancement of Automation technology, life is getting simpler and easier in all aspects. Wireless Home Automation system using IOT is a system that uses computers or mobile devices to control basic home functions and features automatically through internet from anywhere around the world, an automated home is sometimes called a smart home. It reduces human efforts and power efficiency.

The main objective of internet of things is used to help specially challenged people and old age people to control electrical appliances and security purpose. IOT is very useful for these people in crucial situations. The objective of this project is to implement a low cost, reliable and scalable home automation system that can Automatically turn the lights on or off according to the luminosity of the surrounding. It can also sense any unusual movement in the house resulting in sending an image via email to the registered user.

The system is a distributed home automation system, consists of server, sensors. Server controls and monitors the various sensors, and can be easily configured to handle more hardware interface module (sensors). Automation System can be accessed from the web browser of any local PC in the same LAN using server IP ,or remotely from any PC or mobile handheld device connected to the internet with appropriate web browser through server real IP (internet IP).

OBJECTIVE

The objective of this project is to implement a low cost, reliable and scalable home automation system that can include following features

1. Automatically turn the lights on or off according to the luminosity of the surrounding.
2. It can sense any unusual movement in the house resulting in sending an image via email to the registered user.

3. User can Automatically Lock and Unlock the door via android app.

SCOPE AND LIMITATIONS

In our system we provides email-notifications to the user but in future we can add also some voice alerts, SMS or alarm system. This system can be expanded to include various other options which could include home security feature such as open-door and motion detection, energy monitoring for kitchen garden etc. Using such system we can control any device from anywhere.
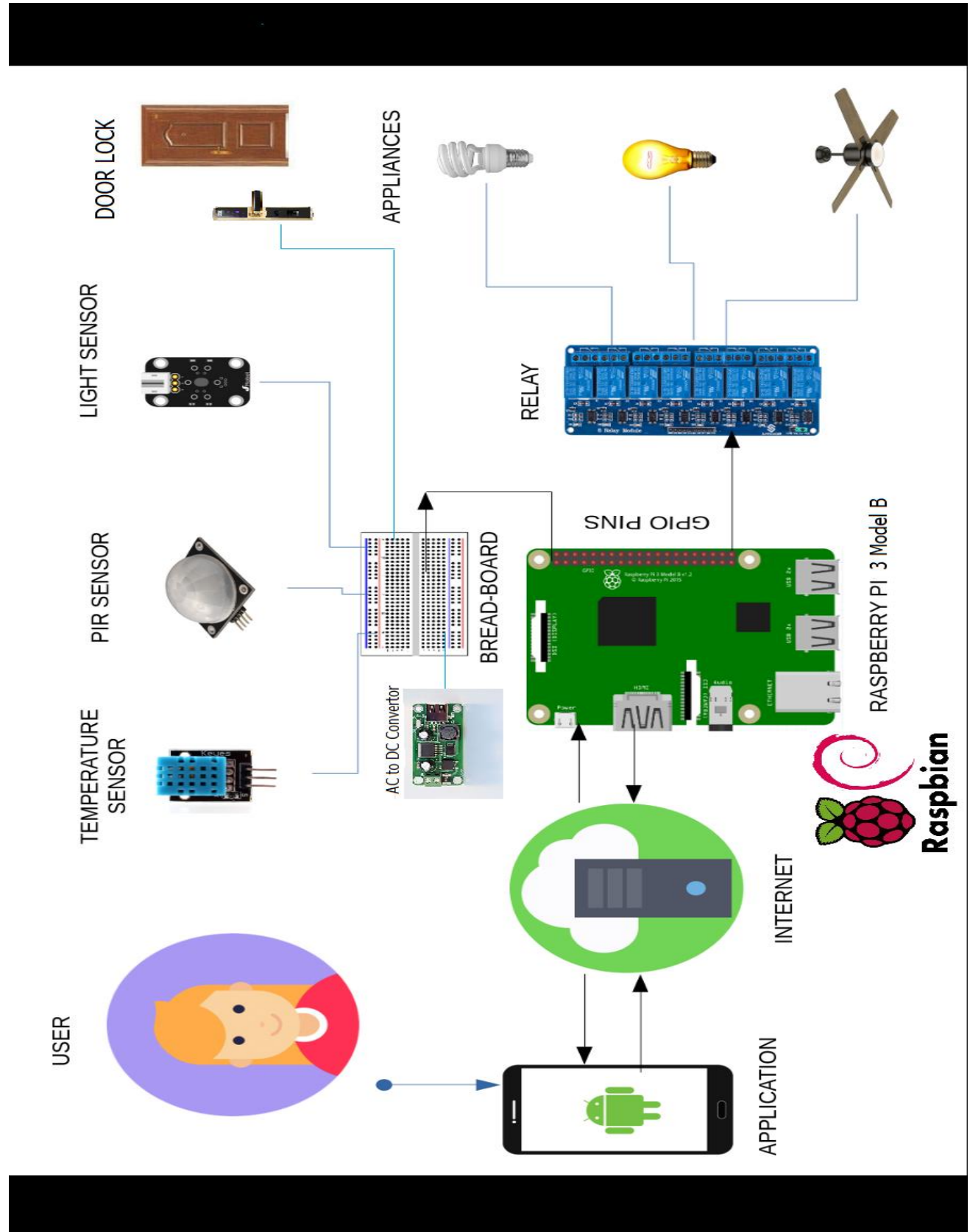
PROBLEM DOMAIN-

A. Problem Definition

Home automation systems face four main challenges, these are high cost of ownership, inflexibility, poor manageability, and difficulty in achieving security. The main objectives of this project is to design and implement a home automation system using **IoT** that is capable of controlling and automating most of the house appliances through an easy manageable interface. The proposed system has a great flexibility by using Wi-Fi technology to interconnect its distributed sensors to home automation server. This will decrease the deployment cost and will increase the ability of upgrading, and system reconfiguration.

