4.1 SYSTEM DESIGN

This design phase defines all the functional and technical parts of the system developed in this project. All the hardware and software that is used presented in this phase of the research work. This is done to ensure that all the requirements set are met and satisfied.

At the beginning of this phase, in order to get the initial overview, we start by mentioning the software. Raspbian is used as an operating system for Raspberry Pi and coding is done on Leafpad, a notepad from Raspbian and on Android Studio an IDE from Google.

For this project, programming language used for the server side is Python while Java is used for the client side.

Figure 4-1: system design

4.2 System Block Diagram

The block diagram of the system is generally described in figure 4.2. The client is the end user of this system who is roaming individuals. The client sends the commands to the server computer through Internet using TCP protocol; the Raspberry pi receives the commands and transfers it to the Arduino.

Whenever a button is clicked by a user, the application sends the command to a server, and then a python code to talk to Pi receives the data and sends it to the Arduino which is responsible for controlling the electrical Appliance.

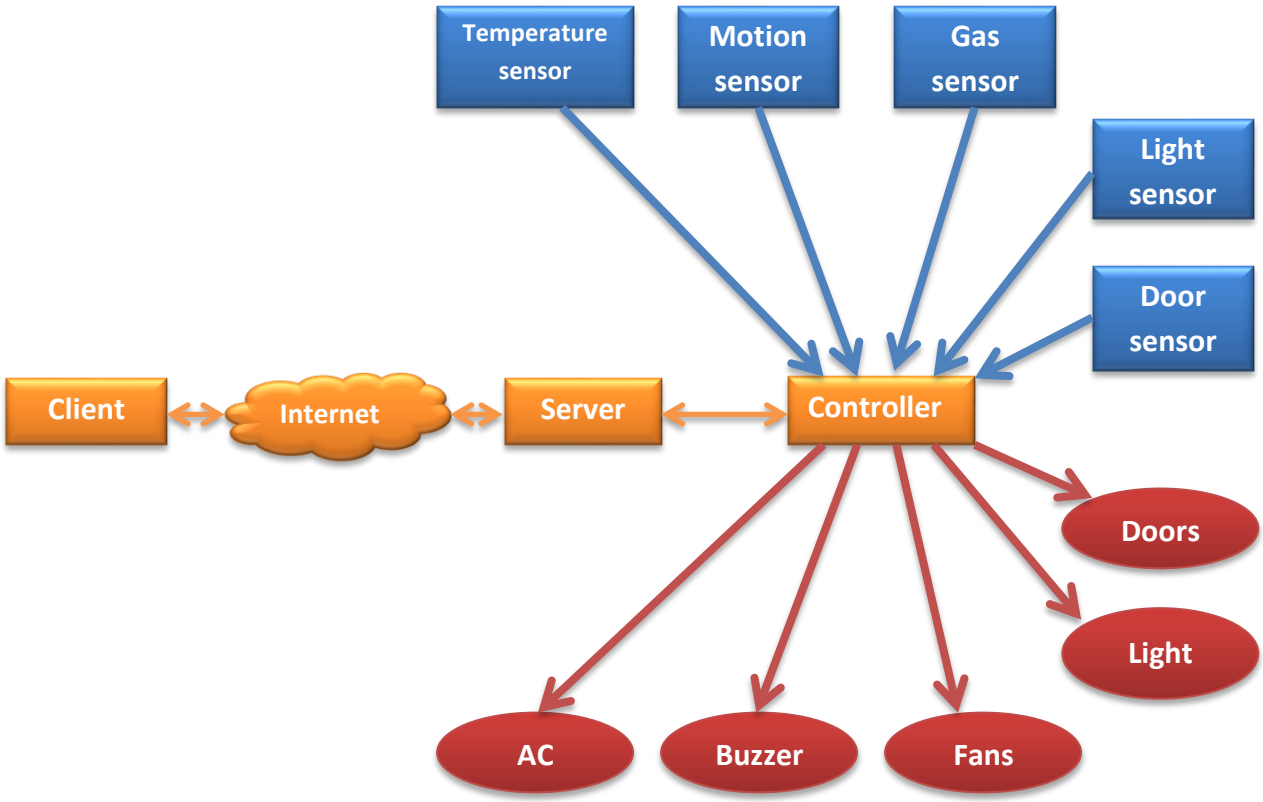

Figure 4-2: System Block Diagram

4.3 System Description

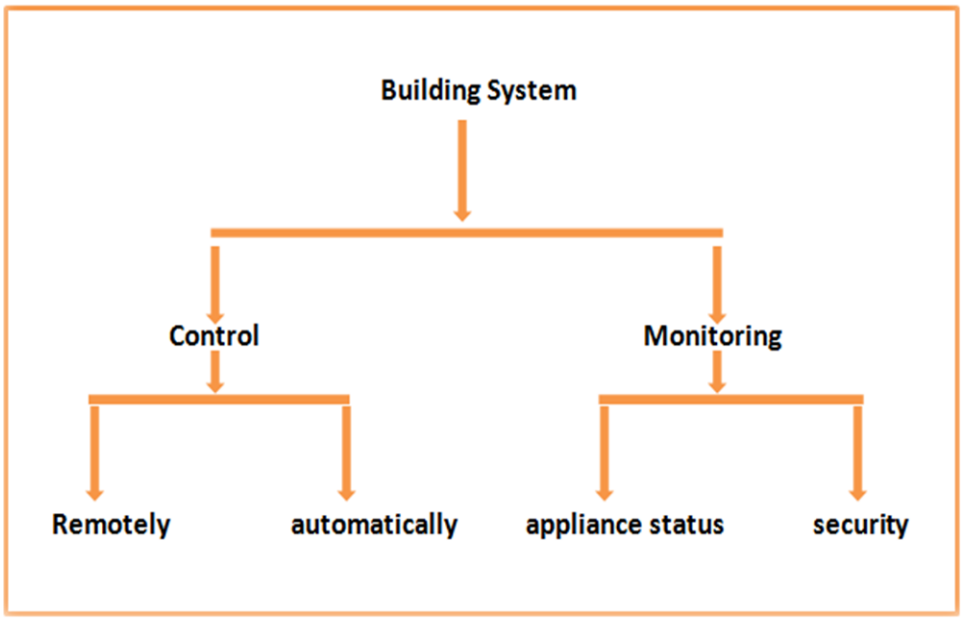

Figure 4-3: System Description

4.3.1 Remote Control

Here we remotely control home appliance through the internet using android application.

Whenever you press a control button in the android application which installed in any smart phone that have valid access to the internet. the control command will be forwarded through the internet to the raspberry pi3 which acts as a server. Internet provides the capability of accessing the server from any place at any time. After that the raspberry pi sends the command to the arduino via serial communication to transfer it into an action that applied on what we want to control .

We use raspberry pi3 as server because it has the capability to access the internet and the arduino does not have this capability but provides more GPIO (general purpose input output) pins .

4.3.1.1 Remote Control Flow

Figure 4-4 shows the sequence of remote control steps and operations.

