Android Controlled Home Automation System based on Different Power Optimization Modes

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DECLARATION

We, hereby declare that this thesis is based on the implementations and results found by ourselves. Materials of work found by other researcher are mentioned by reference. This Thesis, neither in whole or in part, has been previously submitted for any degree.

Signature of Supervisor	Signature of Author
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ABSTRACT

This project is developed for controlling home appliances through internet in real time and also to operate them in different modes from any remote places. Our main focus is to operate the home appliances in our desired modes and control them in an easy way. We have developed an android based application for controlling appliances and operate them in different modes like optimum, sleeping, auto etc. also all the appliances can be controlled individually. Different sensors have been used for analyzing lights, temperature and motion. Based on sensor values our algorithm will operate all the appliances according to modes. So by operating them in different modes it will save power as well as make our life easier and comfortable.

CHAPTER 01

INTRODUCTION

1.1 Motivations

The world has changed after the evolution of term called Automation. In every sector automation is reducing human labor. Firstly introduced in industries and now in a variety of sectors rely on automation system. Development of advanced home automation system has huge opportunity in present time. Again Internet of Things (IoT) is going to be a new era of technology in future. It is expected that 30 billion of devices will be connected within 2020[1]. So it is the right to get prepared for the future technologies.

1.2 Contribution Summary

The summary of main contributions in this project is as follows:

- Controlling appliances based on different modes
- Every modes reduces power consumption
- A real life home automation solution which can be implemented at home and need not to be tensed about controlling
- Android based control system which is more user friendly than web pages.
- Useful user interface

1.3 Thesis Outline

The rest of the thesis is organized as follows:

- Chapter 02 necessary background information about our proposed project.
- Chapter 03 components used for implementation.
- Chapter 04 system architecture and working algorithms.
- Chapter 05 implementation of the projectand result analysis.
- Chapter 06 advantages and limitation of the proposed system.
- Chapter 07 concludes the thesis and states the future research directions.

CHAPTER 02

BACKGROUND INFORMATION

2.1 Home Automation

Home automation makes a home smarter. Smart home is the term which has huge demand in present world and huge possibilities in near future. A home automation system may control lights, temperature, climate, entertainment and many other appliances. Home security is also a part of automation which includes security control and alarm system. Security control means controlling entries based on facial recognition and let recognized people in. On the other hand security alarms could be for fire or security breach in the home and notifying the owners. Home automation typically controls all the appliances from a central hub. The end user interface may vary based on application. The control system could be wall mounted, computers, a mobile phone application or web interface. It actually depends on the developers and the users. In our proposed system we have used mobile phone android application based control system.

2.2 IoT Based Home Automation

Internet of Things allows us to control connected devices from anywhere and exchange data over the devices. Home automation system controls home appliances automatically and when this system is connected to internet it becomes a part of IoT. There are three main generations of home automation. First is, different wireless technology with proxy servers**,** second is Artificial Intelligence (AI) controlled home automation and lastly robots which directly communicate with humans [2]. Our project is first generation automation. For implementing the first generation of the home automation appliances needs to connect with internet so users can control the system from any remote place. That's why IoT has become a need for automation.

2.3 Related Work

In paper [3] they have proposed a sensor based home automation system which can be controlled over android phone. Yet it needs to be controlled manually by increasing or decreasing the speed of fans and intensity of lights from phone. Paper [4] proposed an android based home appliances control and monitor system. Their proposed model can control appliances from internet and from switchboards. Again this system cannot give a solution for a long time control system in home automation. In paper [5] they have proposed a network assistant platform or server for controlling appliances in different modes. This system proposed less power consumption by disabling devices to low power mode.

CHAPTER 03

COMPONENTS USED

3.1 Arduino Mega 2560

The Arduino Mega 2560 is a microcontroller board and the core of the board is ATmega2560 microcontroller chip. As shown in Fig 3.1 which we have used has 54 inputs/outputs pins among them 14 can be used as PWM (pulse with modulation) to level the voltage, some pins are used for communication also like Serial pin: 0 (RX) and 1 (TX); Serial pin 1: 19 (RX) and 18 (TX); Serial pin 2: 17 (RX) and 16 (TX); Serial pin 3: 15(RX) and 14 (TX). Used to receive (RX) and transmit (TX) TTL serial data and rest of the pins are used as digital inputs/outputs. Another 16 pins are used as analog inputs form the environment. It also has 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header and a reset button.

Fig 3.1: Arduino Mega 2560

Arduino Mega runs with 5V of DC voltage which can be a battery or an AC to DC Adapter. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. Normally, 6V-12V as input voltage is recommended. Each pins gives 40mA DC current for 5V operation and for 3.3V operation it provides 50mA DC Current and also has an internal pull-up resistor (disconnected by default) of 20-50 kohms. It also provides 256 KB flash memory for code storage among them 8KB used for bootloader. As well as 8KB Static Read Only Ram (SRAM) and 4 KB Electrically Erasable Programmable Read Only Memory (EEPRAM).

The ATmega2560 provides four hardware UARTs for TTL (5V) serial communication. The channel creates through USB and a virtual com port to arduino IDE on the computer. To run the code operating system like Windows need an .inf file and for other operating system machine will recognize the board as a COM port automatically. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the ATmega8U2 chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

3.2 Esp8266 NodeMCU

There are various platforms for IoT system one of them is NodeMCU. It provides lower level control on devices which is known as firmware. These control runs on ESP8266 Wi-Fi SoC, which hardware is based on ESP-12 module.Esp8266 is a Wi-Fi based communication system's microchip. It uses TCP/IP protocol for communicating with internet through router. It uses 802.11b/g/n slandered technology for Wi-Fi communication. It is a Tensilica L106 32-bit RISC instruction unite microprocessor with 32 KB instruction RAM, 32KB instruction Cache RAM, 80KB Data memory.ESP8266 (Pin) and Arduino Mega's (Pin) common pins are GND TX (0)-3.3V, RX (0), 3.3V. For running the ESP8266 on Arduino platform we need to install ESP8266 package in Arduino IDE. As a board is using, we need to give the additional board manager.

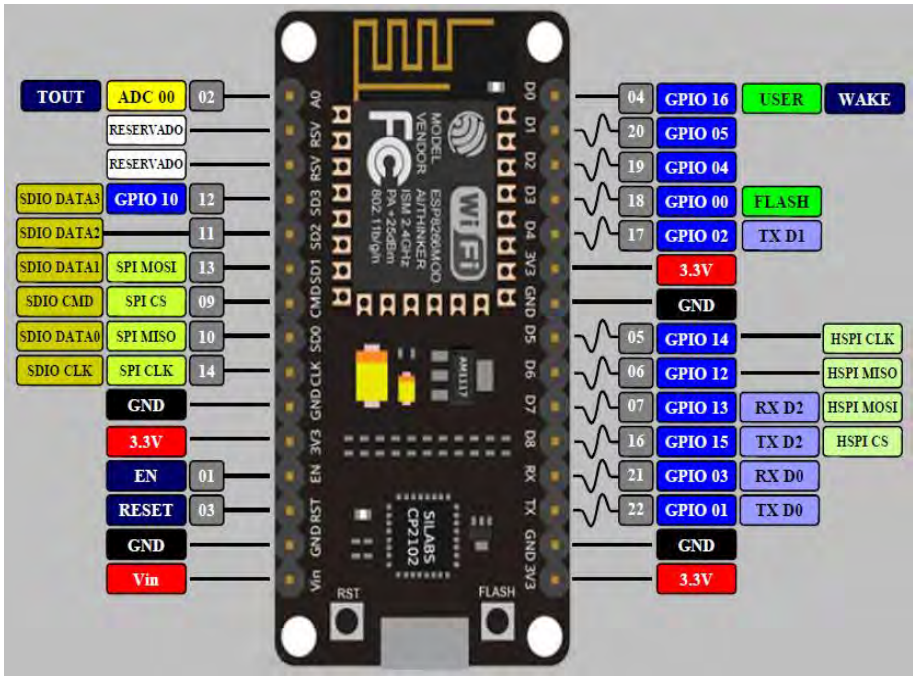


Fig3.2: Esp8266 NodeMCU chip [6]

As shown in Fig 3.2 it has 12 GPIO pins. One ADC pin. For this project 7 GPIO pins have been used. They are D0 to D6 which delivers digital outputs.

