THREE LAYER FAILSAFE HOME AUTOMATION SYSTEM USING IoT

A DISSERTATION

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE AWARD OF THE DEGREE
OF

MASTER OF TECHNOLOGY
IN
CONTROL & INSTRUMENTATION

Submitted By

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CERTIFICATE

This is to certify that Major Project-II report/dissertation entitled **THREE LAYER FAILSAFE HOME AUTOMATION SYSTEM USING IoT** is a bona fide record of the work carried out by **Mr. Prashant Kumar**, bearing Roll No. **2K13/C&I/10**, submitted to Electrical Engineering Department of Delhi Technological University under my supervision and guidance in partial fulfillment of the requirements for the award of the degree of **Master of Technology** in "**Control & Instrumentation**".

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DECLARATION

I, hereby declare that the work which is being presented in this dissertation entitled **Three Layer Failsafe Home Automation System Using Iot** is my own work carried out under the guidance of **Ms. GARIMA**, Assistant Professor, Electrical Engineering Department, Delhi Technological University.

I further declare that the matter embodied in this dissertation has not been submitted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text.

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ABSTRACT

With the development of cutting edge technologies, 21st century homes are going to be fully automated. As we have seen in our near past communication media have involved and it has achieved a maturity. This inculcates various fields on single board with fail out system and develops all new living experience. In this research work we will hash out topic deeper and discuss on recent trends in Home automation. The recent development of open source platform provided greater strength to the application based automation. This automation not limited to home but it is giving exemplary support to other industries also. Home automation system getting broader day-by-day with addition on new features like switching, monitoring, controlling, surveillance etc. In this thesis we will discuss different mode of communication media like wi-fi, Bluetooth, zigbee, gsm system etc. along with feature of said technology will develop working model of triple layer fail out home automation hardware. We also found the merits and demerits over existing technologies.

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CHAPTER 1

INTRODUCTION

In this 21st century Homes will be smarter and intelligent. Simple equipment like a timer to turn on one's tea maker in the morning have been around for years, but much more worldly-wise mechanisms will soon be avert in homes around the world. Suppose you are entering into your home and you receive welcome messages by sound and glowing lights without touching any switch, sit comfortably and enjoy music, this gives you peace of mind. IoT based home automation create all new living experience [1].

Home automation system has become popular in few decades and it increases the luxury and quality of life. In this thesis a sketch of current and upcoming home automation systems is discussed. In recent developments most of HAS are controlled by cloud computing and smart devices. An application based control and monitoring of the households using different types of communication techniques. In this thesis we are working on different technologies such as IR, Bluetooth, WiFi, GSM, etc [2]. Here we will discuss detailed features and compare with all existing home automation systems. In this way we can choose best suited technologies for our environment.

Home automation system (HAS) is developing rapidly. All new advanced HAS are designed is such a way to provide over all upgraded living experience in your daily life. Nowadays, commonly home automation systems are used to provide ease to old and differently able people and they reduce the human effort in the production of services and goods.

Development of home automation generally involve only one microcontroller which has potential to monitor and control various connected home appliances,

such as switches and sensors (humidity, gas , smoke, and fire detectors) along with all security devices. One of the greatest advantages of HAS is that it is able to control and manage easily from an number of devices like smart phone, tablet, laptop and desktop [3].

With the development of smart wireless technologies we have seen drastic change in our life style, our phones have become smarter day by day and they are more capable and advanced now. These devices are not only used for voice call but they can be used in controlling and monitoring different appliances.

This thesis explains the development and working principles of some live HAS techniques and it compares their reliability, speed, real time functionality and other features. There are various home automation available in market with different technical approach, we can choose any one as per our need and budget.

1.1 Intelligent Home

Home Automation and Security System based on ARDUINO implies that whenever a person will enter the house then the count of number of the persons will get incremented, bulb will start glowing and alarm will start ringing. Availability of the human being in any room can be counted and displayed on LCD screen. Whenever the room gets empty i.e. the count of the person reduces to zero then the bulb will automatically stop glowing making the system power efficient.

Security of houses based on Home Automation provide very safe and secure environment by detecting threat to system. Once the problem is detected GSM based network is activated and SMS will be sent to house owner mobile phone indicating security alert. Moreover application based switching of appliances and security system can be enabled just by touching your phone from any location. The list of various home appliances along with TURN ON and TURNOFF buttons will be provided in an android application.

1.2 Intelligent Switching

The Passive Infra-Red (PIR) sensors permits one to sense motion, virtually always it used to detect whether a living object has moved in or out of the sensor range. The Infrared principal based sensor can detect heat emission in room and it may check availability of humans by monitoring changes in the IR level emitted by different objects.

When signal of Motion sensor is high then input signal is also high this means someone is present in room. They are tiny, cheap, low power, easy to install and durable. For that reason they are commonly found in instruments and devices used in homes. When a warm object like a animal or human passes by, it first obstruct one half of the PIR sensor, which detect the change between the two halves of LDR sensor. A LDR is a light-controlled variable resistor. The resistance of a photo-resistor is inversely proportional to incident light intensity.

Home Automation system is getting more mature to full fill the demand of luxury and security. By deploying various sensors and actuators in area under operation this sensors and actuators works as team which is synchronized by micro controller. Sensors received data from ambience (temperature, pressure, humidity, oxygen lave etc.) in analog form and this analog data is converted in digital via ADC (analog to digital converter) so that communication can be stabilized between two different zones. By meeting out above requirements, we can develop a stable hardware to help our elderly and disabled persons. In this hardware development we have focused on real time switching of appliances and actuator so that we can achieve accurate and reliable On and OFF control. Our hardware facilitates different layers of security and switching on single board. We have classified all three layer by labeling different name first IR zone , Bluetooth zone and IoT zone. All three zones are interlinked but the operation of all three are priority based, operation of each and individual zone subjected to availability of personals in zone. IR zone is set as

default because it is kept localized ON-OFF method, this is a directional remote based switching. Zone two comprises Bluetooth control of home appliances, in this mode of controlling we have to make full pairing of system to Home Automation which is subjected to password confirmation to ensure system security. Third and final layer of control is cloud based control which can be implemented using various cloud based services or GSM based communication services. In this research work various mode of communication for all three layers will be discussed and best technology is found for each layer by keeping in mind their stability, availability and cost effectiveness.

CHAPTER 2

LITERATURE SURVEY

2.1 Home Automation In Past

Home automation in recent past was mechanical timer based HAS which was uneconomical and was less efficient. This type of system incorporate mechanical dial for timing and bimetallic sensors. This type of system completely open loop control system there is no feedback process to match reference input. The major evolution of HAS are given in table2.1 below.

Table 2.1 Evolution Of HAS In Different Era[4]

S. No.	Year	Innovation	Technology
1	1950	Television	Broadcast and later IR remote
2	1970	X10	Point to control
3	1966-67	ECHO VI and Kitchen computer	Temperature on- off system
4	1990	Personal Computer	Large scale integration
5	2000	Home Automation	Integration of 3 layer on local tech home system
6	2005	Zen-Sys(Developer)	Combination of short range technology

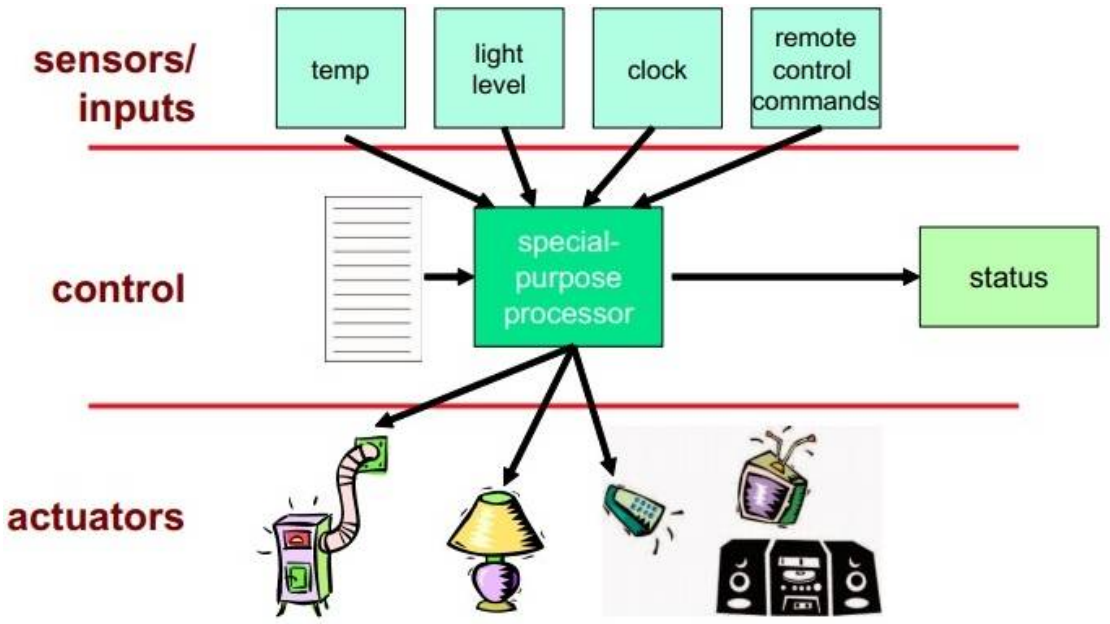


Fig. 2.1 Labeled Diagram Of 3 Layer HAS [4]

2.2 Communication Media

2.2.1 Bluetooth

Home automation systems based on Bluetooth use smart phone. Bluetooth technology and ARDUINO board are safe and cheap. A BT based home automation system is proposed by R.Piyare and M.Tazil [5]. The construction and hardware of this system contains the ARDUINO BT board and a smart phone. Bridging of both system can be done wirelessly using Bluetooth whose operating details are as given in table2.2.

Table 2.2 Generation Of Bluetooth With Frequency And Power

S. No.	LMP (Link Manager protocol)	Bluetooth version	Operating frequency	Power consumption (mW)
1	0	Bluetooth 1.0b	2.4-2.5 GHz	25-100
2	1	Bluetooth 1.1		
3	2	Bluetooth 1.2		
4	3	Bluetooth 2.0+ERD		
5	4	Bluetooth 2.1+ERD		
6	5	Bluetooth 3.0+HS		
7	6	Bluetooth 4.0		
8	7	Bluetooth 4.1		
9	8	Bluetooth 4.2		
10	9	Bluetooth 5		

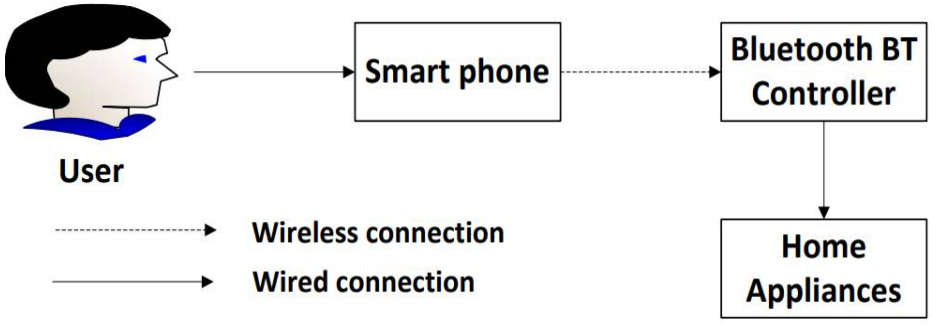


Fig. 2.2 System For Proposed Smart Living System [2]

2.2.2 Voice Recognition Based Home Automation

Voice recognition based HAS has started with most primary element that is MIC, to record voice and convert it in digital data and this is again converted in to useful information by different pattern recognition techniques. Nowadays some leading operating system development companies like Google, Microsoft, apple, Samsung etc. providing inbuilt feature of voice recognition software. This can bridge the gap of hardware and software synchronizing problem. [6]

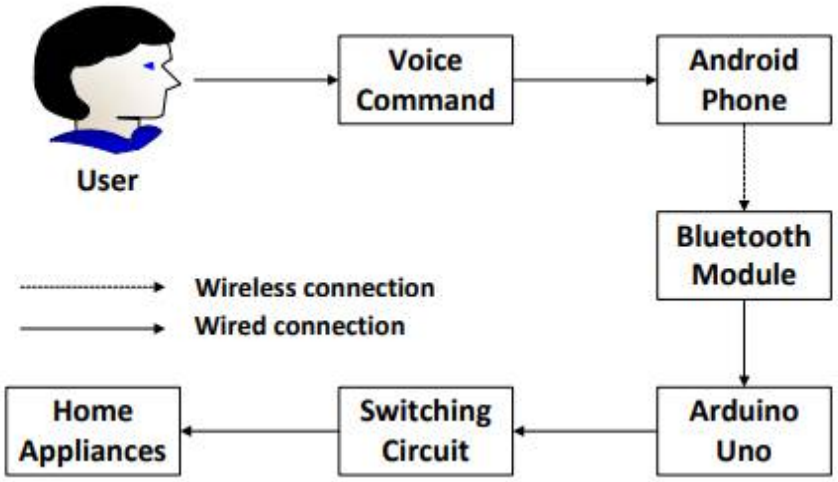


Fig.2.3 Schematic Diagram Of Voice Command [2]

2.2.3 Wi-Fi

Wi-Fi is most common wireless facility in current environment. In very recent past government of India as taken major steps under digital India initiative . Due to this initiative and market competitiveness India has become leader in lowest data pricing . This cheap data pricing makes Wi-Fi most

compatible for HAS due to high operating frequency it can transfer high amount of data in less time. All such features increases its competitiveness.