B. Proposed System Feature

The proposed system is a distributed home automation system, consists of server, sensors. Server controls and monitors the various sensors, and can be easily configured to handle more hardware interface module (sensors). Automation System can be accessed from the application of any local PC in the same LAN using server IP ,or remotely from any PC or mobile handheld device connected to the internet with appropriate web browser through server real IP (internet IP). Wi-Fi is chosen to improve system security (by using secure Wi-Fi connection), and to increase system mobility and scalability.

HOME AUTOMATION AND SECURITY SYSTEM

DOOR LOCK

APPLIANCES

LIGHT SENSOR

PIR SENSOR

TEMPERATURE SENSOR

BREAD-BOARD

AC to DC Convertor

RELAY

GPIO PINS

RASPBERRY PI 3 Model B

Raspbian

INTERNET

USER

APPLICATION

PLATFORM SPECIFICATION-

Hardware Specification–

1. **Raspberry pi –**

    Raspberry pi is using the Advanced Reduced Instruction Set Computing Machine (ARM) technology. ARM technology is used on the board which reduces cost, heat and power consumption. It is energy effective multi core CPU implemented as System-On-Chip (SoC) weighing 50gm and operates on 5V with following specifications-

    - Quad Core 1.2GHz Broadcom BCM2837 64bit CPU
    - 1GB RAM
    - BCM43438 wireless LAN and Bluetooth Low Energy (BLE) on board
    - 40-pin extended GPIO
    - 4 USB 2 ports
    - 4 Pole stereo output and composite video port
    - Full size HDMI
    - CSI camera port for connecting a Raspberry Pi camera
    - DSI display port for connecting a Raspberry Pi touchscreen display
    - Micro SD port for loading your operating system and storing data
    - Upgraded switched Micro USB power source up to 2.5A

2. Web camera

A webcam is a video camera that is connected to a computer, and can let people see each other over the Internet. The webcam can be part of a computer, mobile phone or it can be an independent device. In this system webcam is used for taking photos on triggering by the PIR sensor.

Figure 1.4-Webcam Figure

1.5-PIR top view

3. PIR Sensor

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyro electric" sensors.
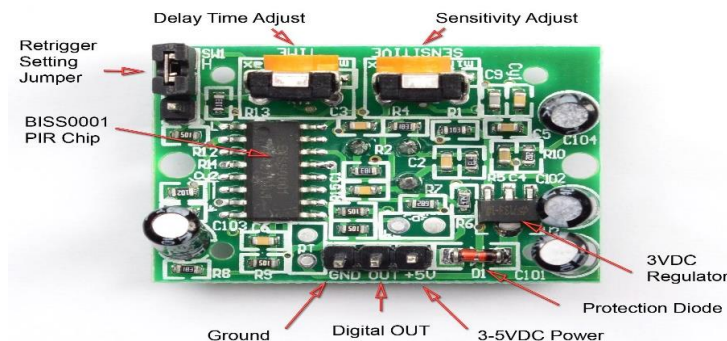

Figure 1.6-PIR Sensor labelled diagram

4. LDR sensors

An LDR or light dependent resistor is also known as photo resistor, photocell, and photoconductor. It is a one type of resistor whose resistance varies depending on the amount of light falling on its surface. When the light falls on the resistor, then the resistance changes. These resistors are often used in many circuits where it is required to sense the presence of light. These resistors have a variety of functions and resistance.
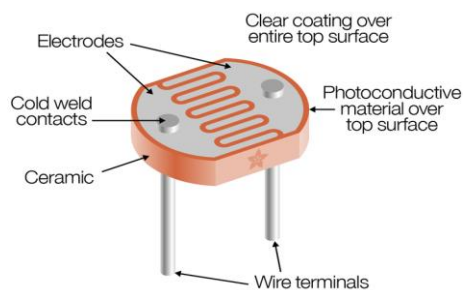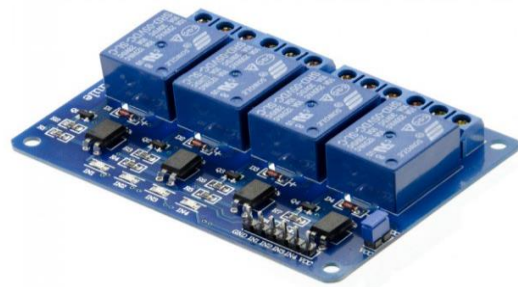

Figure 1.7- LDR sensor labelled diagram

Figure 1.8- Relay Module

5. Relay Module

A Relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate the switch and provide electrical isolation between two circuits.

6. Motor driver

A motor driver is a little current amplifier; the function of motor drivers is to take a low-current control signal and then turn it into a higher-current signal that can drive a motor.

7. Temperature Sensor

Temperature sensors usually measure temperature by sensing some change in a physical characteristic of the measuring device or material.
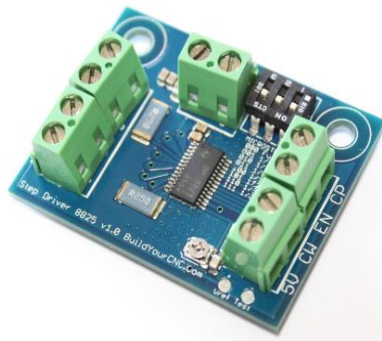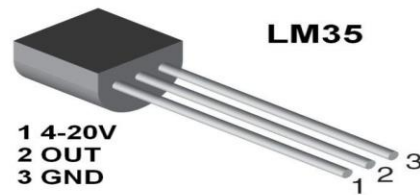
Figure 1.9- Motor Driver Figure   *1.10- Temperature Sensor*