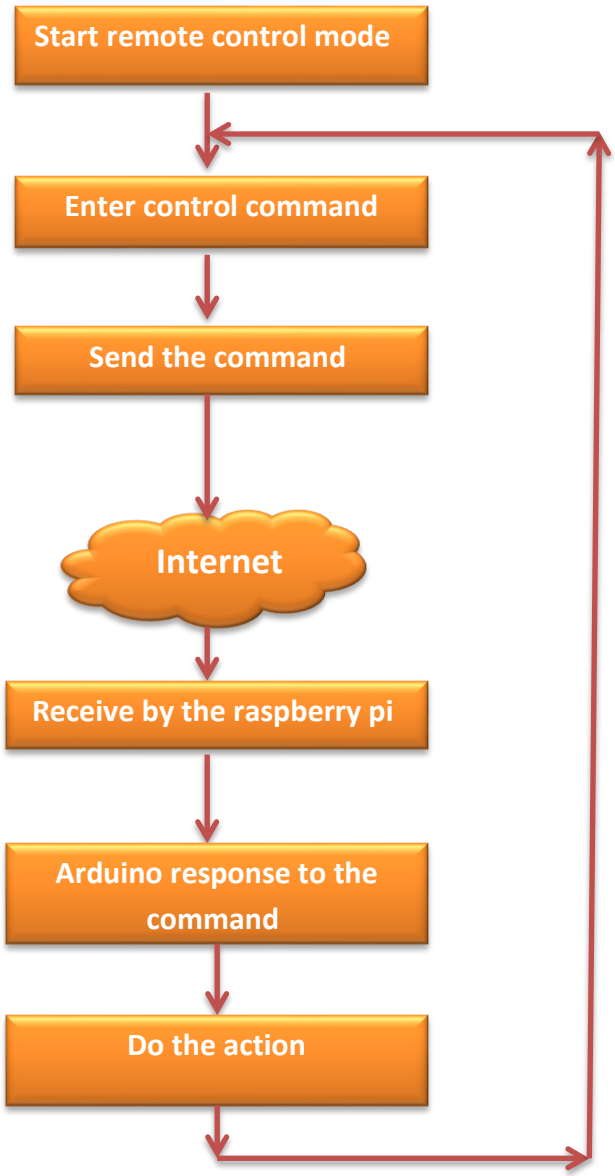

Figure 4-4: Remote Control Flow

4.3.1.2 What We Want To Remotely Control

1. On /off Lights.
2. On / off Fans and air condition.
3. Open / close doors.
4. Active / inactive security mode.
5. Open / close water pump

4.3.2 Automatic Control Mode

Here In automatic control mode there is no need to client server communication technique, all electrical equipment and doors in house are automatically controlled via arduino according to the status of the sensor in the house.

A lot of sensors are used to control this process

4.3.2.1 Doors Control

IR sensor is used to control the process of closing and opening the doors of the house .whenever an obstacle hits the light it reflects and the IR sensor captures the reflected light and send a high voltage to arduino, according to this voltage servo motor rotates from 0 degree to 90 degree, and then after a fixed interval if IR sensor doesn't capture another light servo motor rotates back from 90 degree to 0 degree.

4.3.2.2 Lights Control

LDR circuit is exists in the house garden and it's connected with arduino. Whenever it goes dark the LDR resistances increases and arduino pin goes low, in this case arduino turns on the lights of the garden. However, when light shines onto the LDR its resistance falls and arduino pin goes high, in this case the lights of the garden is turned off.

4.3.2.3 Temperature Control

A lot of temperature sensor circuits are exists in rooms; the circuits will read the temperature of the surrounding environment. The IC we will use to measure the temperature is the LM35 IC. We will integrate this with the arduino to measure the temperature. The arduino will then read this measured value from the LM35 and translate into Celsius degrees, whenever temperature reaches 30 degree or above arduino will fire the air conditioner and fans of the room. And when it reaches 16 or below arduino will turn off the air conditioner and fans of the room.

4.3.2.4 Gas Control

The smoke sensor we will use is the MQ-2. This is a sensor that is not only sensitive to smoke, but also to flammable gas. The MQ-2 smoke sensor reports smoke by the voltage level that it outputs. The more smoke there is, the greater the voltage that it outputs. Conversely, the less smoke that it is exposed to, the less voltage it outputs.

The MQ-2 also has a built-in potentiometer to adjust the sensitivity to smoke. By adjusting the potentiometer, you can change how sensitive it is to smoke, so it's a form of calibrating it to adjust how much voltage it will put out in relation to the smoke it is exposed to.

We will wire the MQ-2 to an arduino so that the arduino can read the amount of voltage output by the sensor and sound a buzzer if the sensor outputs a voltage above a certain threshold. This way, we will know that the sensor is detecting smoke and we will sound a buzzer alerting a person such as a homeowner to this fact.

4.3.2.5 Energy Control

Energy management Home automation applies a light dimmer, a timer and a displacement sensor in order to reduce energy waste.

In fact, lighting takes account for 20 % of the whole national electricity consumption. But, half of the consumption of lighting is being wasted in inefficient lighting or lighting for the empty rooms. In the lighting part, home automation is automated which means it will be turned on or off depending on the actual needs. Outdoor lighting can be controlled by the induction of moving objectives. It will turn on when there is the need, or the owner can set it to turn on when there is the Sunset. Indoor lighting can detect the demand situation by the sensor and if there is nobody in the room it will be turned off.

Light dimmer is another good solution to save energy. By lowering the light level 25 % which cannot be recognized by the human

eye, power consumption can be reduced by 20 % and the lamp life can be extended to four times longer. The surround light sensor can adjust the brightness of the light automatically in the lighting regulator. This design satisfies the usage and energy-saving requirements for the customers.