3.3 4 Channel Relay Board

Relays are electromechanical devices which takes a relatively small amount of power like 5V(15-20mA) to operate the relay coil and then it is used to control a lot more electrical power. Normally A relay is used as switch circuit which is constructed by n-p-n transistors as shown in Fig 3.3. For low base voltage or negative voltage transistor goes to cut off region and stops the flow of collector to base directed current, If a large enough positive current is now driven into the Base to saturate the NPN transistor, the current flowing from Base to Emitter (B to E) controls the larger relay coil current flowing through the transistor from the Collector to Emitter.

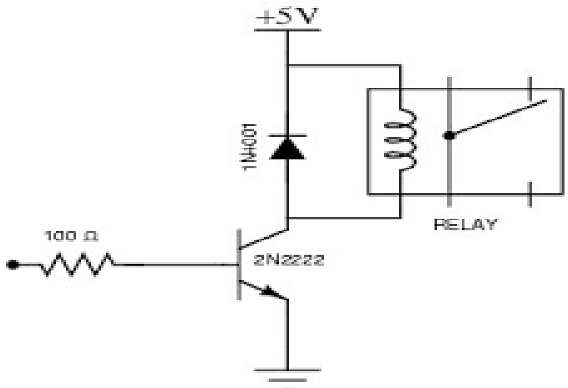


Fig 3.3: Circuit Design of a relay [7]

Maximum range of 4 channel relay board is for DC level 30V and 10A and AC level 250V and 10A. It uses opto-coupler for high voltage safety and prevent ground loop with microcontroller. VCC and RY -VCC are also the power supply of the relay module. In case of driving a large power load, the jumper cap off is taken off and an extra power to RY-VCC is connected to supply of the relay. Connect VCC to 5V of the MCU board to supply input signals. Pins of 4 channel relay are VCC for power supply 5V, gnd for Ground, in1,in2,in3, in4 all are signal controlled pin and connected individually with Arduino ports. And COM is a common pin which is normally grounded unless using for HIGH Voltage. NO is for open connection and NC for closed connection.

Fig 3.4: 4 Channel Relay Board

3.4 LDR

LDR means Light Dependent Register constructed with two Cadmium Sulphide Photoconductive cells with spectral response which is similar to human eye. With the change of density of light it reacts. The range of LDR is 1000lux to 10 lux. It has no polarity as a result it can be fit in the breadboard easily. As shown in Fig 3.5 both the legs are equal.

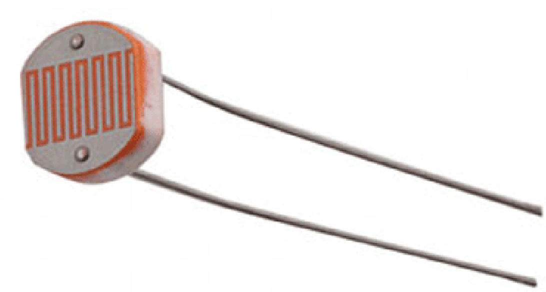
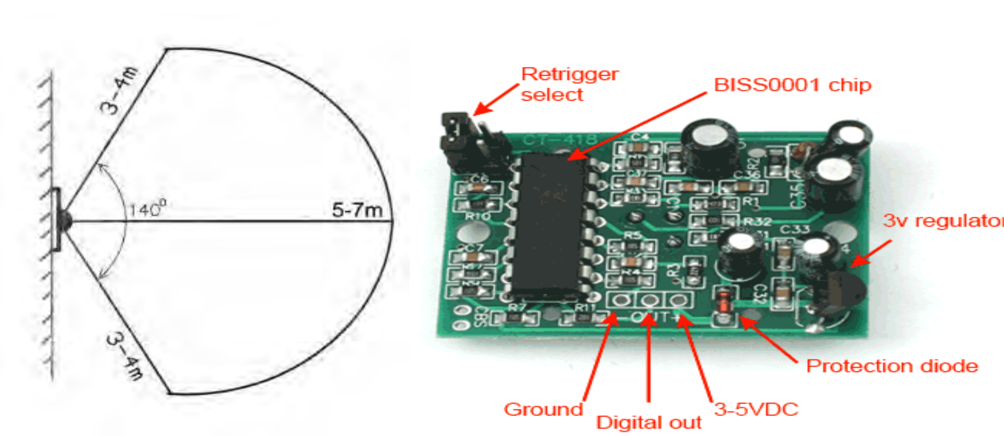


Fig 3.5: LDR Sensor [8]

3.5 PIR

PIR sensor means Passive Infrared sensor which is used for detecting human movement into its range of 0 to 21 feet (7 meters) 140° detection range as shown in Fig 3.6(a). It is compacted having the size of (28x38 mm) and runs with the power supply of at least 5V.



(a) (b)

Fig 3.6(a): Range of PIR Sensor, **(b)**. PIR board[9]

As shown in Fig 3.6(b) it has three pins having spacing of 0.1" where one is used for VCC, the middle one is for driving output voltage which is at least 3.3V TTL output or open collector output. Besides all of these it has two adjustment trimpot for adjusting sensitivity with the environment. They are Delay time adjustment and Distance Adjustment. Clock cycle is used for adjusting the sensitivity. PIR sensor is associated with two timeouts, one of them is TX for calculating the time after detecting movement how long the LED will lit and another one is Ti for calculating the time when will the LED will off when there will be no movement. The equations for calculating TX and TI

For example:

Tx is = 24576 * R10 * C6 = ~1.2 seconds
R10 (leveled on the PIR board) = 4.7K and
C6 (leveled on the PIR board) = 10nF

Likewise,
Ti = 24 * R9 * C7 = ~1.2 seconds
R9 (leveled on the PIR board) = 470K and
C7 (leveled on the PIR board) = 0.1uF

3.6 DHT22

DHT22 temperature and humidity sensors are very basic and slow, but are great for hobbyists who want to do some basic datalogging. The DHT sensors are made of two parts, a capacitive humidity sensor and a thermistor. There is also a very basic chip inside that does some analog todigital conversion and spits out a digital signal with the temperature and humidity.