2.2.4 ZigBee

ZigBee based wireless HAS is also been studied. In this arrangement we use different equipment like main module, microphone, central processing unit and actuator . Microphone receives analog input through diaphragm movement this analog data fed to ADC then ZigBee. Sampling is most important process in this conversion. The operating frequency ranges between 6 Hz to 3.5KHz [7].

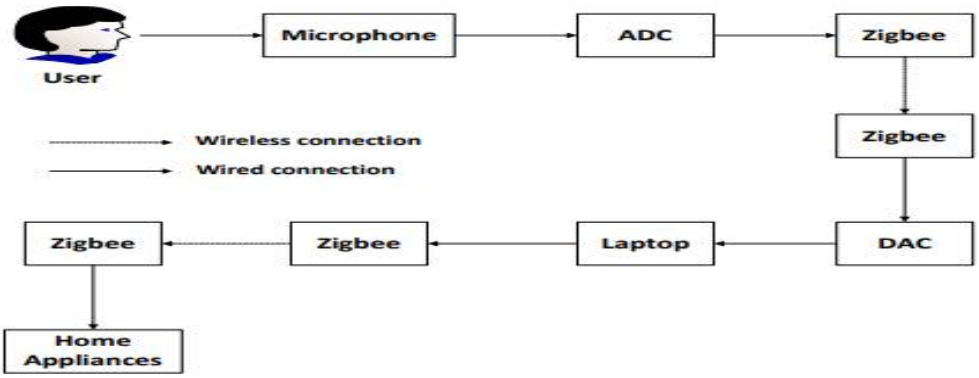


Fig2.4. Zigbee Based HAS[2]

2.2.5 GPRS

General Packet Radio Service (GPRS) is a technology based on packet switching that helps data transfer on cellular networks. It can be used in connectivity of the physical devices over the internet and can actually help in the implementation of concept of Internet of Things (IoT). It can be implemented by use of simple module i.e. SIM-900.

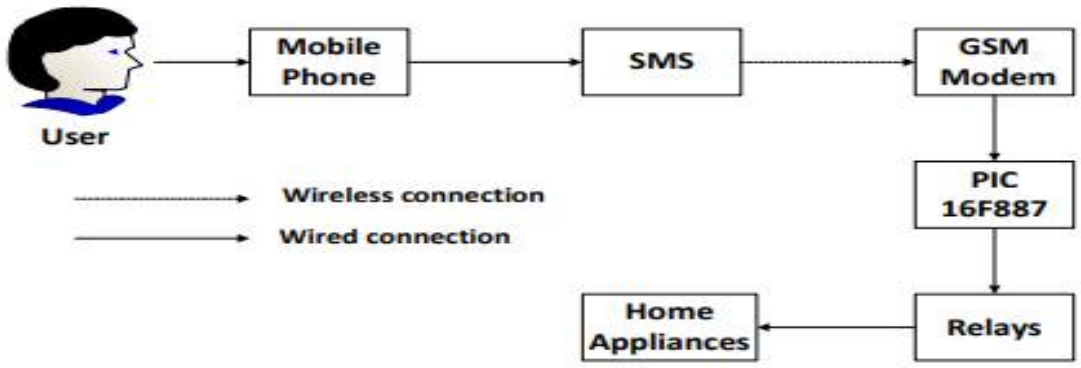


Fig 2.5 GSM/GPRS Based HAS [2]

Similarly in, another GSM based HAS created with the help of GSM SIM 900 pre fabricated module, microcontroller LPC2148, LCD and a smart phone app for the user interactive feature. This system facilitates the users to monitor home appliances by sending a message from android application to GSM SIM 900 module. however, this automation system displays the important notification on the screen and it can monitored and controlled anywhere in the world where mobile network is available [2].

2.2.6 Concept of Internet of Things (IoT)

It is an interconnected communication network of physical devices, buildings, vehicles, and other objects such as embedded with electronic devices, sensors, software, and a network that can enable these physical objects to amass and exchange data. The integration of these things with the Internet means that devices have to be assigned an IP address to be used as a unique identifier.

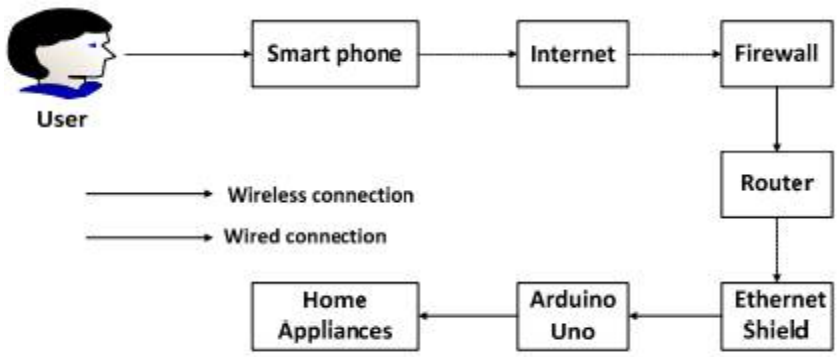


Fig.2.6 IoT Based HAS[2]

2.2.7 Enocean Based Home Automation System

The EnOcean is emerging energy harvesting technology used in transportation, building and HAS[2][8]. EnOcean's technology produces energy by different means with the help of very advanced sensors physical parameters get converted in to electricity and it ultra low power consumption devices. Productivity and logistics are major area where it is being widely used. Some other useful technologies are as listed in table2.3.

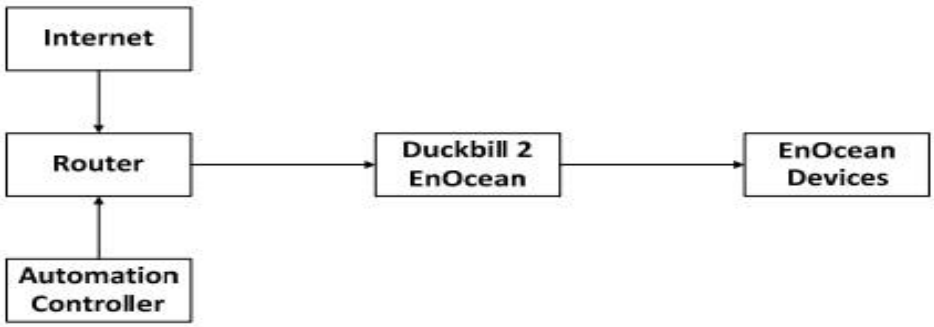


Fig.2.7 EnOcean Based HAS[2]

Table 2.3 Evolution of Communication Technology for HAS

S. NO.	WIRELESS TECH.	RANGE	MAX. NODES	POWER IN (MW)	DATA RATE	NETWORK TOPOLOGIES	FREQUENCY	SECURITY
1.	BLUETOOTH	1-100M	1M+7S	25-100	1-3MBPS	P2PSTAR	2.4-2.5 GHZ	56-128 BIT KEY
2.	WIFI	150-200M	255	1000	54MBPS	P2P,STAR	2.4-2.5 GHZ	WEEP,WPA,WPA2
3.	ZIGBEE	10-100M	65,533	50	250KBPS	P2P,STAR,TREE AND MESS	2.4-2.5 GHZ	128 BIT AES
4.	ENOCEAN	30-300M	_	~0.05 WIDTH ENERGY HARVESTING	125KBPS	P2P,STAR,TREE AND MESS	868,902,928 MHZ	128 BIT AES
5.	Z WAVE	100M	232	100	9.6-100KBPS	MESH	860-960 MHZ	128 BIT AES
6.	RFID	0-3M	1ATA LIMO	200	640KBPS	P2P PASSIVE	13.56,860-960 MHZ	N/A
7.	BLE	1-100M	1M+7S	10	1MBPS	P2P,STAR	2.4-2.5 GHZ	128 BIT AES
8.	HOME PLUG GP	~100M	_	500	4-10MBPS	P2P,STAR,TREE AND MESS	1.8-30 MHZ	128 BIT AES
9.	DASH7	260M-2KM	_	<1	167KBPS	P2P,STAR,TREE AND MESS	315-915 MHZ	128 BIT AES
10.	INSTEON	40-50M	64000 NODES PER NETWORK	_	38KBPS RF-2-13KBPS	P2P,STAR,TREE AND MESS	RF:869.85,915,92 MHZP.L:131.65 MHZ	256 BIT AES

11.	SIGFOX	10-50KM	_	0.11-100	10-1000BPS	P2P,STAR	868/902 MHZ	NO DEFAUT ENCYPTION
12.	NFC	5CM	1 AT A TIME	15	424KBPS	P2P	13.56 MHZ	AES
13.	WIRELESS HART™	50-100M	_	10	_	P2P,STAR,TREE AND MESS	2.5 GHZ	1250 BIT AES
14.	GLOWPAN	25-50M	_	2.23	250KBPS	P2P,STAR,TREE AND MESS	2.5 GHZ	128 BIT KEY
15.	ANT	30M	65,523 IN ONE CHANNEL	0.01-1	20-60KBPS	P2P,STAR,TREE AND MESS	2.4-2.5 GHZ	64-BIT KEY

Advanced Encryption Standard

CHAPTER 3

DEVELOPMENT OF HOME AUTOMATION

Since we have started developing home automation system and its peripheral like driver circuit, microcontroller, IoT enables services available in market. Availability of parts and its component plays very vital role for any emerging technology. Here we have to look at the best possible solutions.

3.1 Microcontroller

It is a small computer (SoC) on a single platform preferably integrated circuit(IC) having a processor, memory, input and output peripherals. The microcontrollers are used mostly in embedded technologies, such as automobiles, telephones, and peripherals for computers. There are several microcontroller architectures and vendors including Intel, Atmel, Freescale, Motorolla etc. By careful analysis and considering all the requirements, Atmel's Atmega-32, which is low power 8bit CMOS based microcontroller is best suited for the work.

3.2 Atmega-328

The Atmel's AVR ATmega-32 is a low-power CMOS based 8-bit microcontroller. It is based on AVR enhanced Reduced Instruction Set Computing (RISC) architecture. It has the following features:

(1) It is low power, high performance and 8 bit microcontroller.

(2) It has advanced RISC architecture which contains 32 x 8 registers for general purpose.

(3) It has 32Kbytes self-programmable flash programmable memory, 1024Bytes of EEPROM and 2Kbytes of internal SRAM.