By thermostat home automation system can adjust the required temperature automatically by the motion sensors which can sense human activities If people leave the room, it can reduce the cooling power and save energy. It also can provide the convenient life for the customers.

PIR sensor will be integrated with arduino to control this process. when PIR sensor detect that there is no motion , arduino will turns off the lights and the air conditioner and the fans of the house regardless of the status of LDR circuit and temperature sensor .

4.3.2 Automatic Control Flow

Figure 4-5 shows the sequence of automatic control steps and operations.

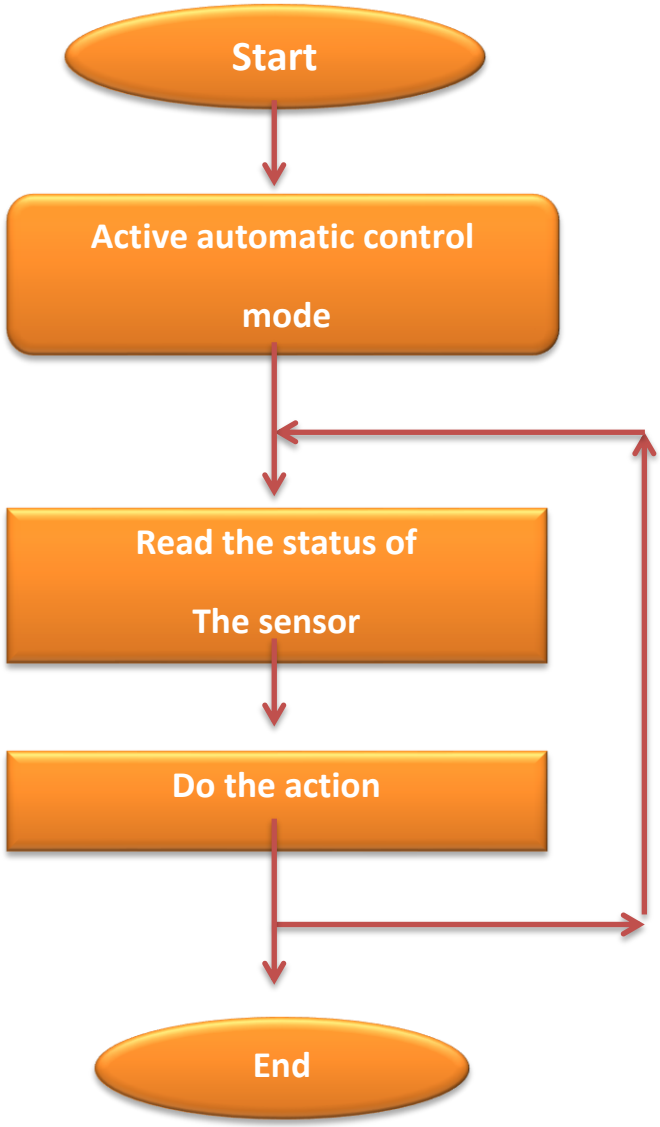

Figure 4-5: Automatic Control Flow

4.3.3 Appliance Status

The android application provides a great interface to the user to give him a feedback about what is going inside the home, when the user

launch the application a request will be sent to the Raspberry Pi through the internet which asks the arduino about the current values read by the sensors, then these values are processed by the Raspberry Pi before sending them to the user.

Also the application reflects the status of the electrical appliance which one is closed and which is not, so the user has the ability to change the status of the lamps, Air conditioners, water pumps and the other electrical appliance according to the reflected status.

4.3.4 Security

Most of the owners of the smart home are rich people. Safety and security are very important for them. Smart safety and security are different from the traditional safety and security. A user can use android phone to control whole security system in an easy way.

In this system we have three Security levels that indicate alarm function.

The first level when a stranger crosses over your house yard, the laser beam enclosure will be blocked-up by him. Then the sensor indicates the Arduino which sends an instruction to the server that some strangers come into your home. After that the server sends a notification to the house owner. For the other two levels PIR Motion sensors stand guard, ready to react to various situations, such as movement inside the garden or in your living room, windows or doors being opened or closed, or a broken window.

In this project PIR Motion Sensor Module is used as an infrared sensor that generates electric charge when exposed in heat and sends a signal to Arduino according to level of the infrared in front of the sensor, Arduino checks the status on and start buzzing speaker, glows the LED and notify the owner of the house. A simple program is running on Arduino which checks sensor if anything is moved or new object has been detected.