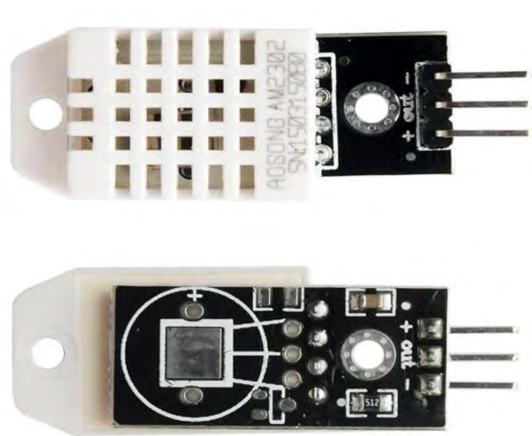


Fig 3.7: DHT22 temperature and humidity sensor [10]

The digital signals are fairly easy to read using any microcontroller. It has the following features:

- Low cost
- 3 to 5V power and I/O
- 2.5mA max current use during conversion (while requesting data)
- Good for 0-100% humidity readings with 2-5% accuracy
- Good for -40 to 125°C temperature readings ±0.5°C accuracy
- No more than 0.5 Hz sampling rate (once every 2 seconds)
- Body size 15.1mm x 25mm x 7.7mm
- 3 pins with 0.1" spacing

3.7Lights and Fan

As home appliances two lights have been used in this project. As shown in Fig 3.8 one is a 5 watt compact fluorescent lamp (CFL) energy saving light. Another is a 40 watt incandescent bulb.

Fig 3.8: Incandescent bulb and CFL bulb [11]

A 56 watt small ac fan was used in this project as shown in Fig 3.9. It runs on 220 Volt and 50 Hz.

Fig 3.9: A 56 watt ac motor fan

CHAPTER 04

SYSTEM ARCHITECTURE

4.1 System Overview

In our proposed system we have developed an android based home automation system which is capable of controlling home appliances based on user command. It also has own intelligence to control all the appliances according to user given modes. If user wishes to turn on or off any individual appliances it is capable of doing that. The most significant feature of this system is mode based operation. Like when user activates the auto mode than all the lights and fan will turn on or off with its own intelligence. If there is sufficient light on the particular room than lights will remain off. On the other hand if light is insufficient than lights will be turned on automatically. Based on different sensor values these actions are executed.

4.2 System Architecture

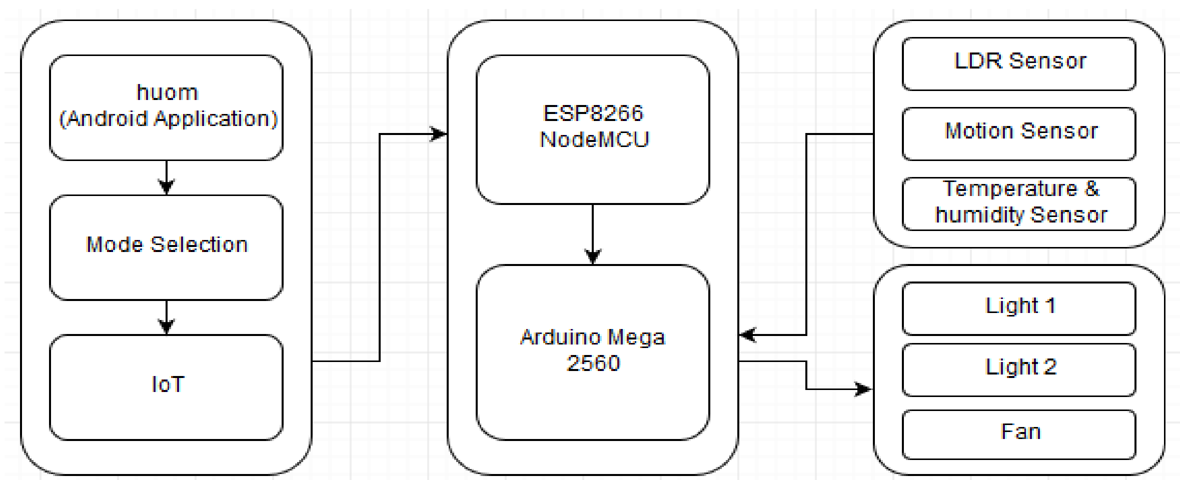


Fig 4.1: Architecture of the proposed system

As shown in Fig 4.1user controls the modes and appliances by an android based device through our application named "huom". User command is transmitted from device via internet. The esp8266 NodeMCU than receives the command from internet via Wi-Fi. The NodeMCU than passes the command to the controller board arduino mega 2560. Arduino than executes the commanded operation. So huom app is for end users to give input. Esp8266 NodeMCU and arduino mega is the control unit of the system. The arduino takes input from the esp8266 for executing actions. For execution of the action arduino also takes inputs from the sensors. Lastly the arduino runs the appliances according to user desired command.

4.3 Huom the Android Application

Huom is an android based application made by us to fulfil the purpose of our system. It is for the end user to control the system. User can control everything of the system by huom. User can also set modes from the application.

Fig 4.2: User interface of the huom application

As shown in Fig 3.2 it has 14 buttons to control different appliances and modes. The first 8 buttons are for turning on or off optimum, auto, sleeping and activate mode. The last 6 buttons are for controlling individual lights and fan. There is another text box for entering ip address. As our esp8266 module generates dynamic ip adresses after connecting new networks or after reset of previous connection. The user interface of the application huom is very interrective and very user friendly. User can turn any button on by pressing the on button and which will give command the system to proceed on the command. We have developed this application by using the mit app inventor 2. Mit app inventor 2 is an open platform fordevelopers to develop useful android basaed aplication. In Mit app inventor 2 the back-end operations are designed by block coding. Block codes are easier to design algorithms. As shown in Fig 4.3 block codes of Huom is designed in a way , when a button is pressed it will connect to the IP address as provided by the user. That IP address is the nNodeMCU’s IP which is connected with a network. This is how the back-end operations are designed in Huom.

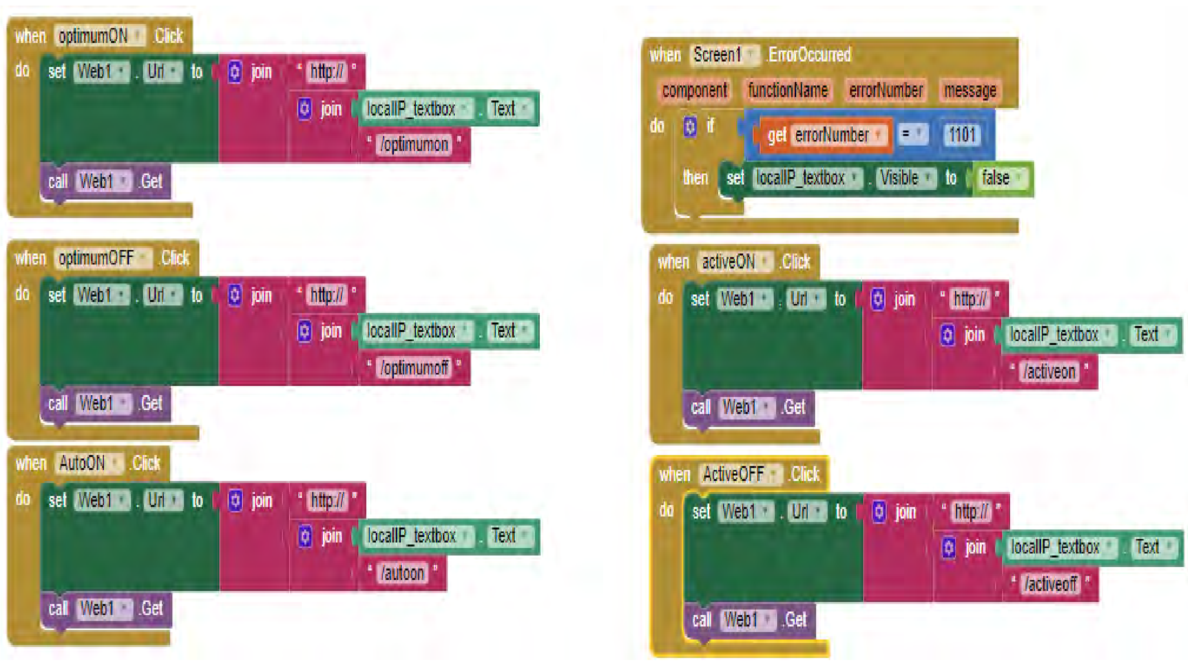


Fig 4.3: Block codes of Huom

4.4 Optimum Mode

Optimum is the most power saving mode among all. The algorithm of this mode is, first it will activate after getting motion from the motion sensor. Than, based on temperature and light intensity from the temperature and ldr sensors appliances will activate. Condition for turning on fan is temperature must be greater than 21 degrees celsius. As shown in Fig 4.4 For turning on the lights ldr sensor value must be less than 1000. Other wise both appliances will be turned off. This is an automatic process where users do not need to bother about controlling. Moreover this mode is saving power consumption by deactivating every appliances when there is no moton detected. So if no one is