(4) It has two 8-bit Timer/Counter and one 16-bit Timer/Counter.

(5) It has four PWM channels and 8-channel 10-bit ADC.

(6) It has programmable serial USART and on chip analog comparator.

(7) It has some special features like internally calibrated RC oscillator and power-on Reset.

(8) It has facility of internal as well as external interrupts.

(9) It has 32 Programmable input/output (I/O) lines.

The above features make it a very powerful microcontroller and all these will supplement the work with a very high end performance. It is commonly available in the market in form of 40 pin dual-in line (DIP) package and is supported by full suite of program and tools for system development by the manufacturer.

3.2.1. ARDUINO

It is an open-source prototyping platform which is based on flexible, easy-to use software and hardware. The circuit board has a microprocessor and input/output (I/O) pins for communication purpose and controlling the physical objects like LED, servos, buttons, etc. The board is powered by USB or an external power supply which allows it to provide power to other hardware and sensors.

It also has an open-source software section which is similar to C++ language. The integrated development environment (IDE) of ARDUINO allows to code writing, compilation, and then uploading to ARDUINO for stand-alone use in projects. It comprises two major components: the ARDUINO board, which is a hardware used to build objects; and the ARDUINO IDE, the software which is run on computer.

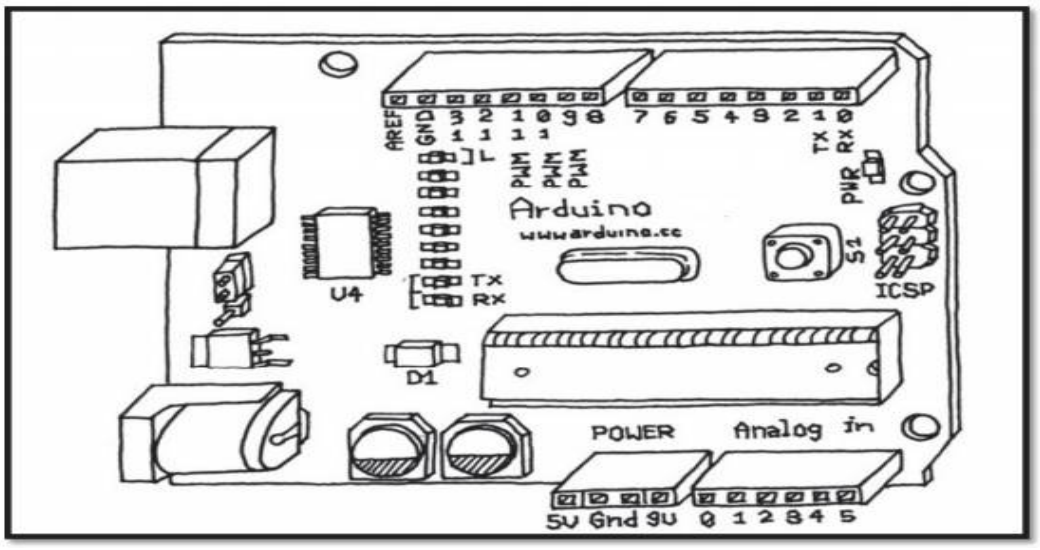


Fig. 3.1 Freehand sketch of ARDUINO

The hardware is easily accessible in the market whereas the relevant software can be downloaded from the official website of ARDUINO.

3.3 IR Based Conventional HAS:

. This is a initial development of inline remote. Remote consist of IR LED which emits light pulse and this light pulse is received by IR receiver, this process can easily be understood by the following diagram Fig. 3.2.

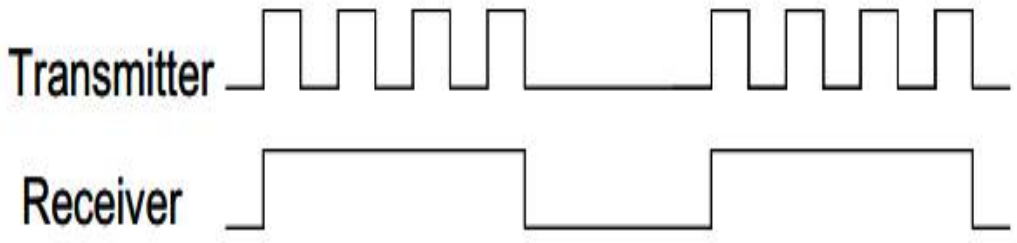


Fig.3.2 IR pulse train of Tx and Rx

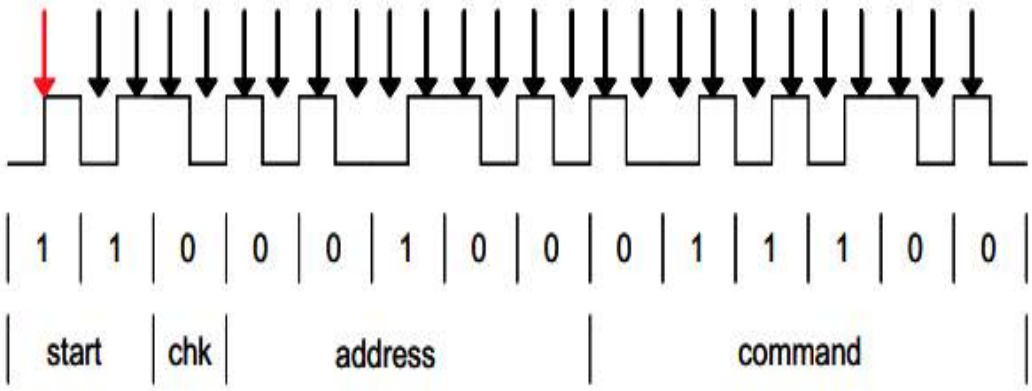


Fig .3.3 Binary coded pulse train

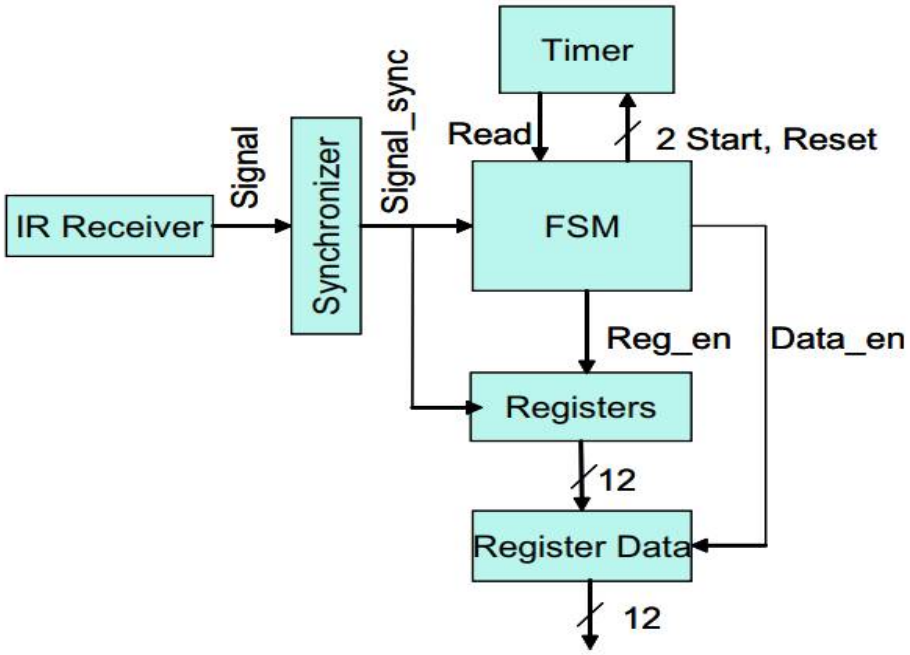


Fig .3.3.1 Flow chart of IR coding [MIT OCW]

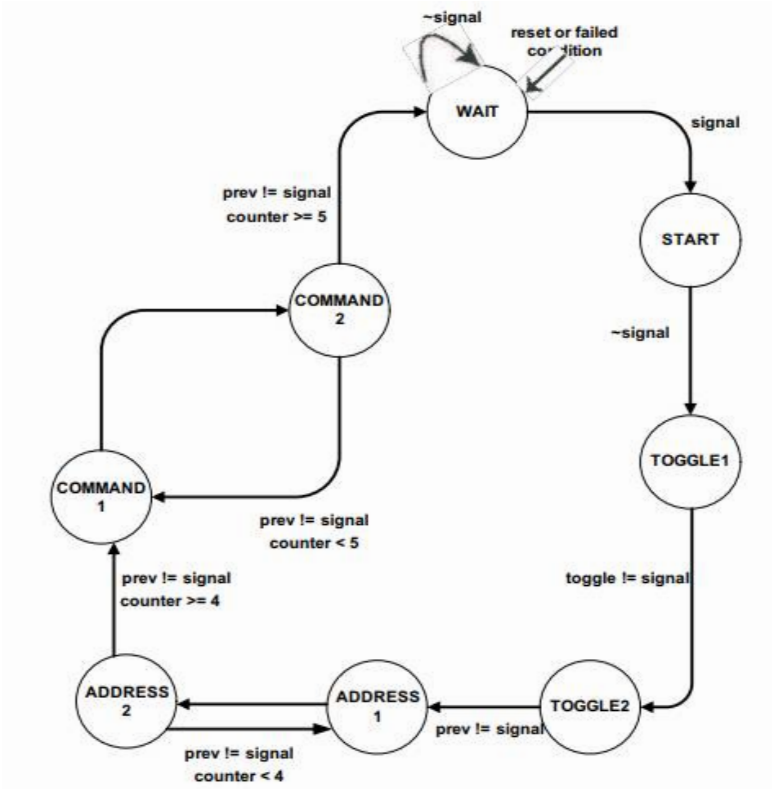


Fig3.4 Flow Chart Of IR Remote With Commands[MIT OCW]

3.4 Bluetooth To Serial Port Module

3.4.1 HC05

HC-05 module is an simple and convenient to use BT SPP (Serial Port Protocol) module, built for clear wireless serial connection setup. Serial port BT module is fully compatible Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband.

3.4.2 Hardware Features

a. Sensitivity -80dBm

b. Transmit power Up to +4dBm radio freq.

c. Low Power 1.8V Operation ,1.8 to 3.6V input/output λ PIO control

d. Programmable baud rate with UART interface

e. Antenna inbuilt

f. Edge connector

3.5 Gathering The Components Needed For The Projects

- Liquid Crystal Display
- HC-05 Bluetooth module
- Push button
- Reset indication light
- Potentiometer- used for brightness of LCD

- Relay 12V
- Crystal 16MHz
- ULN2003A
- Female Header
- ARDUINO UNO
- ATMega328P
- LM7805
- Resistors
- Jumping wires
- Android phone
- Light bulb, small fan (loads)
- Block connectors
- PCB
- IR receiver modules
- IR Remote

3.5.1 LM 7805

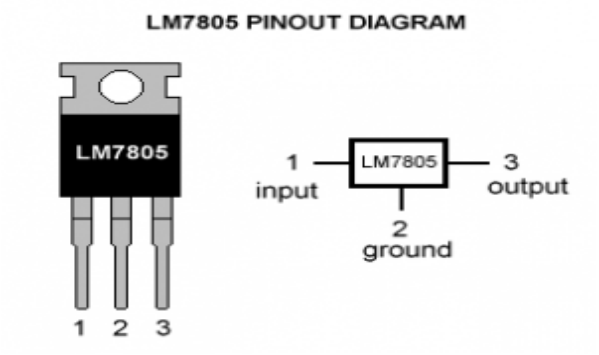


Fig. 3.5 pinout diagram of LM7805

Rating

- 7V- 35V i/o voltage range
- Operating Current rating Ic = 1A
- V Max=5.2V,V Min= 4.8V Output voltage range

3.5.2 Pin Details of 7805 IC

Table 3.1 Pin Description Of 7805 Ic

PIN NO	PIN	Function	DESCRIPTION
1	INPUT	Input voltage (7V-35V)	positive unregulated input voltage
2	GROUND	Ground (0V)	the ground is given. This pin is neutral for equally the input and output.
3	OUTPUT	Regulated output; 5V (4.8V-5.2V)	The output of the regulated 5V volt is taken out at this pin of the IC regulator.