Software Specifications –

1. Raspbian OS-

Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make your Raspberry Pi run. However, Raspbian provides more than a pure OS: it comes with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation on your Raspberry Pi.
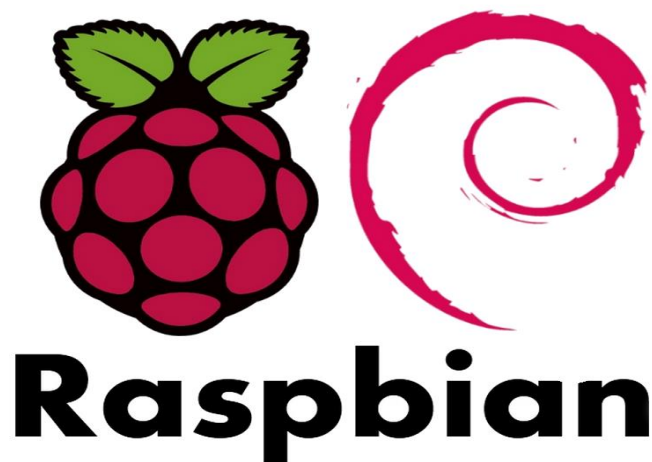
2. MobaXTerm -

MobaXterm is your ultimate toolbox for remote computing. In a single Windows application, it provides loads of functions that are tailored for programmers, webmasters, IT administrators and pretty much all users who need to handle their remote jobs in a more simple fashion.

3. Android Studio-

Android Studio is the official integrated development environment (IDE) for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems. It is a replacement for the Eclipse Android Development Tools (ADT) as primary IDE for native Android application development.
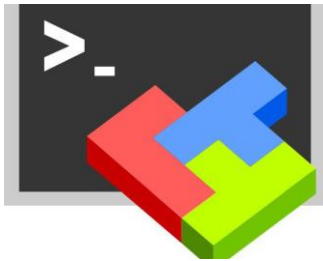
4.Python

Programming for the Raspberry Pi

System Requirement analysis

2.1 Information gathering –

Information gathering helps the individual to undertake complicated tasks that would otherwise be extremely hard to accomplish if not outrightly impossible without the benefit of gathered information. As defined in the dictionary, information gathering is the act of collecting information from various sources through various means. Information sources used are research papers, Interviews, Internet etc.

Information gathering is further classified in the following two categories:-

2.1.1 Functional Requirements –

ID - FR1

TITLE- Sensing Motion

DESCRIPTION – To senses the motion made by any intruder in house using PIR(Passive infrared) sensor which sends the data to Raspberry pi.

ID - FR2

TITLE - Reading Light Intensity

DESCRIPTION – To read the intensity of light of the environment using LDR(Light Dependent Resistor).

ID- FR3

TITLE- Communicating with sensors

DESCRIPTION – All the data from the sensors is communicated to the pi where data is processed and analysed.

ID – FR4

TITLE - Lighting Bulb

DESCRIPTION – It lights the bulb by getting triggered by LDR sensor.

ID – FR5

TITLE - Image Capture

DESCRIPTION – WebCam is used to capture the image of the Intruder as triggered by PIR sensor.

ID – FR6

TITLE – Sending Image

DESCRIPTION – The image captured by the camera is sent to the home owner via email.

ID – FR7

TITLE - Notification

DESCRIPTION – As soon as email is arrived to the inbox, an SMS will be sent to the home owner with URL of the image attached.

ID – FR8

TITLE – Turning ON/OFF Fan

DESCRIPTION – Fan of the model can be switched On and Off using an android application.

ID – FR9

TITLE – Opening/closing Curtain remotely

DESCRIPTION – Curtains of house can be opened and closed using an android application.

ID – FR10

TITLE – Locking and Unlocking door remotely from app.

DESCRIPTION – Door lock will be controlled by android application.

2.1.2. Non Functional Requirements

ID – NFR1

TITLE - Scalability

DESCRIPTION– The system should be able to increase or decrease no. of devices integrated in it.

ID – NFR2

TITLE - Availability

DESCRIPTION – Service should be available 24x7 if required by the user.

ID – NFR3

TITLE - Reliability

DESCRIPTION – The system should be reliable in terms of accuracy and durability.

ID – NFR4

TITLE - Maintainability

DESCRIPTION– It should be compact enough to make maintenance of the system simple.

ID – NFR5

TITLE - Serviceability

DESCRIPTION – The system should require less servicing which in turn should be made available easily.

ID – NFR6

TITLE - Security

DESCRIPTION – The fetched data should be securely stored without chance of any data loss.

ID – NFR7

TITLE – Manageability

DESCRIPTION - The management of the system should be easy.

ID – NFR8

TITLE - Environmental

DESCRIPTION – The system is environment friendly as it reduce the consumption of electricity.

ID – NFR9

TITLE - Data Integrity

DESCRIPTION – It refers to accuracy and consistency of the data stored in the database.

ID – NFR10

TITLE - Image Quality

DESCRIPTION - The image quality should be checked for ensuring its usefulness for future references.

2.2. System Feasibilty

Feasibility analysis is carried out to decide on the viability of a proposed venture; basically it answers the essential question of is it a viable option and should the project be implemented.

2.2.1. Operational –

Operational feasibility is the measure of how well a proposed system solves the problems, and takes advantage of the opportunities identified during scope definition and how it satisfies the requirements identified in the requirements analysis phase of system development. Our system solves the problem of security and automate the home.

2.2.2. Technical –

A technical feasibility study is an excellent tool for troubleshooting and long-term planning. Technically we can enhance our system because we have used raspberry pi which can perform many other operation.