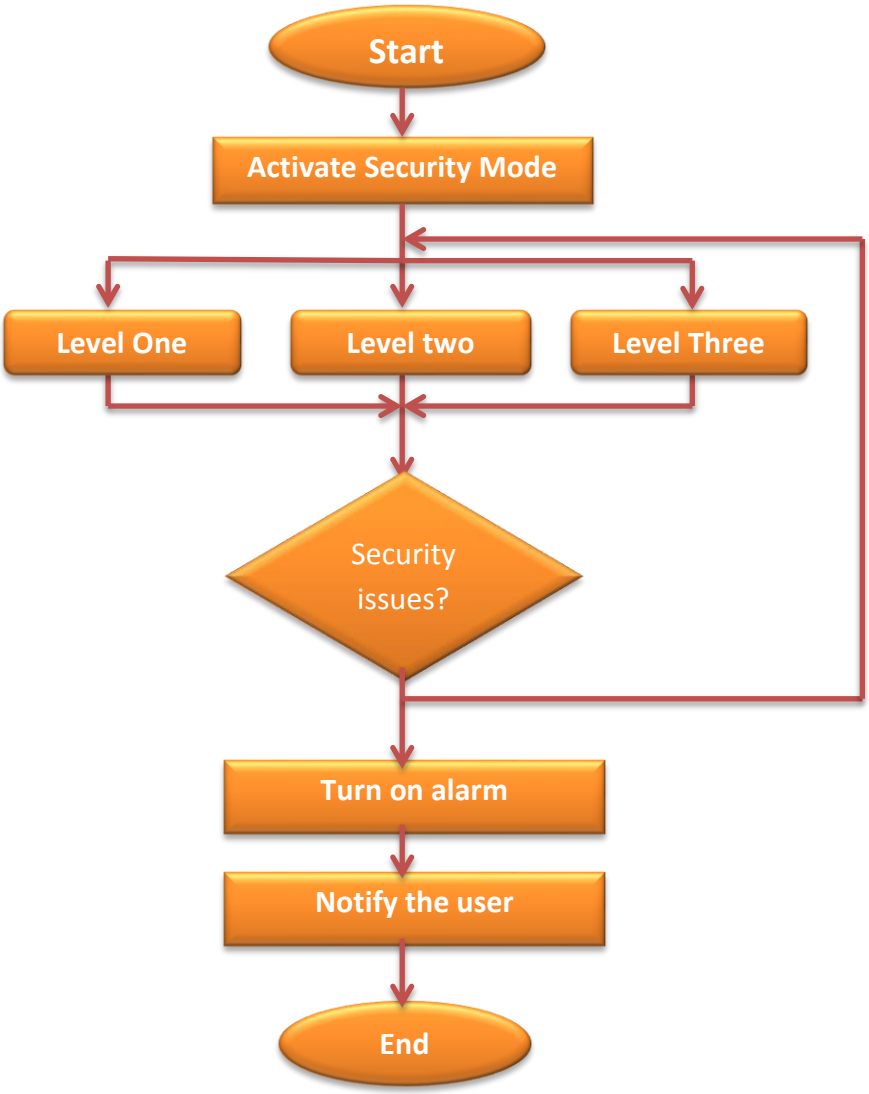

Figure 4-6: Security Mode Block Diagram

4.10 System analysis

The Home Automation task is to monitor and control the data from respective sensors and devices. The Android Application design is one of the most important things in Home Automation systems as it displays the output in structured form for the user. By launching the application we have access to the list of sensors and devices we want to monitor. The home page of the application is shown in Figure 4.12 contains Controlling and Monitoring, Services.