The heat sink dissipate heat which produced by voltage difference at I/O terminal. The larger the difference between the output and input voltage, the larger heat is generated. If large amount of heat is developed, through large input voltage, the regulator can at reach at breakdown condition. If the regulator does

not fixed with heat sink to cooled down this excessive heat, it can be damage and malfunction. Hence, it is advised to maintain the voltage in a operating range maximum of 2-3 volts higher than the output voltage.

3.5.3 LCD (LIQUID CRYSTAL DISPLAY)

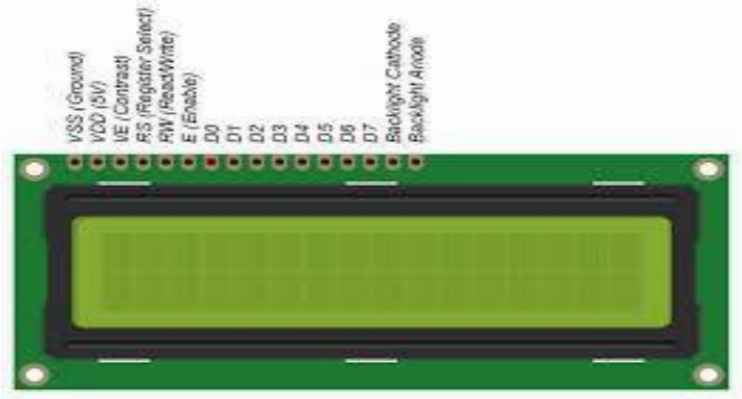


Fig.3.6 16x2 liquid crystal display

A compact -panel display is liquid-crystal display (LCD) fixed with optical device that uses the light-modulating characteristics of liquid crystals.

3.5.4 CRYSTAL OSCILLATOR 16 MHZ

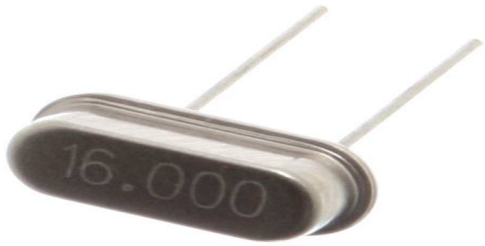


Fig. 3.7 16MHz oscillator

3.5.5 ULN 2003A IC

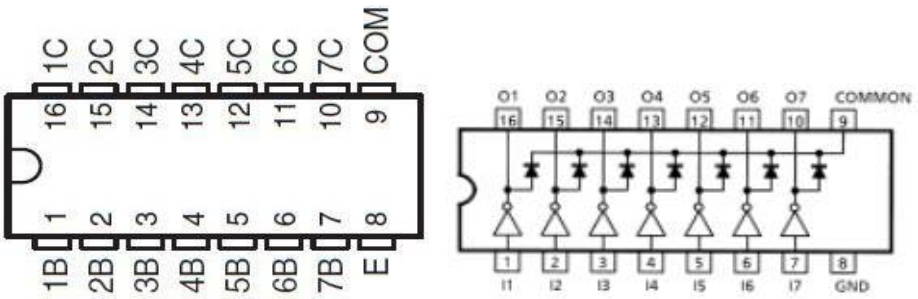


Fig. 3.8 ULN2003A NPN Darlington transistors

Table 3.2 Pin Function Of ULN2003A NPN Darlington Transistors

PIN		**IO(1)**	***DESCRIPTION***
NAME	***No.***		
1B	*1*	*I*	
2B	*2*		
3B	*3*		
4B	*4*		
5B	*5*		
6B	*6*		
7B	*7*		
1C	*16*	*0*	
2C	*15*		
3C	*14*		
4C	*13*		
5C	*12*		
6C	*11*		
7C	*10*		
COM	*9*		Common cathode node for flybackdiodes(required for inductive load)
E	***8***	**-**	Common emitter shared by all channels (typically tied to ground)

3.5.6 **PUSH BUTTON**

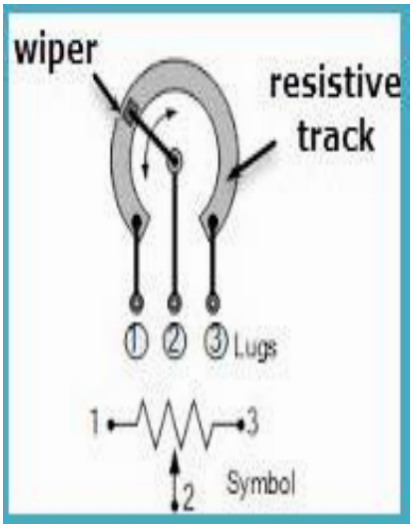
A push-button or simply button is a simple switch arrangement for controlling some feature of a machine or a process. Buttons are typically made out of hard insulating material, usually plastic. The surface is usually agronomic

to accommodate the human finger or hand, so as to be comfort depressed or pushed.

Fig. 3.9 push button

3.5.7 Potentiometer

A



B

Fig. 3.10 A. Actual image of Potentiometer B. schematic diagram of potentiometer

A potentiometer is a three-terminal variable resistor with a sliding or rotating contact that forms an adjustable voltage divider.

Type	Description	Applications
Single-turn pot	Single rotation of approximately 270 degrees or 3/4 of a full turn	Most common pot, used in applications where a single turn provides enough control resolution.
Multi-turn pot	Multiple rotations (mostly 5, 10 or 20), for increased precision. They are constructed either with a wiper that follows a spiral or helix form, or by using a worm-gear.	Used where high precision and resolution is required. The worm-gear multi turn pots are often used as trimpots on PCB.
Dual-gang pot	Two potentiometer combined on the same shaft, enabling the parallel setting of two channels. Most common are single turn potentiometers with equal resistance and taper. More than two gangs are possible but not very common.	Used in for example stereo audio volume control or other applications where 2 channels have to be adjusted in parallel.
Concentric pot	Dual potmeter, where the two potentiometers are individually adjusted by means of concentric shafts. Enables the use of two controls on one unit.	Often encountered in (older) car radios, where the volume and tone controls are combined.
Servo pot	A motorized potmeter which can also be automatically adjusted by a servo motor.	Used where manual and automatic adjustment is required. Often seen in audio equipment, where the remote-control can turn the volume control knob.

Table 3.3 Types of potentiometer

3.6 Hardware Implementation

This part explains the implementation of the complete arrangment, from ARDUINO-UNO board to the appliances. This system is developed using ARDUINO-UNO board, a HC-05 Bluetooth module, relays modules, an android device, an android app to control the ARDUINO board, and other electronics elements. Figure3.11 shows hardware implementation.

Fig.3.11 Bread board simulation of bluetooth based HAS

3.7 How it is different from existing setup

3.7.1 Flow Chart

Here I am giving the flow chart of existing setup in this arrengement.. When we start this system, program tries to find bluetooth device. If any bluetooth device is discovrable then it tries to connect with that as permission granted by consumer. If bluetooth is unavailable to the HAS it set to the IR sensor. This is a default setting of microcolntroller, so devices can be easily controlled by any general purpose remote control. This provides flexibilty of Dual control of home automation.