2.2.3. Economical -

The purpose of an economic feasibility study (EFS) is to demonstrate the net benefit of a proposed project for accepting or disbursing electronic funds/benefits, taking into consideration the benefits and costs to the agency, other state agencies, and the general public as a whole. Our system cost is higher than usual electronic products but it is a onetime investment and the cost on implementing it for whole house will not be more than 120% of its usual price.
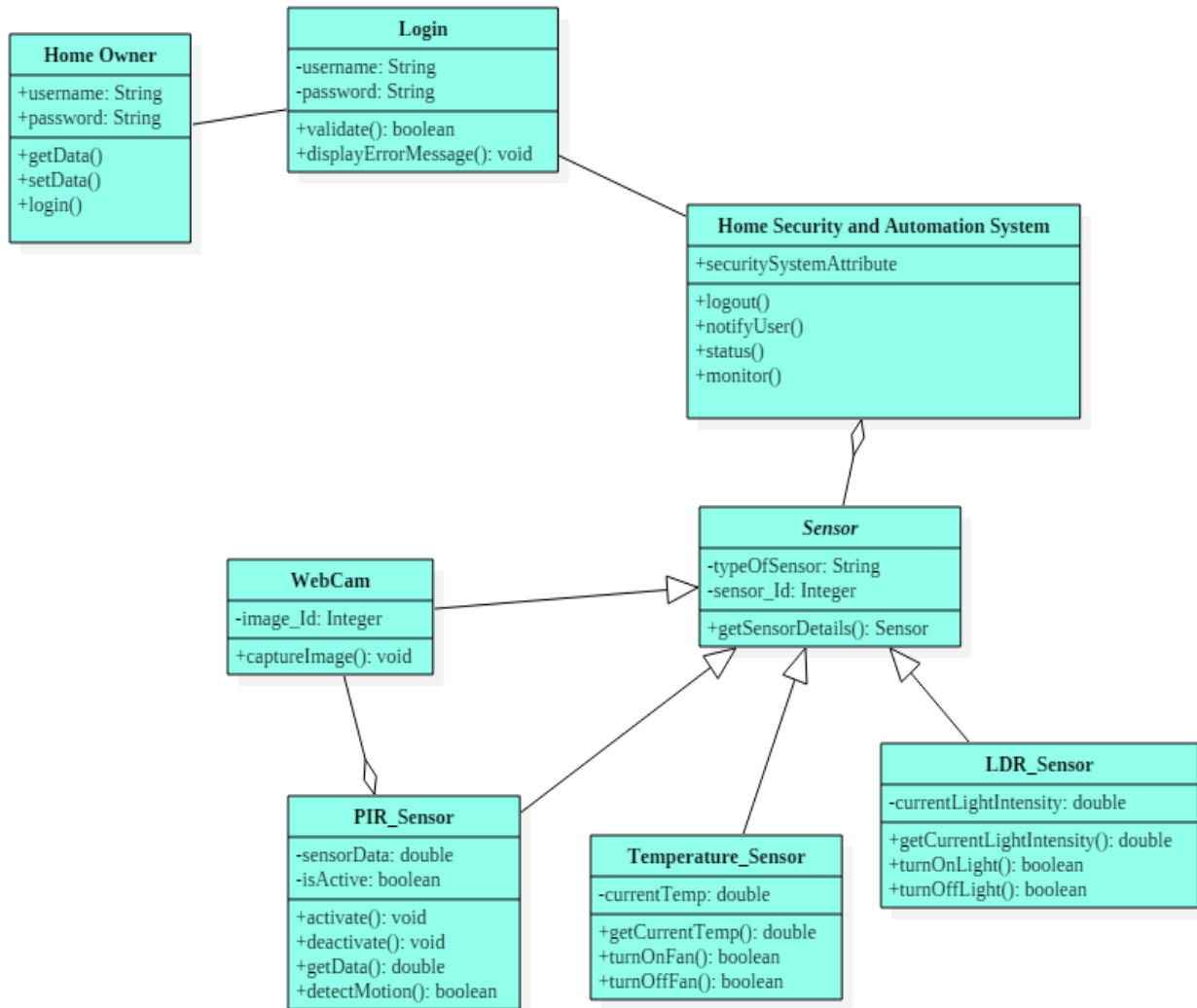
Diagrams