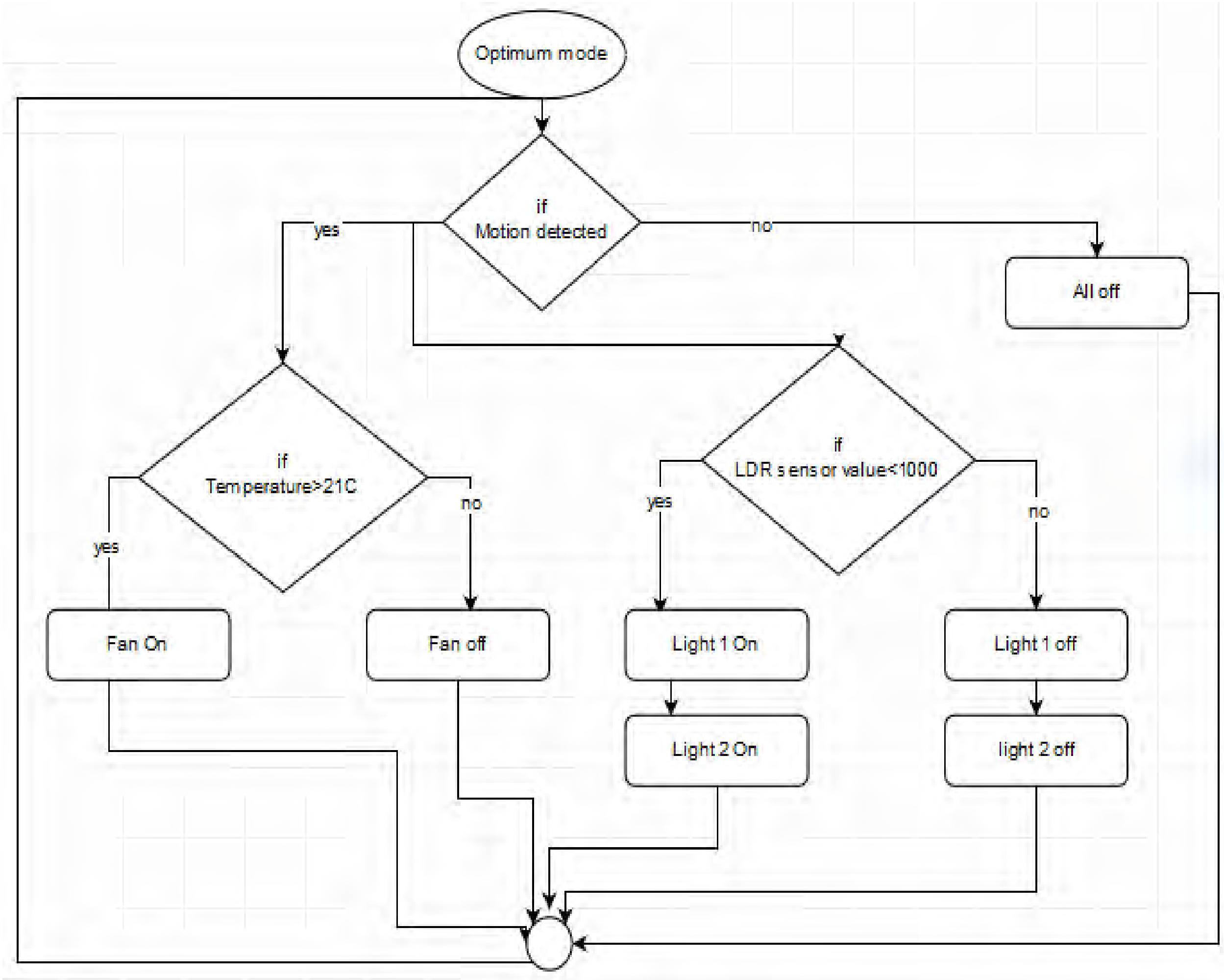


Fig 4.4: Flow chart of optimum mode

in room every appliances will remain in off condition. Than if someone enters in room all appliances will activate and execute according to sensor values.

4.5 Auto Mode

Features of this mode is it controls the appliances automatically. It is more comfortable than the optimum. Auto mode has the same features of optimum mode except activting after getting any motion in the room. It does not depend on motons. So the algorithm for turning fan and lights on are the same as previous. Based on threshold temperature and ldr sensor value as mentioned in optimum appliances will turn on and off. Condition for turning on fan is temperature must be greater than 21 degrees celsious. For turning on the lights ldr sensor value must be less than 1000. Other wise both appliances will be turned off.So this mode is very relaiable and comfortable for users.