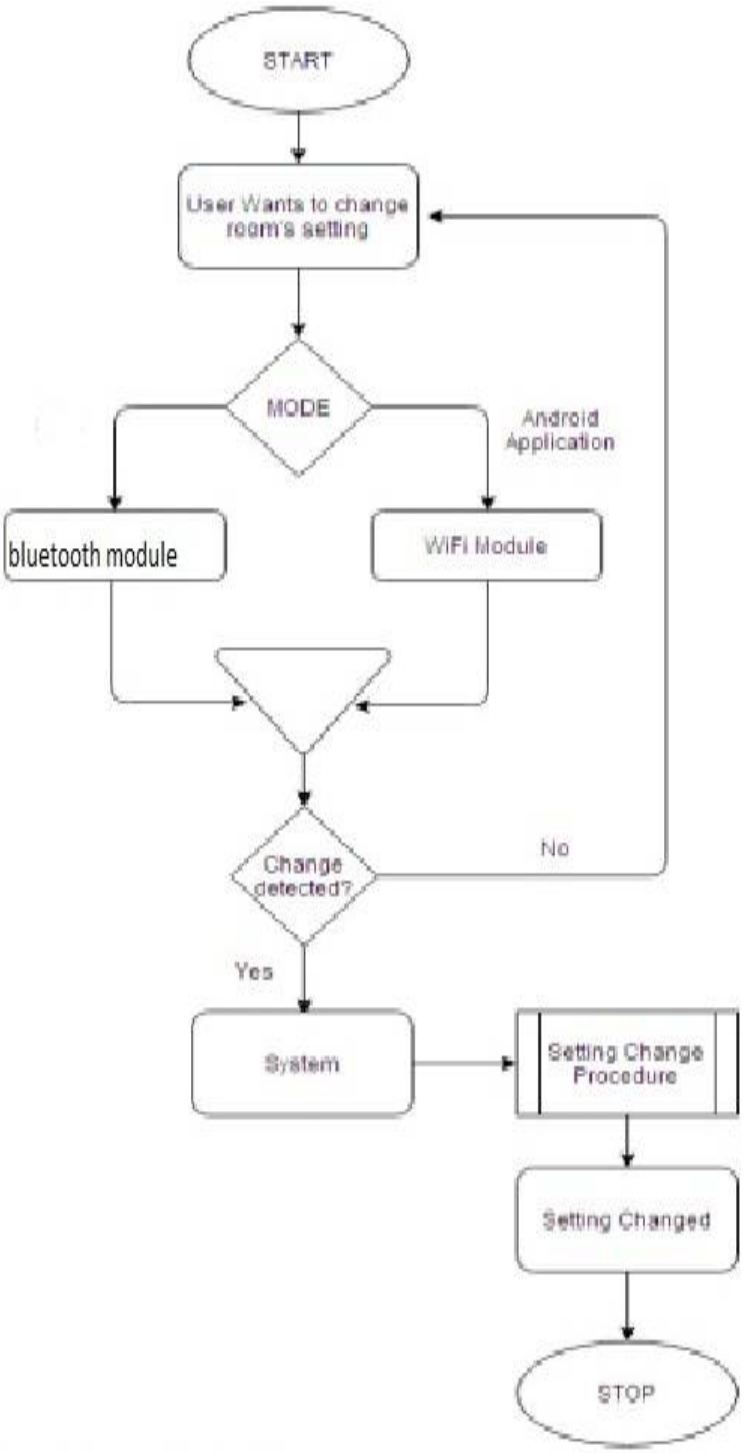


Fig.3.12 Flow chart of dual control of HAS

3.7.2 Developed hardware.

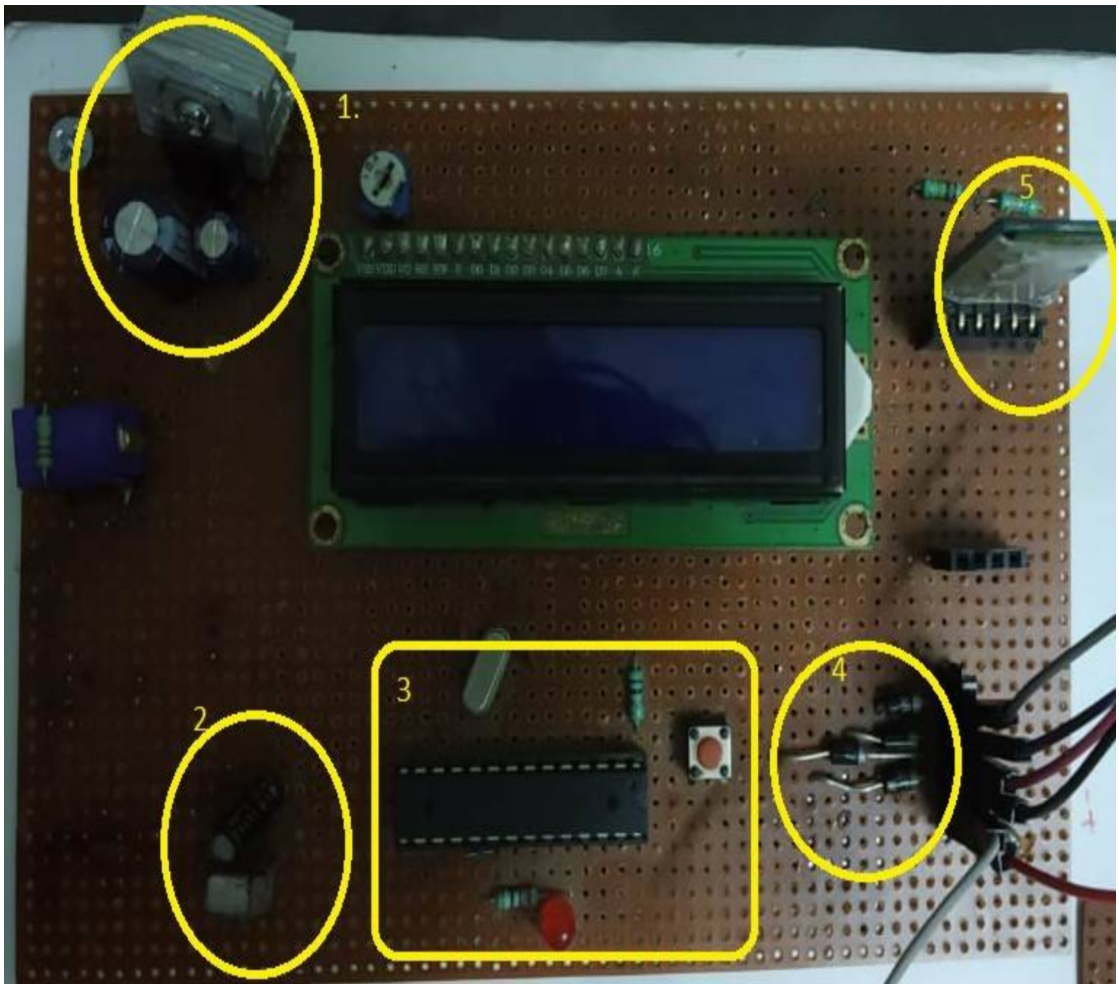


Fig.3.13 Actual circuit of Dual Mode of HAS

1. 5Volt regulated power supply
2. IR sensor
3. Control circuit of AT328p
4. Protection scheme with general purpose diodes
5. Bluetooth Module

3.8 Result and discussion of IR and Bluetooth HAS

When we connect supply to the HAS following massages received and display on lcd screen. Status of HAS can be examined by looking on it. It also shows the relay operating condition whether relay is on or off.

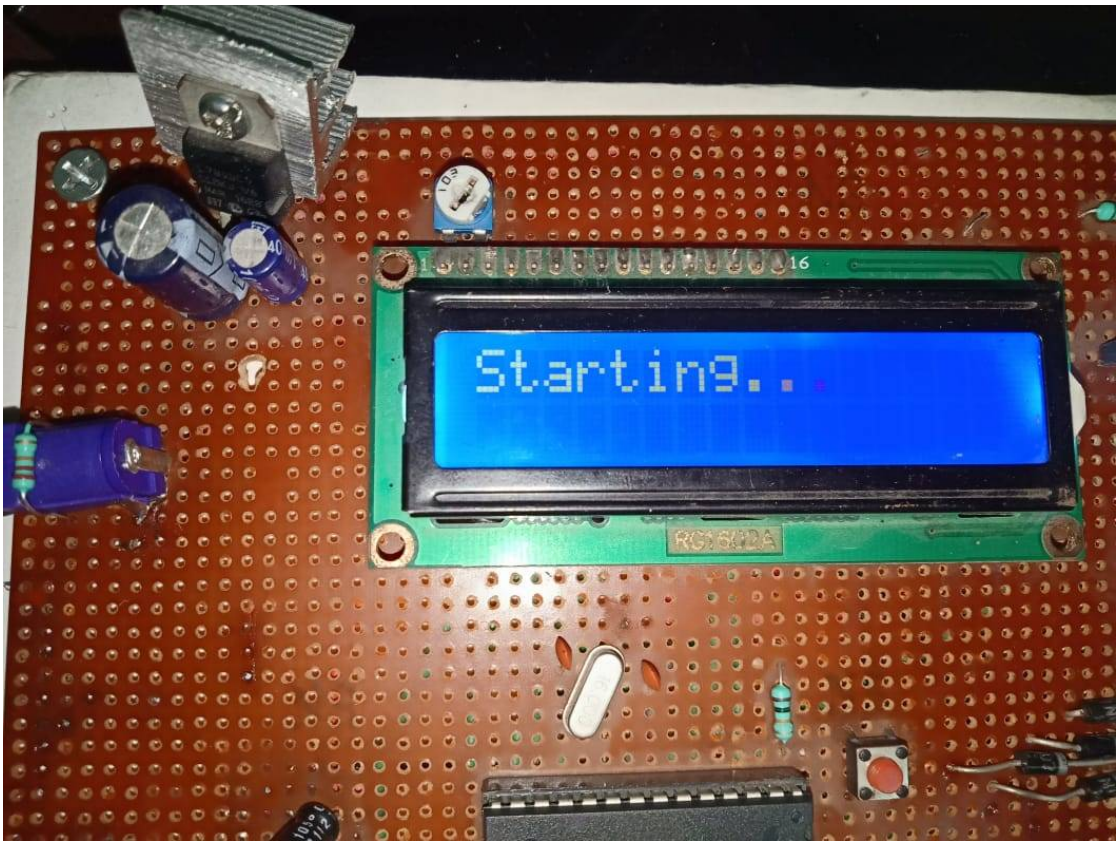


Fig. 3.14 starting condition of HAS

Fig.3.15 Status of Bluetooth device connected

3.8.1 How IoT based HAS is Better

In 20th century we have faced many technology developments. This evolution is not limited to mobile, television, laptop and its peripherals but also include development in various technologies in HAS. This is a very fast growing sector. Home automation is acquiring market due to nuclear family growth, in few years it will become billion dollar industry.

IoT based system gives flexibility of operation and monitoring of various parameters . Monitoring different parameters at different levels gives us precise and optimization ability in different fields.

3.9 ESP8211EX IoT enable chip

Espressif Systems' Smart Connectivity Platform (ESCP) is a set of high performance, high integration wireless SOCs, designed for space and power constrained mobile platform designers. It provides unsurpassed ability to embed WiFi capabilities within other systems, or to function as a standalone application, with the lowest cost, and minimal space requirement.

Fig 3.16 ESP 8266

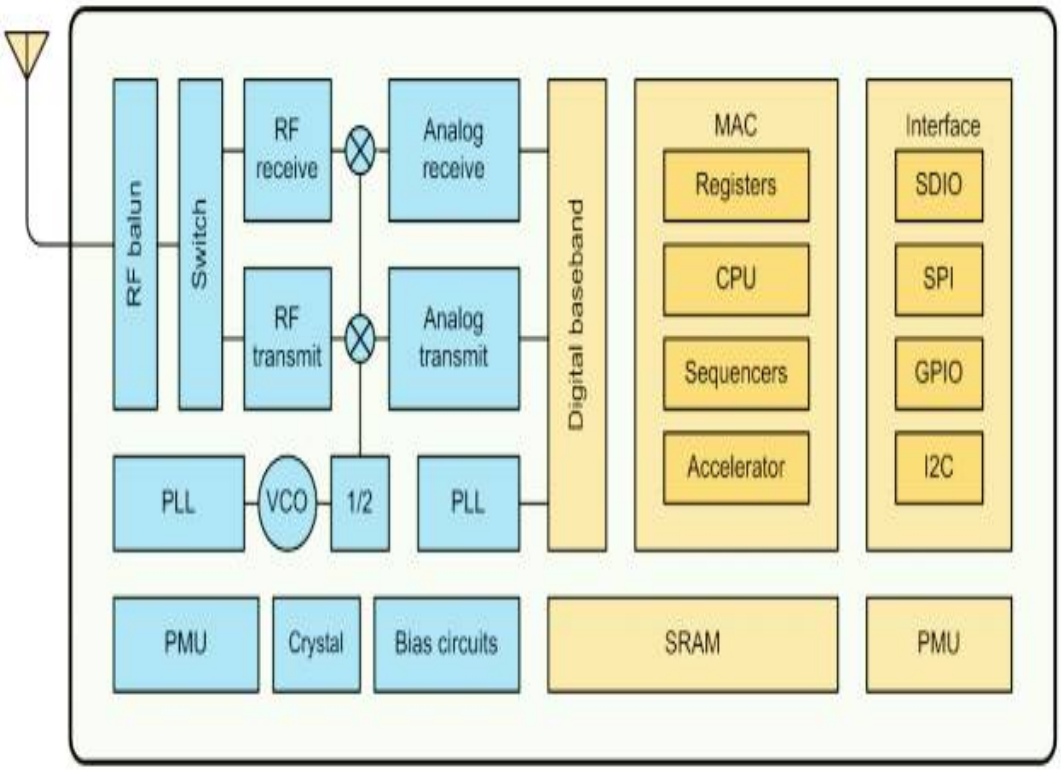


Fig.3.17 ESP8266EX block diagram

Features:

• 802.11 b/g/n

• Integrated low power 32-bit MCU

• Integrated 10-bit ADC

• Integrated TCP/IP protocol stack

• Integrated TR switch, balun, LNA, power amplifier and matching network

• Integrated PLL, regulators, and power management units

• Supports antenna diversity

• WiFi 2.4 GHz, support WPA/WPA2

• Support STA/AP/STA+AP operation modes

• Support Smart Link Function for both Android and iOS devices

• SDIO 2.0, (H) SPI, UART, I2C, I2S, IR Remote Control, PWM, GPIO

• STBC, 1x1 MIMO, 2x1 MIMO • A-MPDU & A-MSDU aggregation & 0.4s guard interval

• Deep sleep power < 5uA

• Wake up and transmit packets in < 2ms

• Standby power consumption of < 1.0mW (DTIM3)

