

ENERGY EFFICIENT AND FULLY AUTONOMOUS RESIDENTIAL POWER MANAGEMENT SOLUTION

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering Degree in
Electrical and Electronics Engineering

DEEPA.K (Register No.37140020)
BHAVANA.P (Register No.37140015)



**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING
SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade "A" by NAAC

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MARCH 2021



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APRIL 2020

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of
BHAVANA P (Reg. No. 37140015) and **DEEPA K** (Reg. No. 37140020) who
carried out the project entitled "**ENERGY EFFICIENT AND FULLY
AUTONOMOUS RESIDENTIAL POWER MANAGEMENT SOLUTION** " under
our supervision from Dec 2019 to April 2020.

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Submitted for Viva voce Examination held on _____

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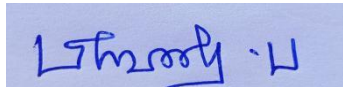
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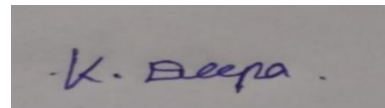
DECLARATION

We **DEEPA.K (Reg. No. 37140020)** and **BHAVANA.P (Reg. No. 37140015)** hereby declare that the Project Report entitled “**ENERGY EFFICIENT AND FULLY AUTONOMOUS RESIDENTIAL POWER MANAGEMENT SOLUTION**” done by us under the guidance of **DR.M.L.BHARATHI** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering Degree in Electrical and Electronics Engineering.

1.



2.



DATE

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SIGNATURE OF THE CANDIDATES

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We are pleased to acknowledge our sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. We are grateful to them.

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We wish to express our thanks to all Teaching and Non-teaching staff members of the Department of Electrical and Electronics Engineering who were helpful in many ways for the completion of the project.

ABSTRACT

Life today is getting easier and simpler with advancement of automation technology. Manual systems are getting replaced by automatic systems. With the rapid increase in Internet users it has become part of life. One of its kinds is IOT, latest and emerging technology. Things like consumer goods, industrial goods, etc., can be networked to share information and complete the task remotely. Basic home functions and features can be controlled using IOT from anywhere in the world. It is meant to save human and electrical energy. In this system each load is monitored by current and potential transformer.

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LIST OF SYMBOLS AND ABBREVIATIONS

IOT	- INTERNET OF THINGS
GPIO	- GENERAL PURPOSE INPUT OUTPUT
CPU	- CENTRAL PROCESSING UNIT
MAC	- MEDIA ACCESS CONTROL
SDI	- SERIAL DIGITAL INTERFACE
I2C	- INTER INDTEGRATED CIRCUIT
SPI	- SERIAL PERIPHERAL INTERFACE
SDIO	- SECURE DIGITAL INPUT OUTPUT
IC	- INTEGRATED CIRCUIT
ESP	- ELECTRONIC STABILITY PROGRAM
FTDI	- FUTURE TECHNOLOGY DEVICE INTERNATIONAL LIMITED
SOC	- SYSTEM ON A CHIP
RTOS	- REAL TIME OPERATING SYSTEM
LDO	- LOW DROP OUT
UART	- UNIVERSAL ASYNCHRONOUS RECEIVER TRANSMITTER

PWM	- PULSE WIDTH MODULATION
CT	- CURRENT TRANSFORMER
PT	- POTENTIAL TRANSFORMER
USB	- UNIVERSAL SERIAL BUS
LDR	- LIGHT DEPENDENT RESISTOR
API	- APPLICATION PROGRAMMING INTERFACE
REST	- REPRESENTATIONAL STATE TRANSFER
MQTT	- MESSAGE QUEUING TELEMETRY TRANSPORT
UMAD	- UNIVERSAL MOBILE APPLICATION DEVELOPMENT

CHAPTER 1

INTRODUCTION

1.1 EXISTING SYSTEM

The most basic issue faces by the present world is sporadic force. Individuals in numerous nations don't get the essential requirements of lights, fans, and so forth Scientists expect the capacities of existing energy creation will neglect to satisfy future need without new fuel sources. We can utilize accessible force productively. A framework can be made to accomplish proficient utilization of force which screens the climate and controls the force gadget and turns ON just when required. The electrical boundaries like voltage, flow and recurrence from savvy framework can be gained distantly and send these ongoing qualities utilizing IOT. EB Electric board.

1.1.1 DISADVANTAGES

- This system cannot detect any fault
- This could cause unnecessary billing
- Cannot detect over usage immediately

1.2 PROPOSED SYSTEM

Force utilization checking framework that can quantify the force use of every one of the heaps independently. This framework is planned around NODEMCU miniature regulator board. In the event that the general utilization goes past a predefined level client will be informed about this and fine will be added if still utilization isn't decreased. This framework can be utilized for distinguishing broken electrical gadgets in a family that is burning-through strange measure of force.

1.2.1 ADVANTAGES

- Can detect any faulty loads
- Fully automated system
- Can monitor each load individually
- Can reduces EB bill

CHAPTER 2

2.1 LITERATURE SURWAY

[1] Yasin Kabir,1,Yusuf Mohammad Mohsin and Mohammad Monirujjaman Khan(2015):

Efficient generation of power at present is crucial as wastage of power is a global concern. Power factor measures a system's power efficiency and is an important aspect in improving the quality of supply. In most power systems, a poor power factor resulting from an increasing use of inductive loads is often overlooked. A power factor correction unit would allow the system to restore its power factor close to unity for economical operation. The advantages of correcting power factor include reduced power system losses, increased load carrying capabilities, improved voltages and much more.