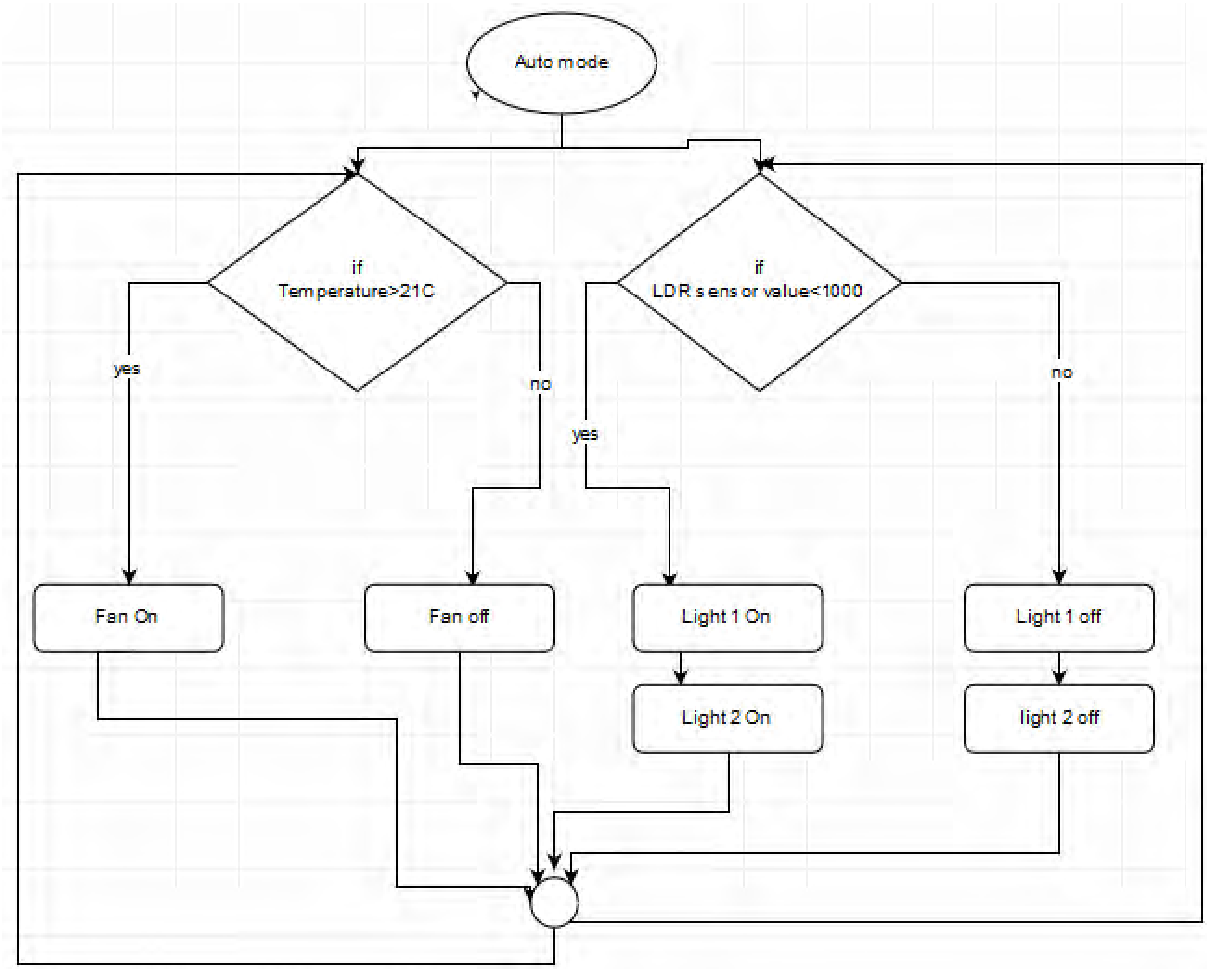


Fig 4.5: Flow chart of auto mode

Just activate the auto mode and relax. Once the mode is on than it does not change its mode until user changes it. Once auto mode is activated than if the huom application goes offline it does not change its state of mode or funtionality. It will continue running on this mode.

4.6 Sleeping Mode

This mode is designed for sleeping time. The features of this mode is it will turn off all the lights and make the room dark so that users can sleep without any disturbance of light. The other feature is fan controlling. It will also control fan based on temperature. As shown in Fig4.6, here the algorithm of fan is desined in a way, it will be turned on if the temperature rises above the threshold value.

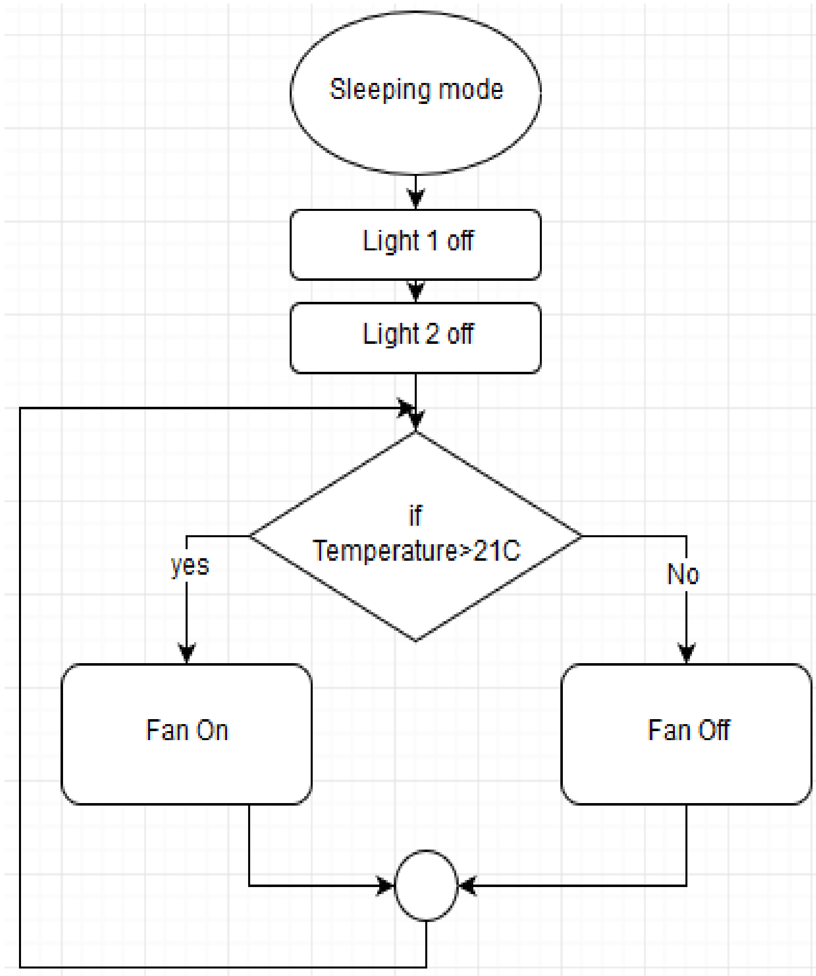


Fig 4.6 : Flow chart of sleeping mode

The threshold temperature we have set is 21 degrees Celsius. So if temperatures goes above the threshold fan will be turned on and again if temperature goes down of threshold temperature fan will be turned off. This mode is comfortable and reliable to run in the time of sleeping.

4.7 Active Mood

Active mood is designed for turning on and off the appliances at the same time. Activating this mood will turn on all the appliances and do not change its state until the mood is deactivated. So this mode is for very busy environment where users want to activate all the fans and lights at the same time. The algorithm of this mode is very simple. As shown in fig 407 when the mood is activated all the appliances are instructed to turn on. On the other hand if this mood is off it is instructed to turn off all the appliances.

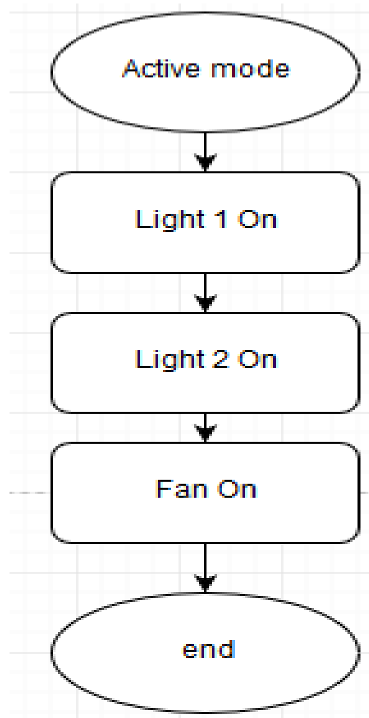


Fig 4.7: Flow chart of active mood

4.7 Pseudo Code for NodeMCU

Code for NodeMCU are given below

```
IF input string is "optimumon"

 DO pin D0 HIGH

IF input string is "optimumoff"

DO pin D0 LOW

IF input string is "autoon"

           DO pin D1 HIGH
```

```
IF input string is "autooff"
          DO pin D1 LOW
IF input string is "sleepingon"
         DO pin D2 HIGH
IF input string is "sleepingoff"
         DO pin D2 LOW
IF input string is "activeon"
         DO pin D3 HIGH
IF input string is "activeoff"
         DO pin D3 LOW
 IF input string is "light1on"
         DO pin D4 HIGH
IF input string is "light1off"
         DO pin D4 LOW
IF input string is "light2on"
         DO pin D5 HIGH
IF input string is "light2off"
         DO pin D5 LOW
IF input string is "fanon"
         DO pin D6 HIGH
IF input string is "fanoff"
```

```
DO pin D6 LOW
```