• +20 dBm output power in 802.11b mode

• Operating temperature range -40C ~ 125C

• FCC, CE, TELEC, WiFi Alliance, and SRRC certified

3.9.1 NndeMCU IoT based HAS Hardware implementation

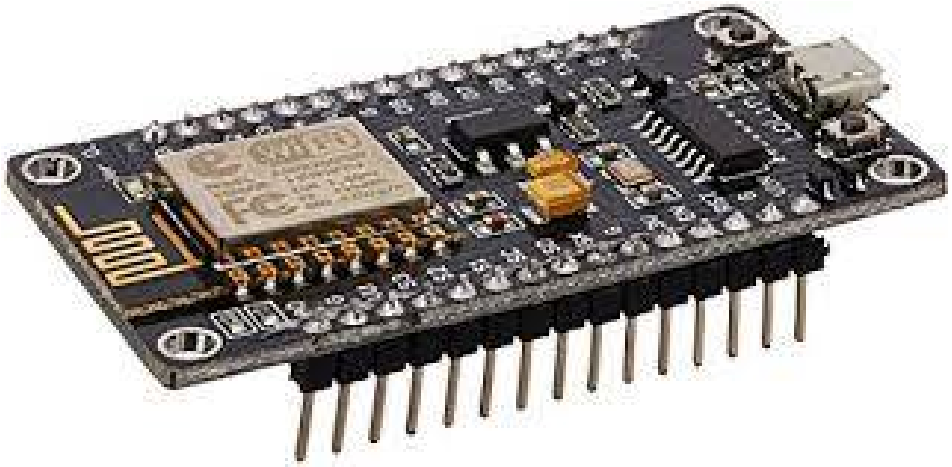


Fig.3.18 Node MCU

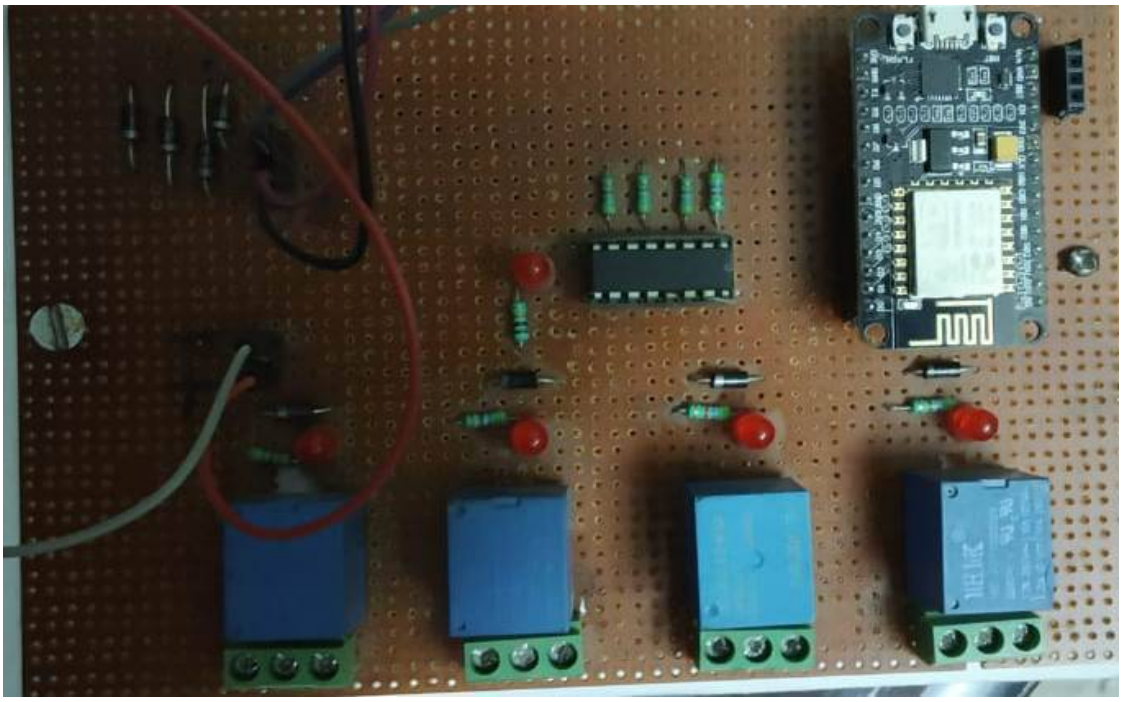


Fig.3.19 NodeMCU (WiFi) enabled home automation system(Actual Circuit)

3.9.2 Three layer control diagram

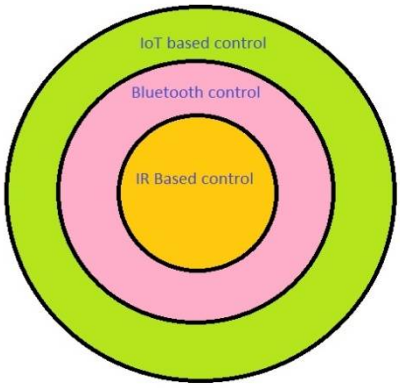


Fig. 3.20 Layer Control Diagram

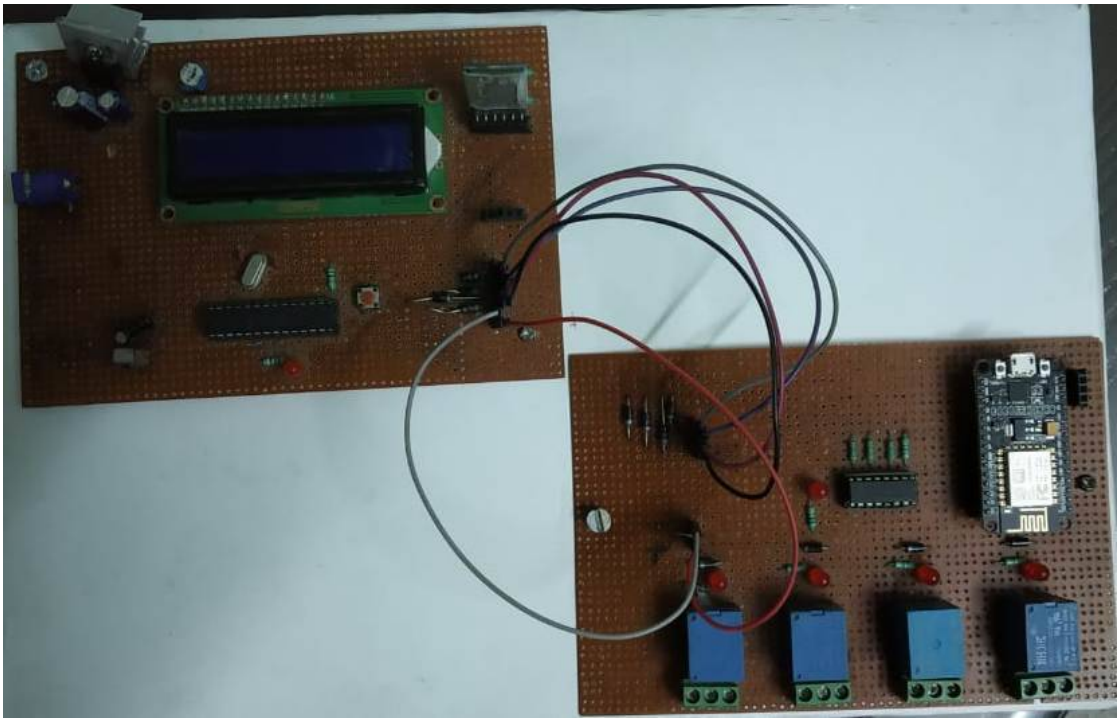


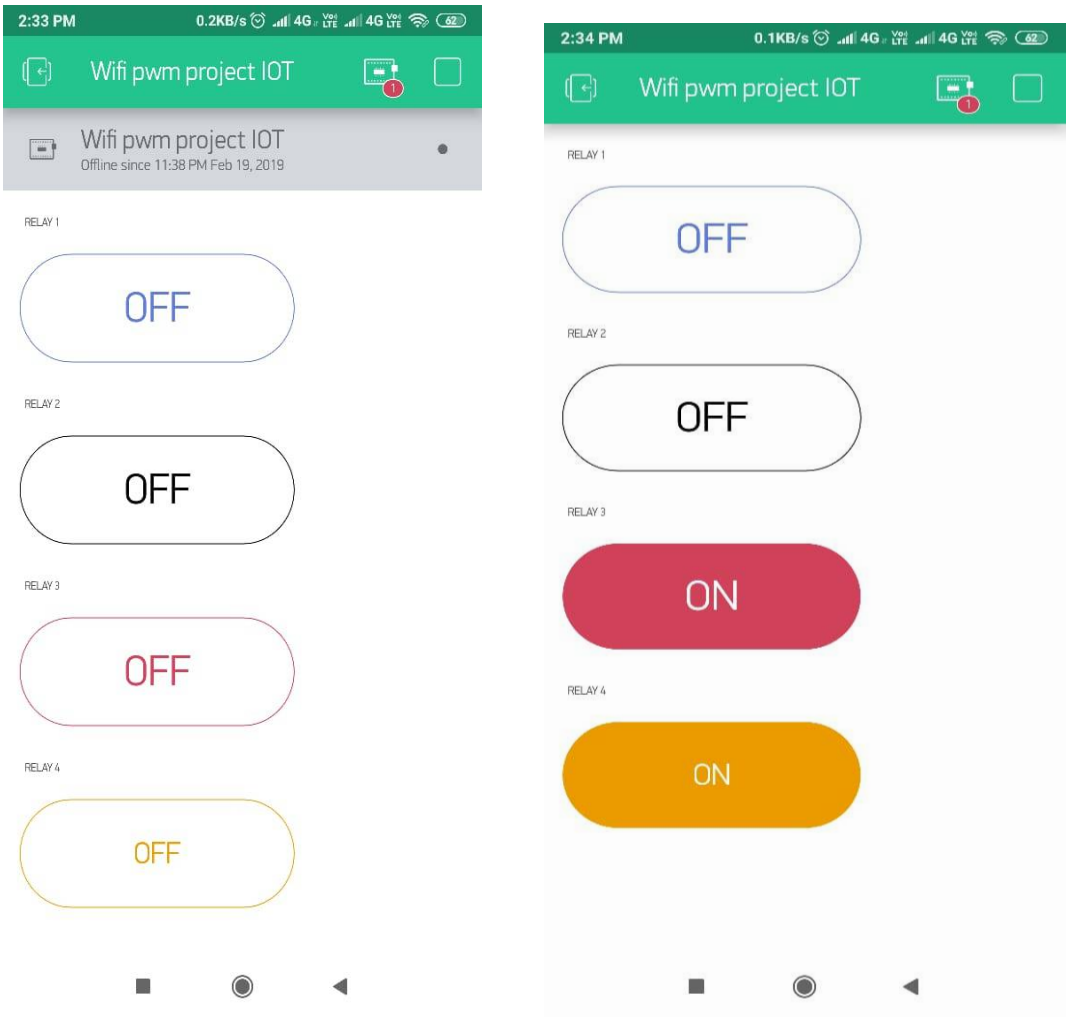
Fig.3.21 Actual Circuit Of 3 Layer Control

3.10 Blynk.com

Blynk provide web platform by which we customize our IoT based home automation and bio medical automation services. This web service is easily available on Google play store and apple store. We can install this application and connect to our desired platform like ARDUINO, nodemcu, all series of ruspburry, pi,zero, banana etc. by following this procedure.

1. Buy nodemcu commercially available on e commerce sites
2. Connect to laptop
3. Open ARDUINO editor and download bynk library
4. Now install blynk app on mobile phone and get register

5. When you will finish your registration you will receive a token
6. Received token can be filled in your blynk program along with user id and password.
7. And start burning your program to your nodemcu
8. Now check your app and you will get your HAS connected to IoT.



(a) (b)

Fig. 3.22 **a**. Blynk app not connected to nodemcu **b**. Bynk is connected to nodemcu

CHAPTER 4

DEVELOPMENT OF DRIVER CIRCUIT

Development of driver circuit is one of the very important task of whole circuit because the output voltage microcontroller ranges from 0-5v. It is very insufficient voltage to derive heavy load like motor and other electrical equipment. Such loads derive heavy current and voltage which can damage microcontroller or its supporting components.

Driver circuit can be made by using electronic components like power transistor, power MOSFET ,IGBT etc. by developing such circuits we can further improve the performance control strategies. This could be achieved by simple and most common technique like PWM, integral cycle control etc..

Here I would like to explain one technique which is commonly known as integral cycle control using PWM. We can see some PWM methods in following diagram.