1. Use Case Diagram-

A use case diagram at its simplest is a representation of a user's interaction with the system that shows the relationship between the user and the different use cases in which the user is involved. A use case diagram can identify the different types of users of a system and the different use cases and will often be accompanied by other types of diagrams as well.
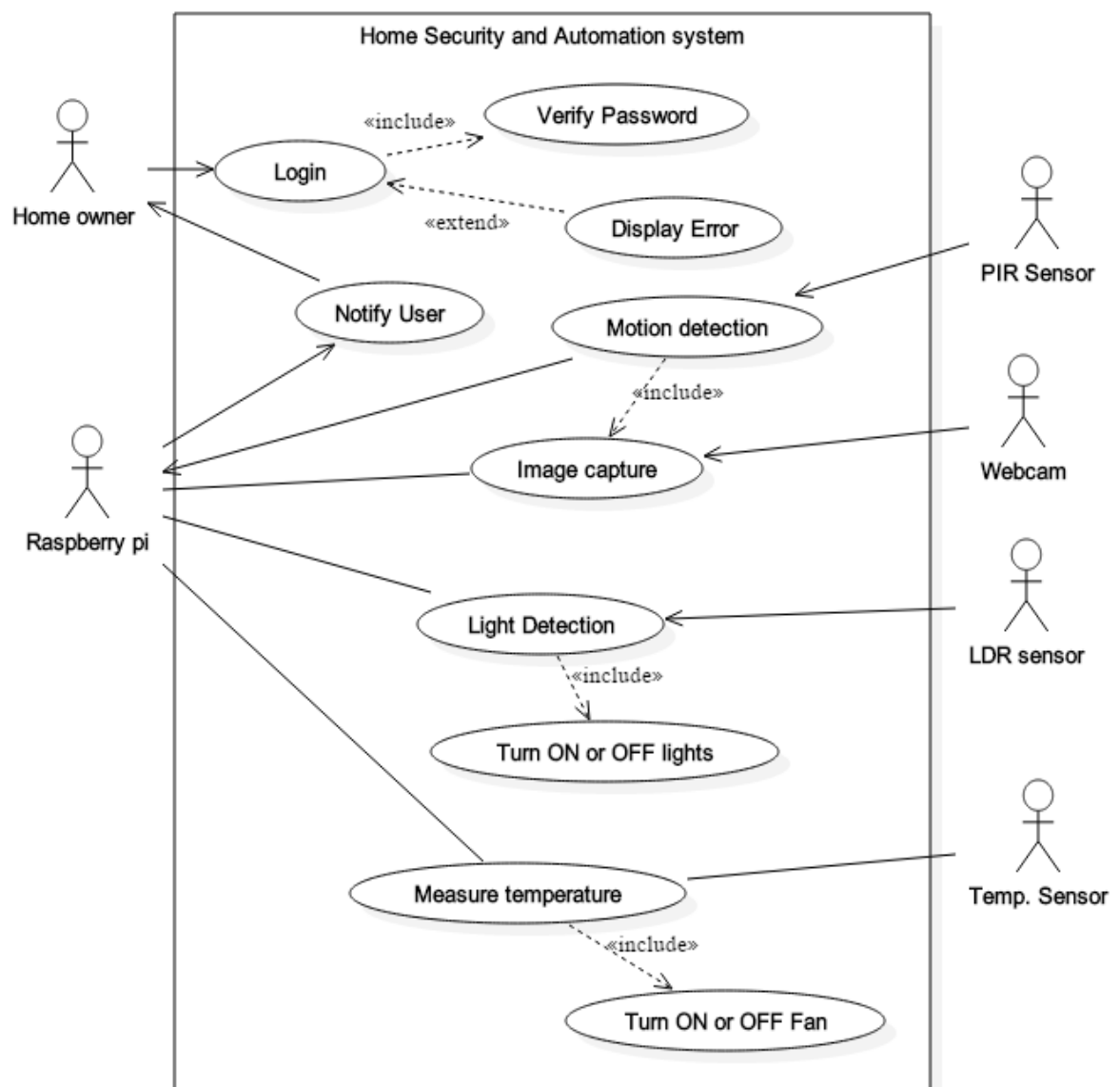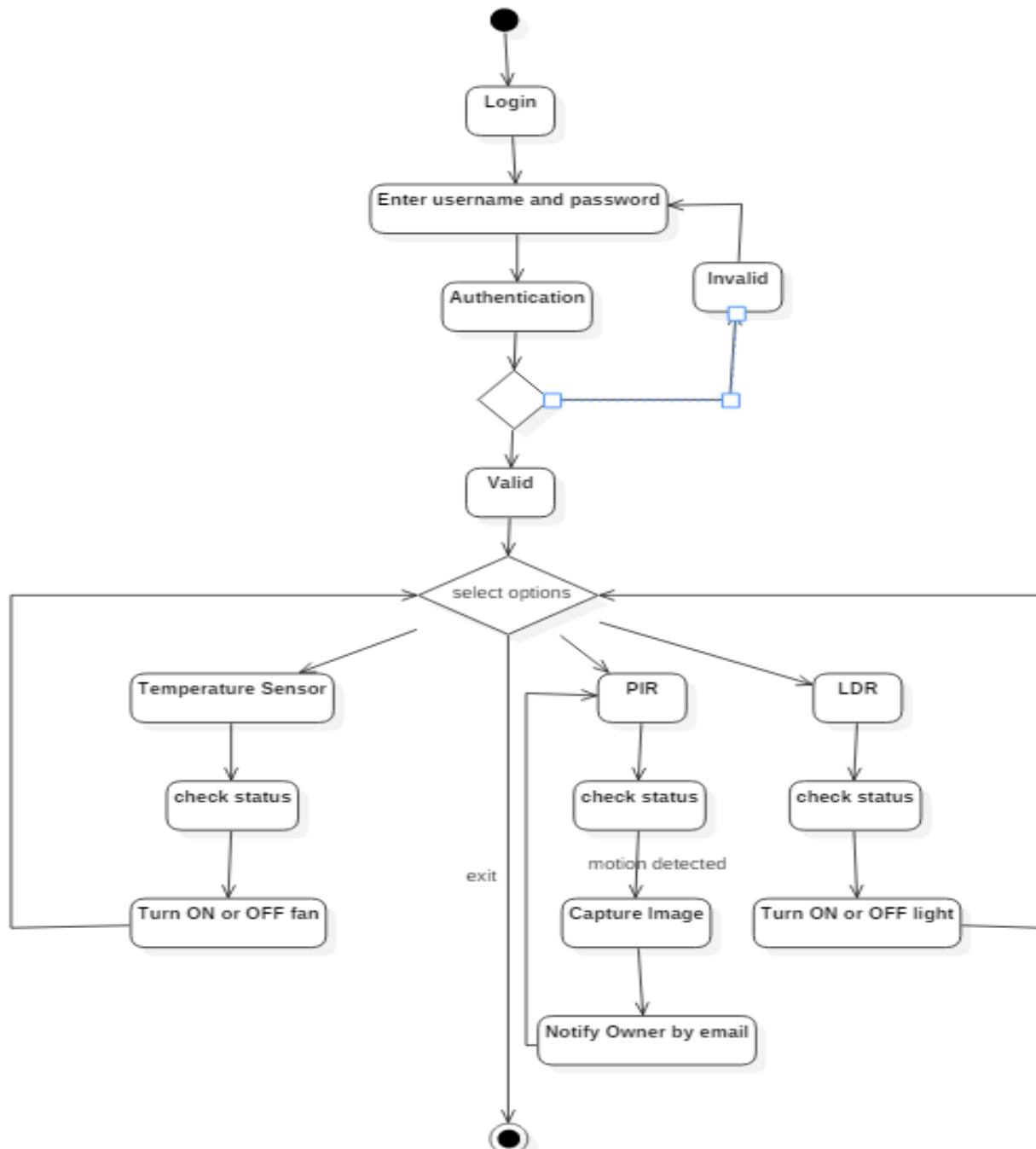
2. Class Diagram

A class diagram is an illustration of the relationship and source code dependencies among classes in the UML. In this context, a class defines the methods and variables in an object, which is a specific entity in a program or the unit of code representing that entity.