4.8 Pseudo Code for Arduino

Code for arduino mega are given below

```
 IF   input pin44==HIGH    //active on called
              PRINT fan HIGH
              PRINT light1 HIGH
              PRINT light2 HIGH
ELSE
              PRINT fan LOW
PRINT light1 LOW
              PRINT light2 LOW
IF   input pin42==HIGH   //Light1 on called
              PRINT light1 HIGH
ELSE
           PRINT light1 LOW
IF   input pin36==HIGH   //Light2 on called
              PRINT light1 HIGH
ELSE
            PRINT light2 LOW
IF   input pin32==HIGH   //Fan on called
              PRINT fan HIGH
```

```
ELSE
 PRINT fan LOW
IF input pin48==HIGH   //sleeping mode on called
    PRINT light1 LOW
    PRINT light2 LOW
               IF temperature > 21 Degrees Celsius
                     PRINT fan HIGH
               ELSE
                     PRINT fan LOW
ELSE
              PRINT fan LOW
              PRINT light1 LOW
              PRINT light2 LOW
IF input pin53==HIGH   //auto mode on called
           IF temperature > 21 Degrees Celsius
                     PRINT fan HIGH
               ELSE
                     PRINT fan LOW
             IF ldr Sensor value < 1000
                     PRINT light1 HIGH
                     PRINT light2 HIGH
```

```
            ELSE
                    PRINT light1 LOW
                    PRINT light2 LOW
ELSE
             PRINT fan LOW
             PRINT light1 LOW
             PRINT light2 LOW
IF input pin2==HIGH   //optimum mode on called
          IF Motinosensor1==HIGH OR Motionsensor2==HIGH
                     IF temperature > 21 Degrees Celsius
                              PRINT fan HIGH
                     ELSE
                               PRINT fan LOW
     IF ldr Sensor value < 1000
                             PRINT light1 HIGH
                              PRINT light2 HIGH
                     ELSE
                              PRINT light1 LOW
                            PRINT light2 LOW
          ELSE
                PRINT fan LOW
```

```
        PRINT light1 LOW

        PRINT light2 LOW

ELSE

        PRINT fan LOW

        PRINT light1 LOW

        PRINT light2 LOW
```

CHAPTER 05

IMPLEMENTATION AND RESULT

5.1 Implementation of Home Automation

In the implementation process firstly, we have tested the home automation part. For home automation we have used all our sensors as input, arduino mega as the controller and lights as appliances or output. In this process optimum and auto modes are tested separately. We have checked weather the conditions for turning on fan and lights work properly or not, as shown in Fig 5.1. After succeeding this part we moved into the next phase which is controlling over internet.

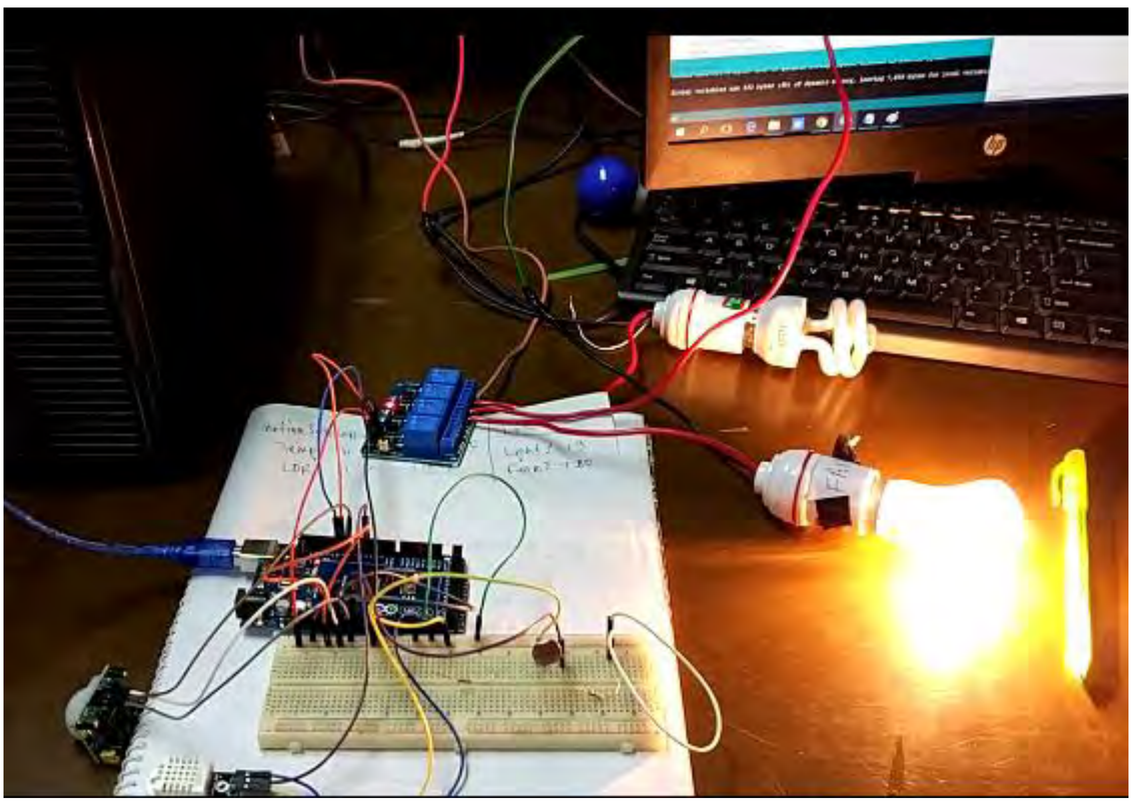


Fig 5.1: Implementation of home automation

5.2 Controlling from Android Application

In this phase we have controlled the above operation mentioned earlier from an android phone. We have used “blynk” which is an open application for beginners to test IoT stuffs. We have tested our home automation modes from this app. For this case we needed the blynk app installed in our phone. On the other hand another controller NodeMCU is added with the arduino. So the process is command was sent through the blynk app to internet towards the NodeMCU which is connected to internet via Wi-Fi. The NodeMCU takes input from internet and according to input it gives output to the arduino mega. Arduino mega than works according to the home automation algorithms. Like when optimum mode on is pressed in the blynk app, the command is sent to NodeMCU via internet. Than the NodeMCU will make the pin high which is assigned to optimum mode on. So the NodeMCU's output is the input of arduino mega. Arduino mega now gets an input pin high which is actually telling the arduino to run the optimum mode part. This is how the appliances was controlled from blynk app.