4.1 _Pulse width Modulation

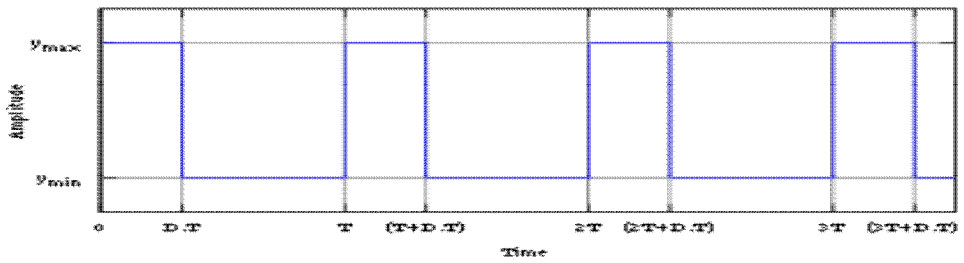


Fig. 4.1: A pulse wave, showing the definitions of V_{min}, V_{max} and D

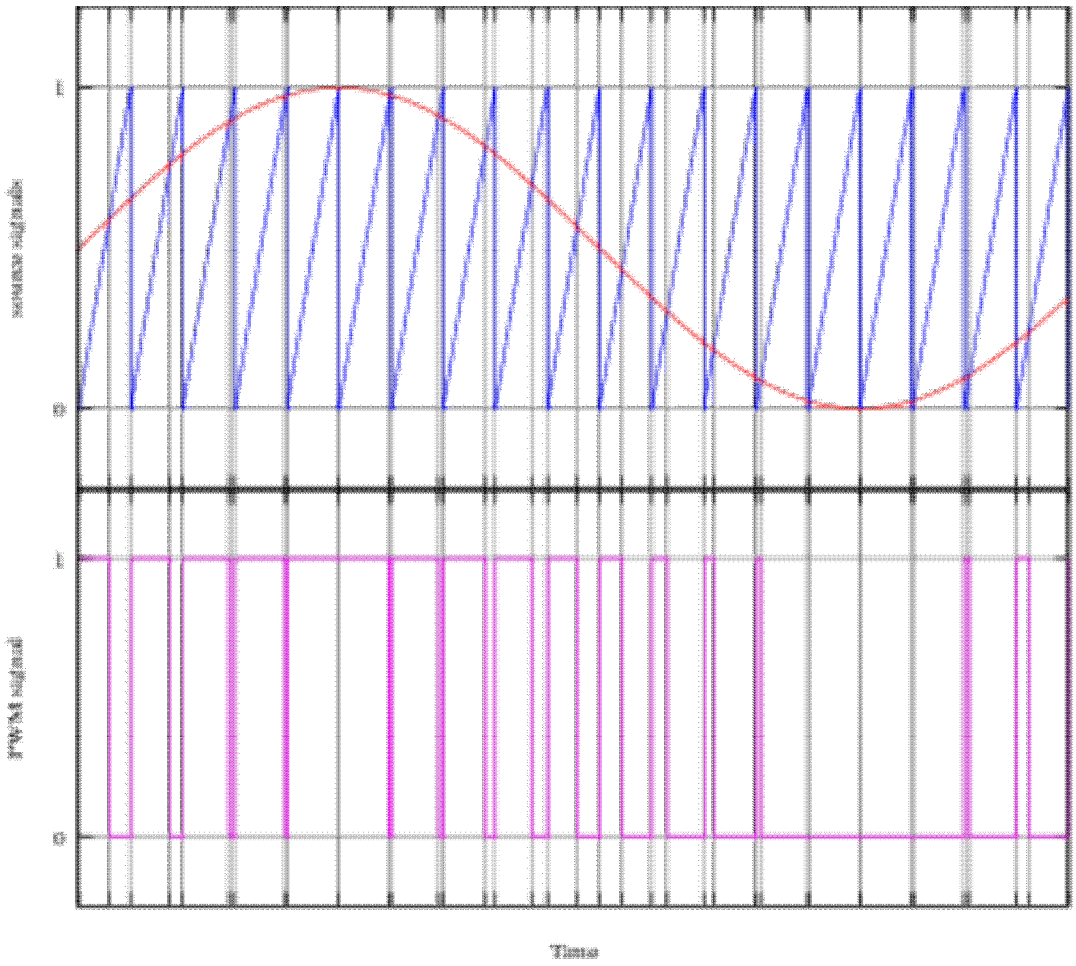


Fig. 4.2: A simple method to generate the PWM pulse train

PWM signals can be achieved by programming PIC microcontrollers which is easily available in electronic market like AT8059,8051 etc. Now a days many controllers are available which have pre defined analog ,digital and PWM pin outs.

ICs like AT328P is most popular now a days which is very capable and easy to program.

4.2 **Simulation of driver circuit**

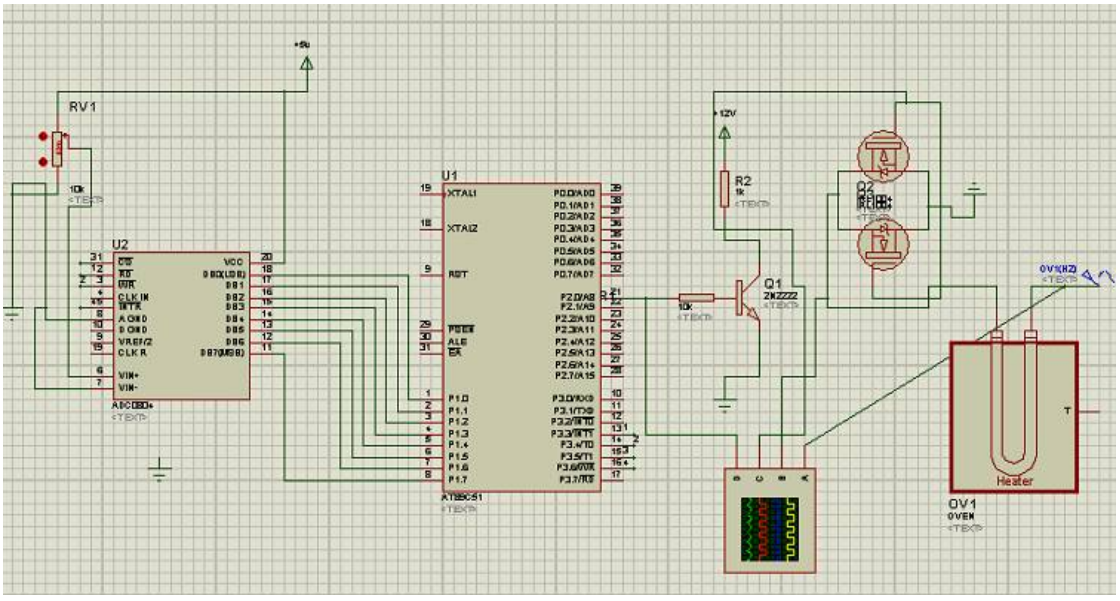


Fig. 4.3 – Proteus Simulation of Circuit

The above circuit is simulated in proteus software in this circuit we are controlling heater temperature using integral cycle control with the help of PWM. Starting from left we are using potentiometer to vary width of pulse this pulse is in analog but microcontroller is unable to understand analog input. Here we have to change this analog signal in digital so we need to apply a ADC (analog to digital converter). Now this converted signal is perfect for microcontroller .Pulse width modulation signal is out from pin no. 21 which is not sufficiently high to operate the MOSFET gate so we have to employ a driver circuit which can amplify the signal from controller.

So the transistor based driver circuit now can drive the power handling circuit. Switching MOSFET circuit is purely based on power electronics based study so I have attached all data sheets in annexure .