Login
-username: String
-password: String

+validate(): boolean
+displayErrorMessage(): void

Home Owner
+username: String
+password: String

+getData()
+setData()
+login()

Home Security and Automation System
+securitySystemAttribute

+logout()
+notifyUser()
+status()
+monitor()

Sensor
-typeOfSensor: String
-sensor_Id: Integer

+getSensorDetails(): Sensor

WebCam
-image_Id: Integer

+captureImage(): void

PIR_Sensor
-sensorData: double
-isActive: boolean

+activate(): void
+deactivate(): void
+getData(): double
+detectMotion(): boolean

Temperature_Sensor
-currentTemp: double

+getCurrentTemp(): double
+turnOnFan(): boolean
+turnOffFan(): boolean

LDR_Sensor
-currentLightIntensity: double

+getCurrentLightIntensity(): double
+turnOnLight(): boolean
+turnOffLight(): boolean

3. Activity Diagram-

Activity diagram is an important diagram in UML to describe the dynamic aspects of the system.

Activity diagram is basically a flowchart to represent the flow from one activity to another activity. The activity can be described as an operation of the system.
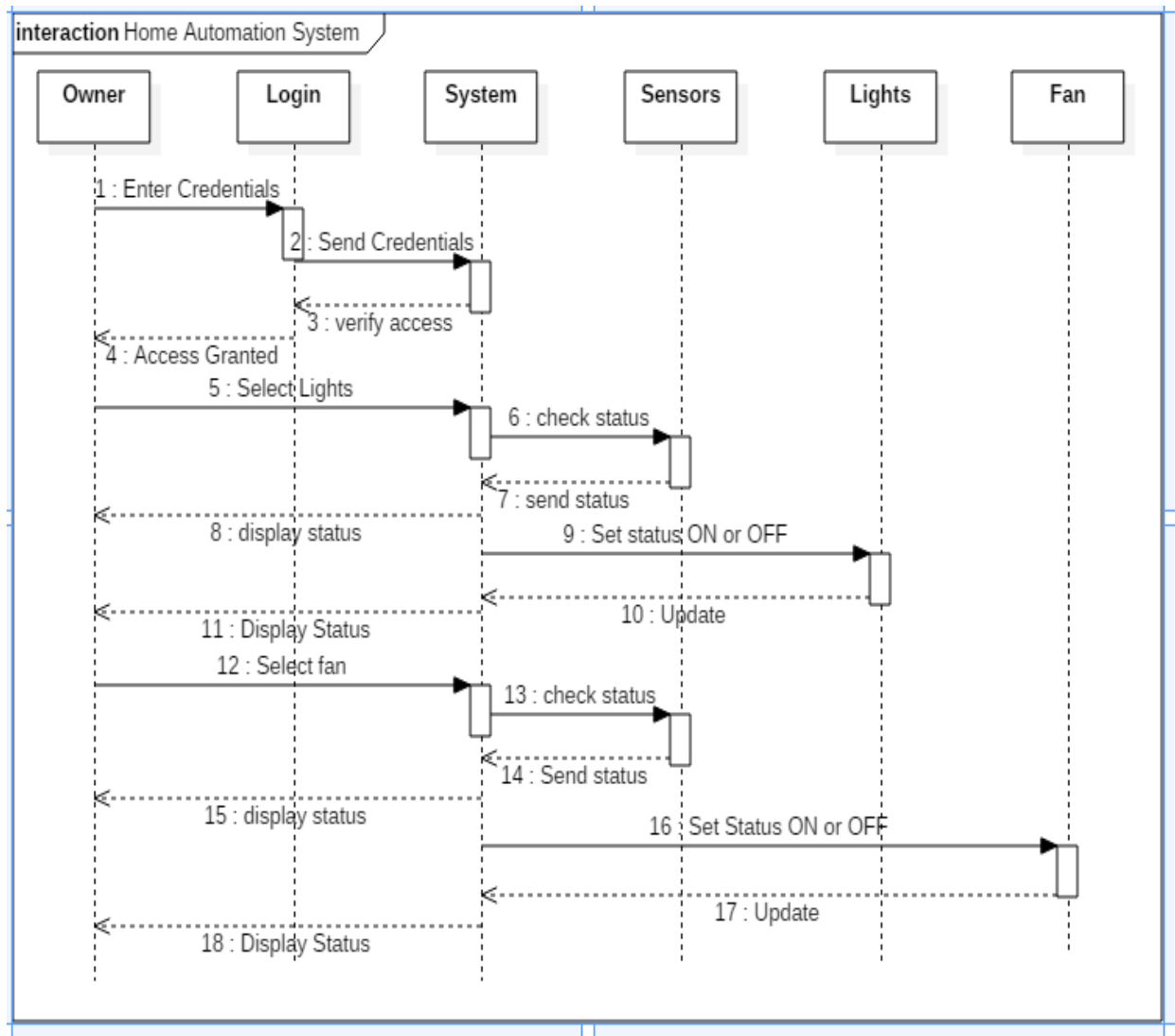
4. Sequence Diagram-

A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the object needed to carry out the functionality of the scenario.