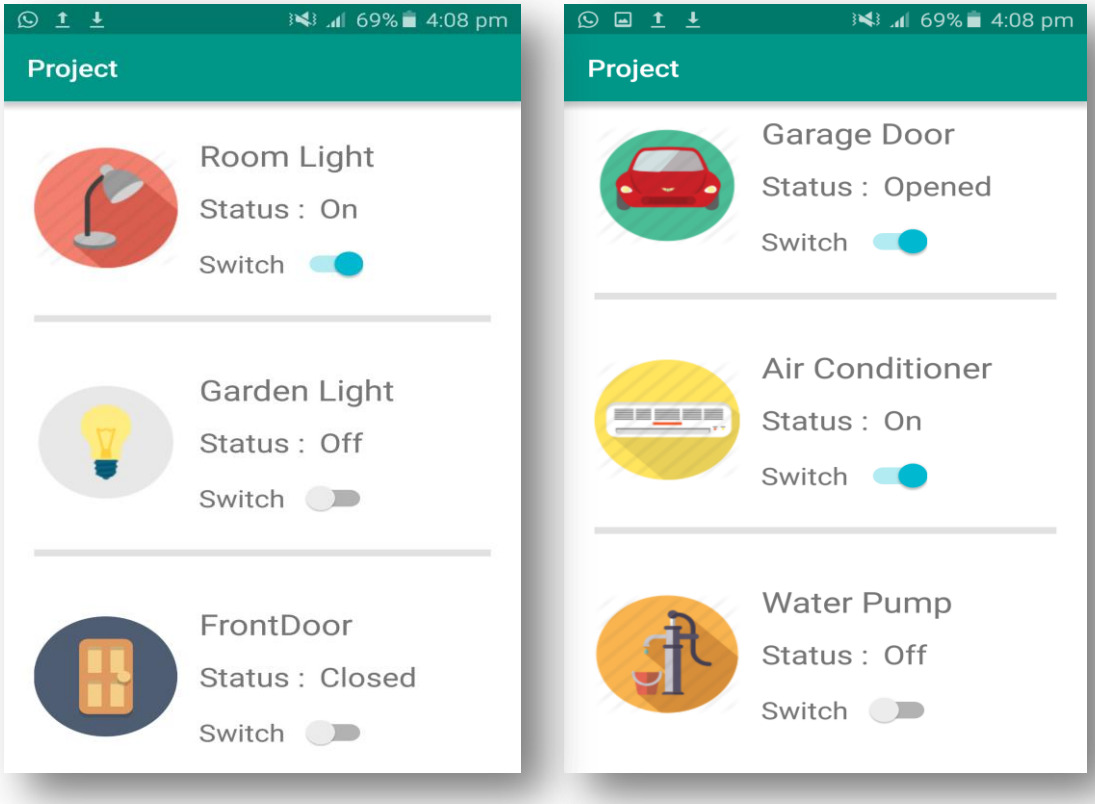

Figure 4-7: Android Application Home Page.

In the application home page, we developed a number of lists of sensor/devices to monitor. These lists include Temperature Monitoring, Light Monitoring, Fan Monitoring, water pump Monitoring and door Monitoring as shown in figure 4.12.

The first thing we measure is temperature inside room. In Temperature Monitoring, we monitor the temperature inside all rooms in the house. As there will be number of rooms in house, we need temperature sensor in each room. Figure 4.13 shows temperature data information dragged in the application to have clear idea of temperature inside the house, so that user will have information if there is high or low temperature according to the value.