4.3 Result

4.3.1 Half Cycle Control

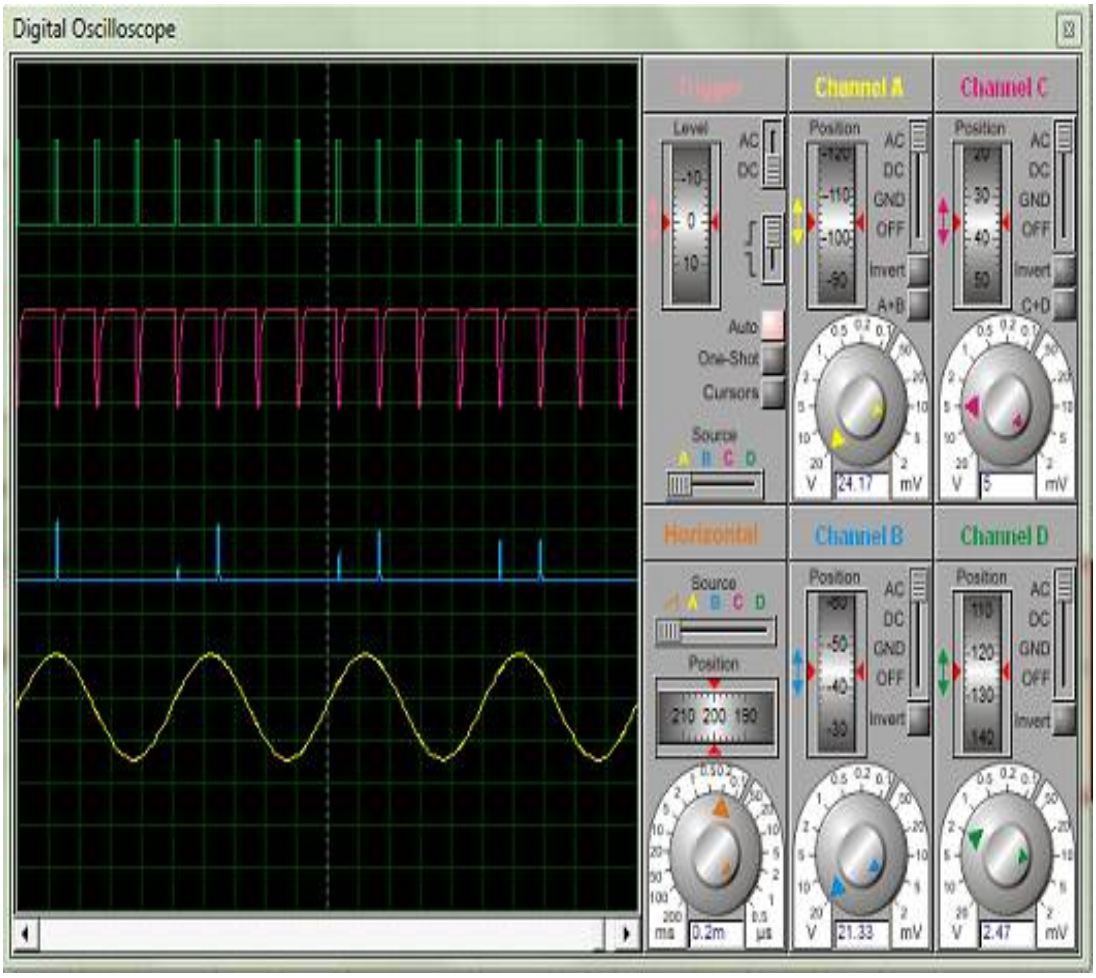


Fig 4.4 Pulse width corresponding to low Power to Heater

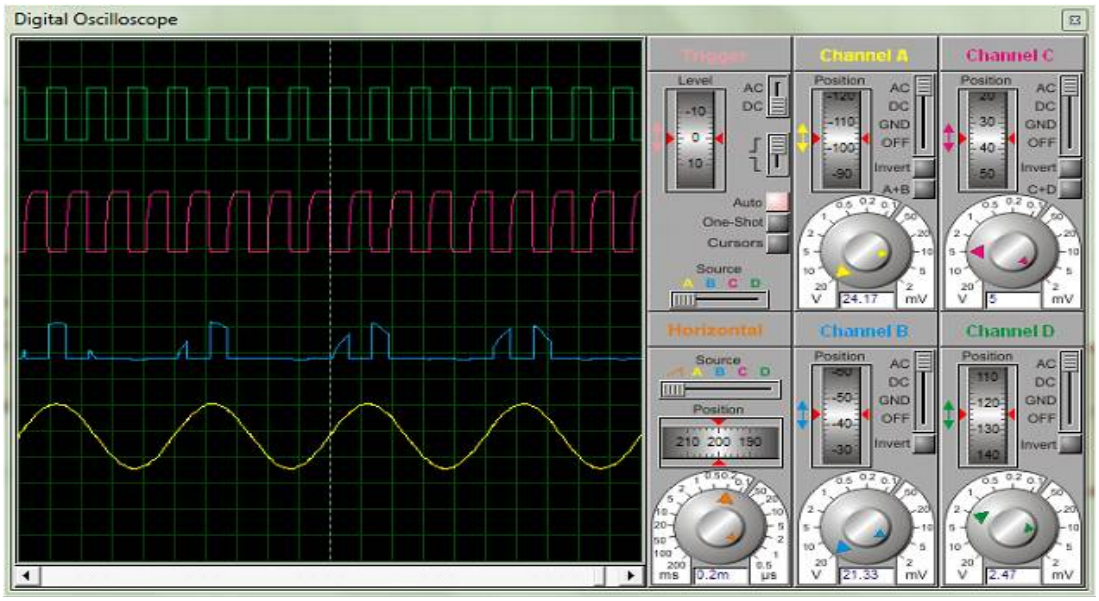


Fig 4.5 Pulse width corresponding to intermediate Power to Heater

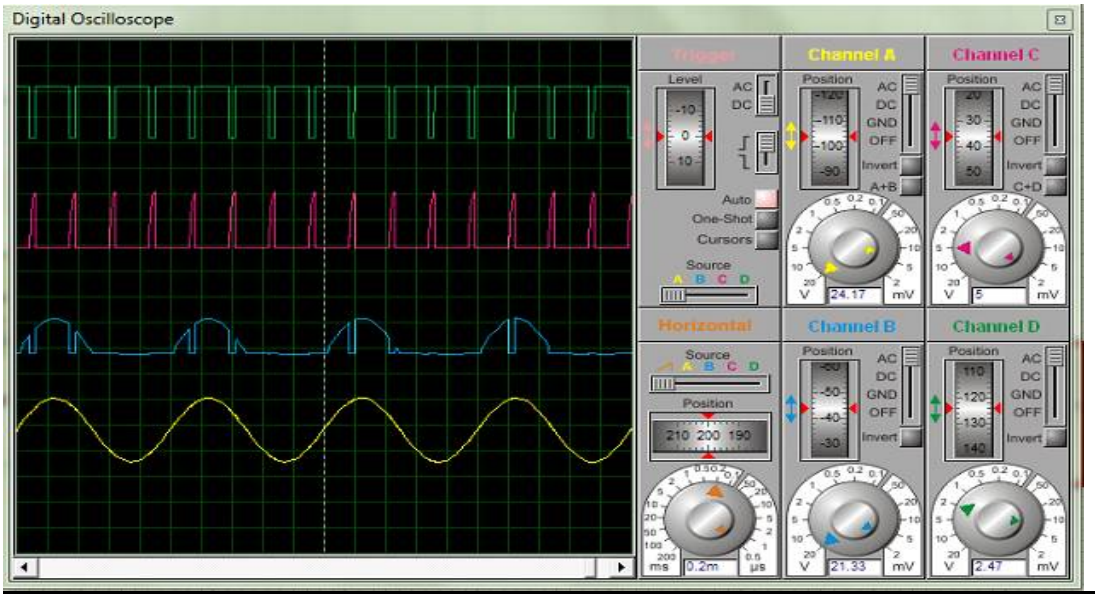


Fig 4.6 Pulse width corresponding to Maximum Power to Heater

4.3.2 Full Cycle Control

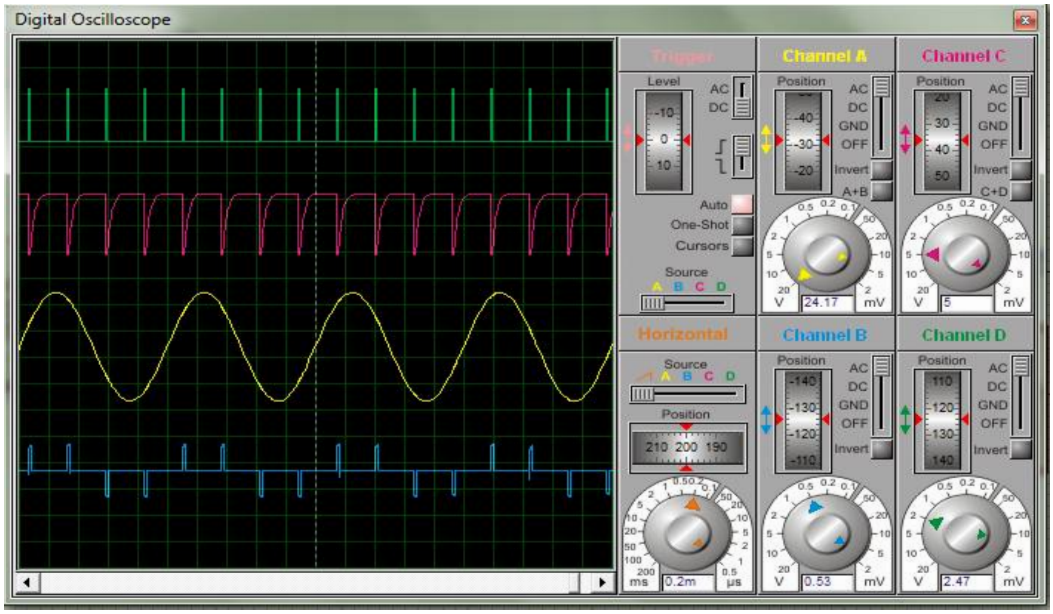


Fig 4.7 Pulse width corresponding to low Power to Heater

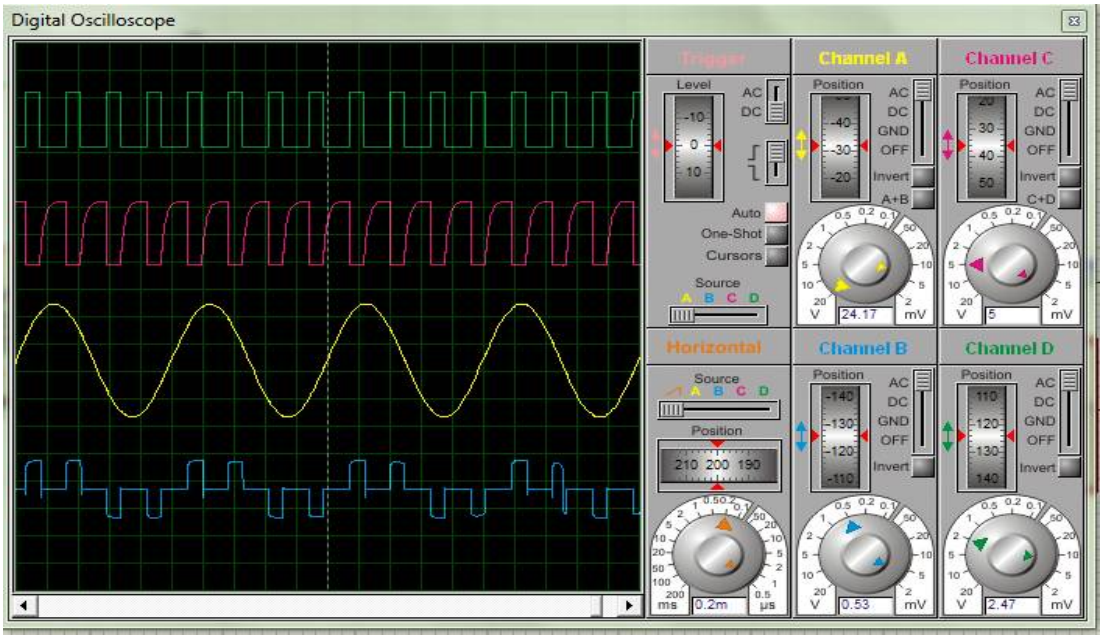


Fig 4.8 Pulse width corresponding to intermediate Power to Heater

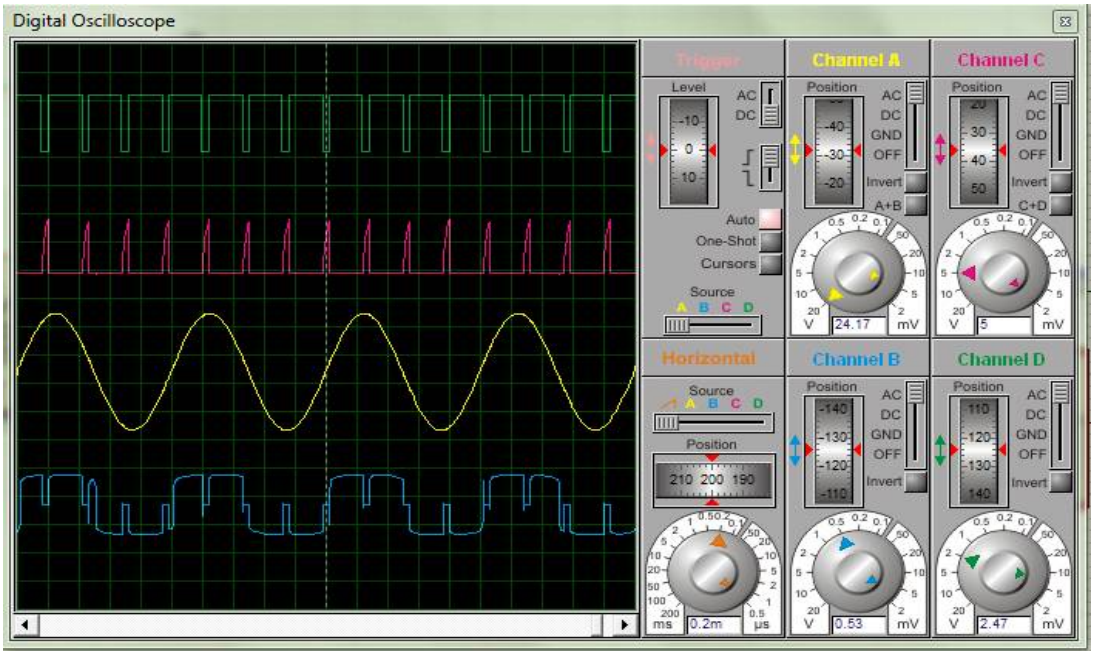


Fig 4.9 Pulse width corresponding to Maximum Power to Heater

Discussion- For avoiding confusion CRO signals are color coded

Green Line – pin no. 21 and 20 is out pin of microcontroller

Red Line – transistor collector emitter signal

Yellow Line – supply AC input signal

Blue Line – pulse at drain of MOSFET

CHAPTER 5

CONCLUSION

This project is proposed to develop IoT based home automation along with its driver and controllers by keeping conventional features. So that this IoT based home automation system can be easily integrated to existing setup without any odds to the consumer and it is also kept in mind that load profiling and customer behavior analysis by cloud based data collection. Data collection of consumer can be converted into useful information and later it may be used for profiling (consumer and load) so that best facilities can be delivered to end user.

This IoT based system provides more precision and accurate data collection for devices by which we can offer some more paid services or on demand services. We can represent data in different forms like pie, bar graph and other statistical representation for better understanding.

While developing this IoT based HAS it was our priority that it should be cheaper and parts of the system should be available to all. Because availability of parts and services makes technology popular and acceptable.

This IoT is based on open source so this can be easily maintained after small training on by social media. Being an open source codes and libraries are available on internet on paid and free.

This developed system has gone through number of tests to avoid failure. Keeping it in our mind we have developed 3 layer of protection of IoT so it is a fail out system and to avoid harmonics based damage of system. We have provided diode based protection which makes is cheap but reliable.

CHAPTER 6

Future Scope

This work has ability to grow and develop more aspects of control system by implementing additional features like online monitoring and regulation of the individual appliances of the house hold. For being cloud based system information can be processed periodically so that overhauling maintenance and repair works may be carried out on time to avoid major loss . If devices are connected to iot and raw data is collected as well processed in well defined way it can detect load and supply. In this way we can match our demand and supply gap. By matching this demand and supply gaps we can use this system for load forecasting.

In power system simulation technique we use different algorithm like ANN, fuzzy, PSO and many more for artificial intelligence. By using such AI we can find out boundary and its clustering methods. By getting crisp and exact out comes we can use best technique for load profiling or power profiling. Many researches are available with more purpose full utilization of data and set these parameter accordingly. This IoT based project have lot more potential when it will club with some more technological advancements in future.

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IMPORTANT DIAGRAM

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