**Home Security System-**
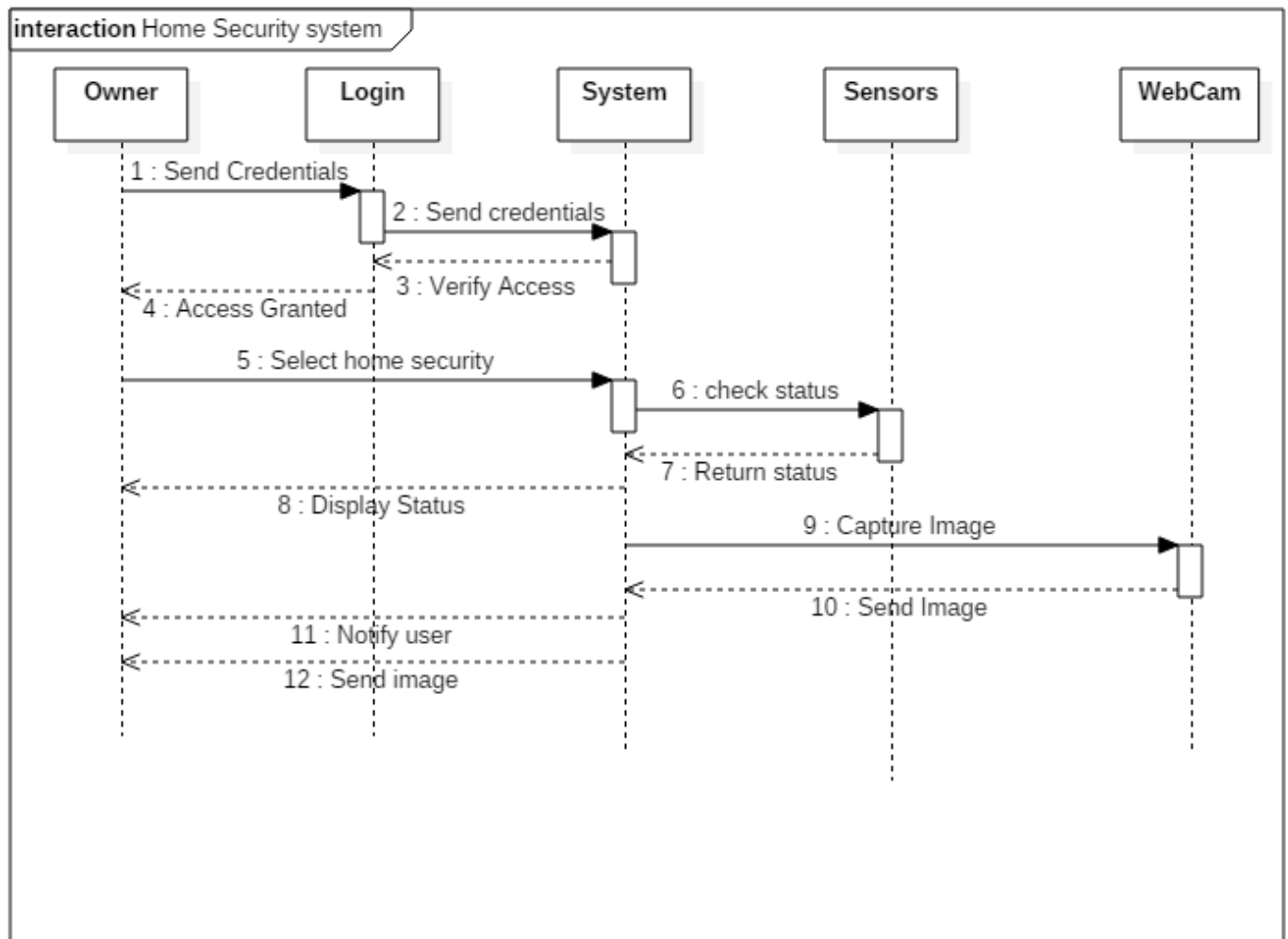
Home Automation System-

5. Data Flow Diagram-

A data flow diagram is a graphical representation of the "flow" of data through an information system, modelling its process aspects. A DFD is often used as a preliminary step to create an overview of the system without going into great detail, which can later be elaborated.

5.1 Context Diagram

It is a basic overview of the whole system or process being analyzed or modelled. It is designed to be an at-a-glance view , showing the system as a single high level process, with its relationship to external entities.
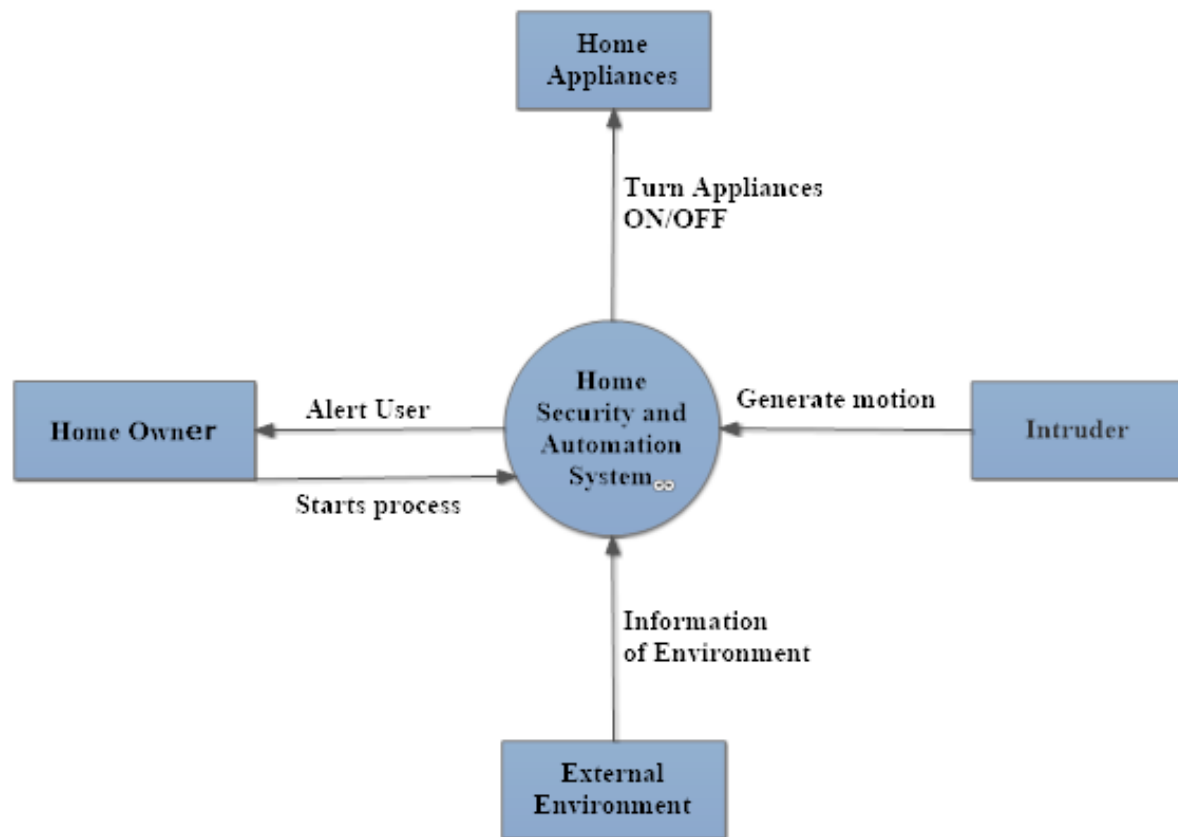