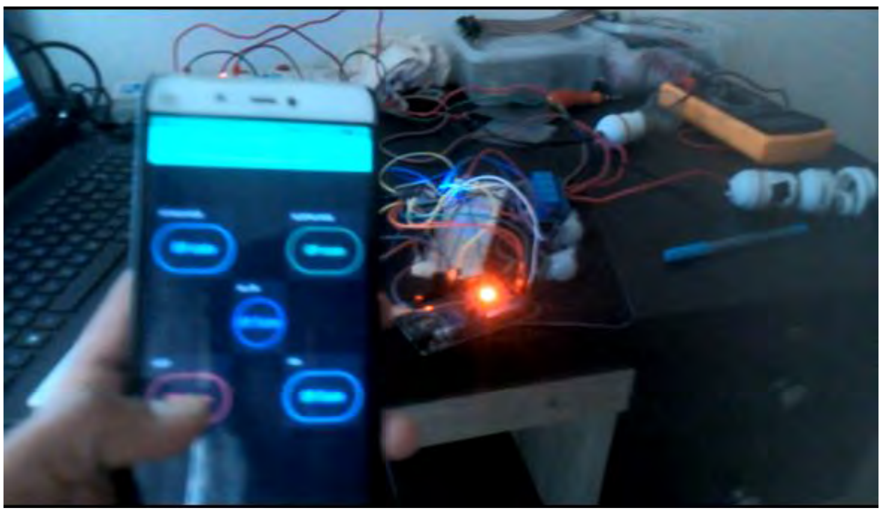


Fig 5.2: Controlling from blynk app

As shown in Fig 5.2 appliances are being controlled from blynk app.

5.3 Controlling from Huom App

This is the final phase of implementation. We have developed our android based application huom. After developing huom application we went for final testing. The control process is the same as previous. When a button is pressed in the app, it will send the instruction related to that particular button to NodeMCU through internet. The NodeMCU than gives output as instructed. As the output of the NodeMCU is the input of the arduino mega, so the arduino will execute its algorithm based on input. Like if active mode on button is pressed in huom app than NodeMCU will make the pin high which is assigned for active mode on. Next, arduino mega will get the input as high which is assigned for active mode. Than it will perform the active mode. As a result all the appliances will turn on.

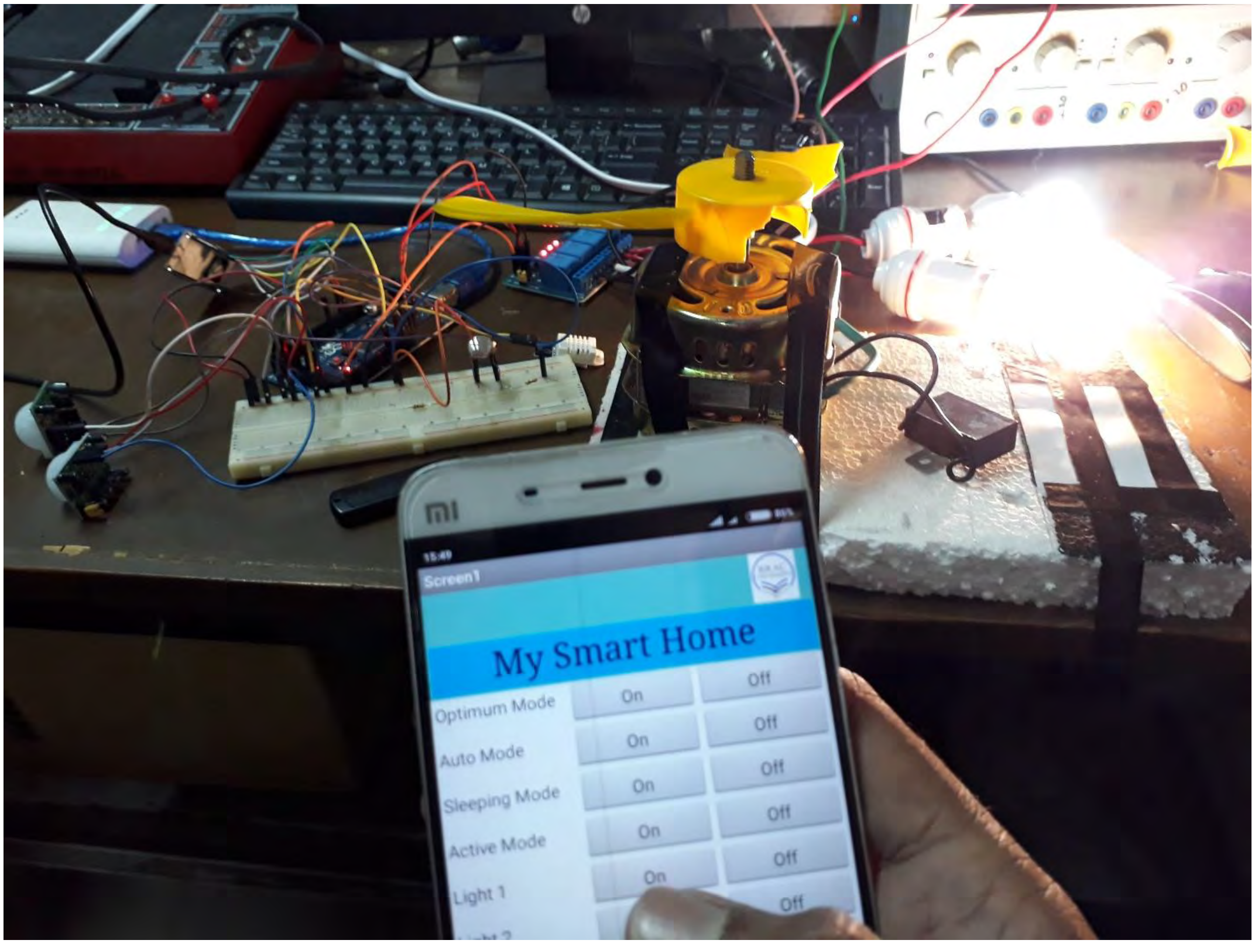


Fig 5.3: Controlling from huom app

As shown in Fig 5.3 modes are being controlled by smart phone with huom app. This is how modes are being checked weather they work properly. This system worked with a high accuracy rate.

5.4 Approximate Energy Saving Calculation

Power usage actually depends on climate change, like in winter we use fan less and in summer we use fan more. As like as that nights are broader in winter and days are broader in summer. According to the intensity of sunlight we use lights in our home.

5.5 Optimum Mode Approximate Energy Saving Calculation

According to world data information [12] November, December and January average sunshine is 10 hour that means within 5.30-6.00PM we need to power our lights. During the time 6PM to 11Pm is used as peck hours.

Hour= (11-6) =5 hour

Energy usage in peck hours = (kilo watt X hour)/1000

= (40 X 5)

=0.2KW/Hour

proposed Optimum mood can save 2.5 min per hour so

hour (O) = 5-(5*0.041) =4.795 hour

Energy usage (O) in peck hour = (kilo watt X hour)/1000

= (40 X 4.795)/1000

=0.19 KW/Hour

So power saves (O) = (0.2-0.19) = 0.01KW/Hour

monthly power consumption savings = 30X0.01 = 0.3KW/Hour

% of energy consumption savings (O) = .3/6*100=5%

Energy usage in off-peck hour = (kilo watt X hour)/1000

= (40 X 19)/1000

=0.76 KW/Hour

proposed Optimum mood can save 10 min per hour so

hour (O) = 19-(19*0.166) =15.846 hour

Energy usage in off-peck hour = (kilo watt X hour)/1000

= (40 X 15.846)/1000

=0.63 KW/Hour

So power saves (O) = (0.76-0.63) = 0.13KW/Hour

monthly energy consumption savings = 30X0.13 = 3.9KW/Hour

% of energy consumption savings (O) = 3.9/14.44*100=27%

Total saving could vary from 5% to 27%.