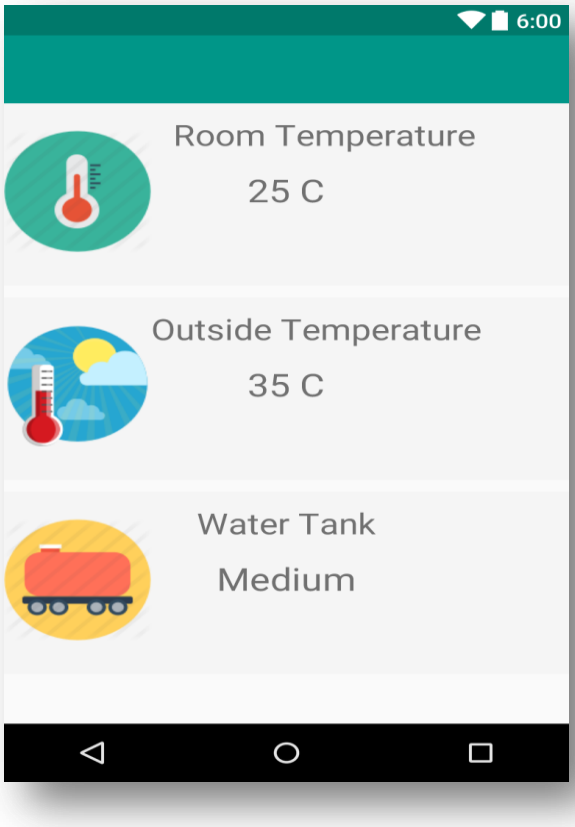

Figure 4-8: temperature Data page

Similar is the case with Light Monitoring. Depending on LDR sensor sensitivity, light inside the house will be controlled automatically. If enough light falls on LDR sensor, it will have low resistance, then light inside room will be turned off and vice-versa. Also, threshold limit and location of LDR affects light operation. Depending on threshold limit, decisions are made on when to turn light on and off. We are monitoring lights inside the house and the garden lights.

Next is Fan Monitoring, where the fan inside room is monitored and controlled automatically depending on temperature inside room. If the temperature sensor reads high temperature than normal value, then fan will automatically turn On and if temperature is within normal then fan is turned Off and these information are displayed in the application for user.

With Alarm Monitoring, we monitor if the smoke detection sensor inside the house detected smoke or any other kind of gas. If the reading of the sensors shows a high value, then alarm will go on. Also the alarm will go on if the PIR sensor detected motion. The alarm is an essential part in the home as it secures and provide alert and then the user can respond according to it. The Arduino, Raspberry Pi and sensors used in Home Automation tasks are shown in Figure 4.14

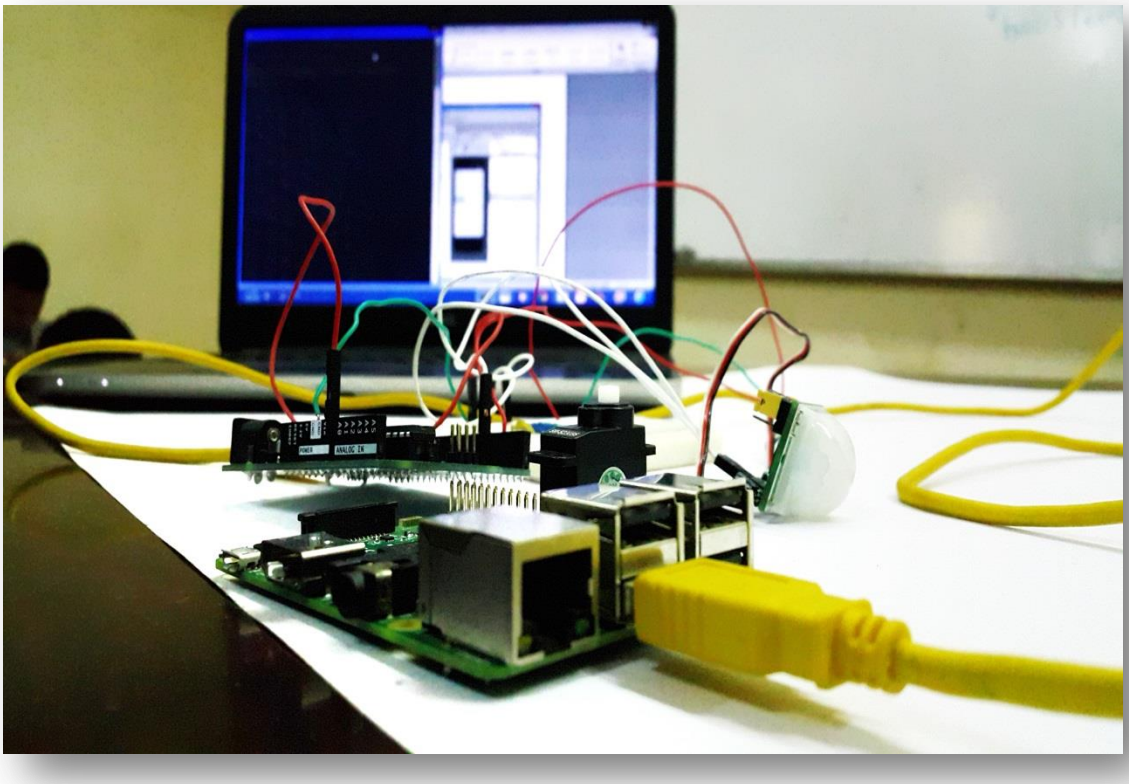

Figure 4-9: PIR Sensor Circuit Implementation