5.2 Level 1

DFD Level 1 provides a more detailed breakout of pieces of the context level diagram. You will highlight the main functions carried out by the system as you breakdown the high level process of the context diagram into its subprocesses.
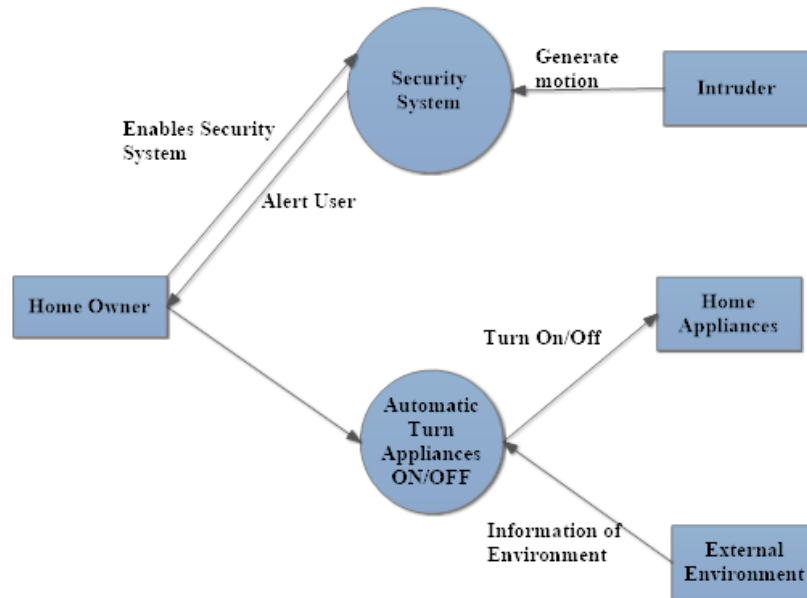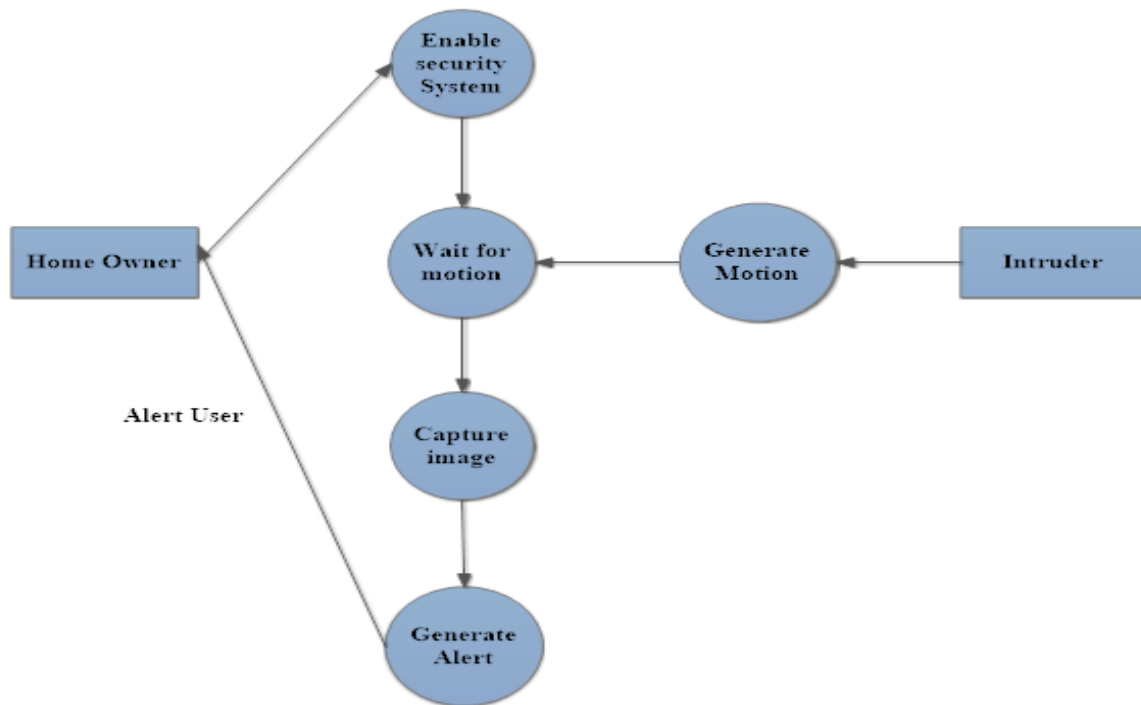
5.3 Level 2.1

DFD level 2 then goes one step deeper into parts of level1.It may require more text to reach the necessary level of detail about the system's functioning.
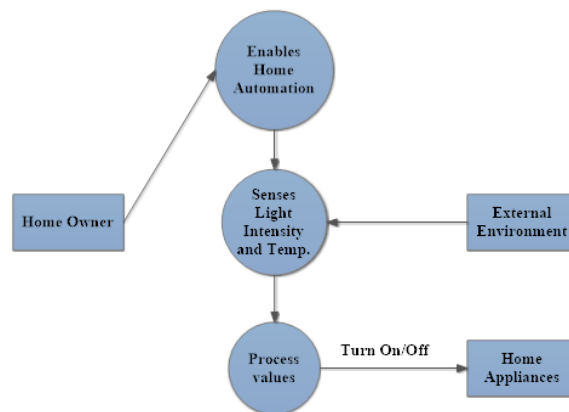
5.4 Level 2.2

6. State Chart Diagram