5.6 Auto Mode Approximate Energy Saving Calculation

Proposed Auto mood can save 5 min per hour so

hour (A) = 24-2 =22hour

Energy usage in peck hour = (kilo watt X hour)/1000

= (40 X 24)/1000

=0.96 KW/Hour

Energy usage (A) in peck hour = (kilo watt X hour)/1000

= (40 X 22)/1000

=0.88 KW/Hour

So power savings (A) = (0.96-0.88) = 0.08KW/Hour

monthly consumption savings = 30X0.080 = 2.4KW/Hour

% of energy consumption savings (A) = 2.4/28.8*100=9%

5.7Advantages

There are a plenty of advantages in our proposed system. The advantages of our project are discussed below:

- Intelligent home automation system
- Home appliances can be controlled in just one click
- Android based application to control appliances
- Easy user interface of the android application
- Multiple modes to control and run appliances when necessary
- Optimum mode for saving consumption of power and also let the appliances to run on its own intelligence.
- Auto mode to let the appliances run on its own intelligence where users need not to worry about the appliances and also gives comfort

- Sleeping mode for night time where users can sleep without tensing about temperature controlling
- Individual appliances can be controlled from the app
- Home appliances can be controlled from any remote places
- This system turns a home into a smart home

5.8 Limitations

Besides all the advantages there are also some limitations in our projects which we look forward to overcome in our future works. The limitations of this system are discussed below:

- Wireless connection was designed based on dynamic IP addresses which changes every time after switching to a different network
- Home controlling devices must be connected to internet with a good bandwidth otherwise controlling could be disrupted
- If no internet is available in the client side or in the home devices controller side than this system cannot be controlled but it will keep executing the last command that was received by the controller
- User have to give IP addresses of the controller every time it connects with a new network

CHAPTER 06

CONCLUTION

6.1 Concluding

In our proposed model a high percentage of accuracy has been achieved though implementation. This system is capable controlling the home appliances based on user's desired mode. All the modes works with a good accuracy which was found during implementation. Users only need to select modes from their smart phones and our system will do the rest of controlling the appliances. This proposed project is highly reliable. So it can be said that this system has higher accuracy with great efficiency.

6.2 Future Modification

This system has huge opportunities to upgrade in future. As mentioned earlier this is the first generation of home automation. It could be upgraded to second generation by storing and analyzing data on the cloud servers. Than using machine learning algorithms, we do not even have to choose modes from smart phones. Rather it might be able to switch modes with its own artificial intelligent.

REFERENCES

[1] Nordrum, A. (2016, August 18). Popular Internet of Things Forecast of 50 Billion Devices by 2020 Is Outdated. Retrieved April 14, 2018, from https://spectrum.ieee.org/tech-talk/telecom/internet/popular-internet-of-things-forecast-of-50-billion-devices-by-2020-is-outdated

[2] Li, R. Y., Li, H. C., Mak, C. K., & Tang, T. B. (2016). Sustainable Smart Home and Home Automation: Big Data Analytics Approach. *International Journal of Smart Home,10*(8), 177-198. doi:10.14257/ijsh.2016.10.8.18

[3] Reddy, P. S., Reddy, K. T., Reddy, P. A., Ramaiah, G. N., & Kishor, S. N. (2016). An IoT based home automation using android application. *2016 International Conference on Signal Processing, Communication, Power and Embedded System (SCOPES)*. doi:10.1109/scopes.2016.7955836

[4] Rahman, M. S., Masud, S., Sultana, S., & Bari, M. R. (2017). Web based electric home appliance controller and monitoring system. *2017 IEEE 8th Annual Ubiquitous Computing, Electronics and Mobile Communication Conference (UEMCON)*. doi:10.1109/uemcon.2017.8248983

[5] Park, H., Jung, E., Lee, W., Lee, H., & Lee, Y. (2017). Network assistance platform for saving power consumption of IoT devices and set-top boxes. *2017 IEEE International Conference on Consumer Electronics (ICCE)*. doi:10.1109/icce.2017.7889335

[6] NODEMCU ESP8266 CP2102 WIFI MODULE IOT. (n.d.). Retrieved April 14, 2018, from http://www.ifuturetech.org/product/amica-nodemcu-esp8266-lua-cp2102-wifi-development-module-iot-ifuture-baroda-vadodara-gujarat-india/

[7] Can we use this circuit to prevent going flyback to supply line? (n.d.). Retrieved April 14, 2018, from https://forum.allaboutcircuits.com/threads/can-we-use-this-circuit-to-prevent-going-flyback-to-supply-line.126791/

[8] LDR(Small). (n.d.). Retrieved April 14, 2018, from https://www.cytron.io/p-sn-ldr-s

[9] PIR Motion Sensor. (n.d.). Retrieved April 14, 2018, from https://learn.adafruit.com/pir-passive-infrared-proximity-motion-sensor?view=all

[10]DHT22 AM2302. (n.d.). Retrieved April 14, 2018, from http://www.robotop.lv/en/temperaturnye-humidyty-pressure/467-dht22-am2302.html

[11] Parsons, S. (2010, March 18). Toshiba Kills Incandescent Bulb Production. Retrieved April 15, 2018, from https://inhabitat.com/toshiba-kills-incandescent-bulb-production/

[12] "Climate in Bangladesh." Worlddata.info, Retrieved April 15, 2018, fromwww.worlddata.info/asia/bangladesh/climate.php

[13] Mandula, K., Parupalli, R., Murty, C., Magesh, E., & Lunagariya, R. (2015). Mobile based home automation using Internet of Things(IoT). *2015 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT)*. doi:10.1109/iccicct.2015.7475301

[14] Nair, K., Kulkarni, J., Warde, M., Dave, Z., Rawalgaonkar, V., Gore, G., & Joshi, J. (2015). Optimizing power consumption in iot based wireless sensor networks using Bluetooth Low Energy. *2015 International Conference on Green Computing and Internet of Things (ICGCIoT)*. doi:10.1109/icgciot.2015.7380533

[15] Thomas, D., Mcpherson, R., Paul, G., & Irvine, J. (2016). Optimizing Power Consumption of Wi-Fi for IoT Devices: An MSP430 processor and an ESP-03 chip provide a power-efficient solution. *IEEE Consumer Electronics Magazine,5*(4), 92-100. doi:10.1109/mce.2016.2590148

[16] Gray, C., Ayre, R., Hinton, K., & Tucker, R. S. (2015). Power consumption of IoT access network technologies. *2015 IEEE International Conference on Communication Workshop (ICCW)*. doi:10.1109/iccw.2015.7247606

[17] Saahithyan, R., Mishra, S. K., & Das, D. (2016). Efficient algorithm for less power consumption in Extended-Coverage-GSM for low Data-Rate IoT devices. *2016 IEEE Annual India Conference (INDICON)*. doi:10.1109/indicon.2016.7839096

[18] Pang, Z., Cheng, Y., Johansson, M. E., & Bag, G. (2014). Preliminary Study on Wireless Home Automation Systems with Both Cloud-Based Mode and Stand-Alone Mode. *2014 IEEE*

17th International Conference on Computational Science and Engineering. doi:10.1109/cse.2014.194

[19] Kepuska, V., & Bohouta, G. (2018). Next-generation of virtual personal assistants (Microsoft Cortana, Apple Siri, Amazon Alexa and Google Home). *2018 IEEE 8th Annual Computing and Communication Workshop and Conference (CCWC)*. doi:10.1109/ccwc.2018.8301638

[20] Fezai, F., Menudier, C., Thevenot, M., Vollaire, C., Chevalier, N., & Monediere, T. (2016). Reducing Electronic Device Standby Power Using a Remote Wake-Up System [Antenna Applications Corner]. *IEEE Antennas and Propagation Magazine,58*(5), 66-73. doi:10.1109/map.2016.2593974