[2] Naveen Kumar R Kulkarni
Prof. H. Vijay Murthy Akhil P Raju(2015)

In recent years, the quality of power supplied to the consumer devices by an ac system has become an issue of great concern due to the rapidly increasing inductive loads, electronic Equipment, power electronic devices and high system voltage. Power factor correction (PFC) is a technique of minimizing the undesirable effects of electric loads that create poor power factor conditions. Correction of power factor may be effected either by transmission utility which improves the stability and efficiency of the transmission network or by individuals customers.

[3] K.Vani parimala Dr. Nisha.KCR(2016)

Power Quality monitoring is very important especially for high frequency nonlinear loads, high speed adjustable drivers. Accurate measurement of electric parameters is required to determine the quality of power which involves collecting, analyzing and processing of voltage and current samples over a period of time. So addressing to this a power meter is required that measures electric parameters with high accuracy and computation speed for different loads.

[4] Preethy V. Warriar,(2015)

Development in the field of electrical engineering is quick and commendable. Even though the nonlinear power electronic equipment introduce power quality issues, their use is unavoidable. Most of the medical equipment make use of power electronic devices. Serious issues include low input power factor and increased ripples in the input current. Many topology have been introduced to mitigate the above mentioned problems. Common topology make use of buck, boost, buck and Specific converters. In this paper zeta converter with one cycle control for display monitors in hospitals has been proposed.

[5] D.P.Mishra, (2015)

Monitoring of power supply is required in power systems to increase the performance, supervision and control over the system. Power quality is defined as perfectly sinusoidal voltage and uninterrupted power supply to the customers. The power quality factor (PQF) is a unique indicator ranging from 0 to 100%, which reflects quality of the 3 phase power supply given the user has been suggested here.

CHAPTER 3

3.1 AIM

To design and implement a system to monitor and control electrical appliances for energy saving.

3.2 SCOPE OF THE PROJECT

IOT based Power Management can be used to continuously monitor the load, control the appliances with more flexibility like controlling the speed of fan.

Some of the future scopes are:

- Industrial automation,
- management through internet, Improvement of security problem,
- Usage in extremely restricted areas.

CHAPTER 4

MATERIALS AND METHODS

4.1 BLOCK DIAGRAM

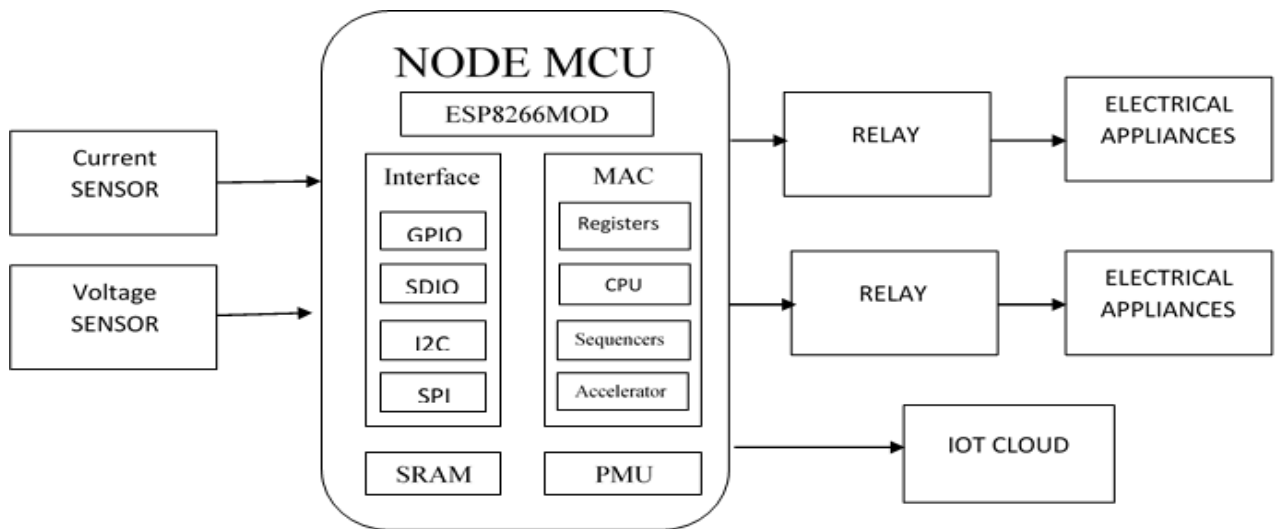


FIG NO : 4.1

4.1.1 BLOCK DIAGRAM DESCRIPTION

- NODEMCU is the controller board used here
- Every other component is connected to NODEMCU
- It reads the sensor values through an external ADC IC
- All the loads are connected to it using relays
- Relays are connected to GPIO pins in NODEMCU
- NODEMCU is a has a WiFi called ESP8266
- It is used for connecting NODEMCU to a WiFi network

4.2 HARDWARE TOOLS

Current sensor

Voltage sensor

Loads

4.3 SOFTWARE

4.3.1 NODEMCU

4.3. INTRODUCTION

General-purpose input/output (GPIO) is a pin on an IC (Integrated Circuit). It can be either input pin or output pin, whose behaviour can be controlled at the run time.

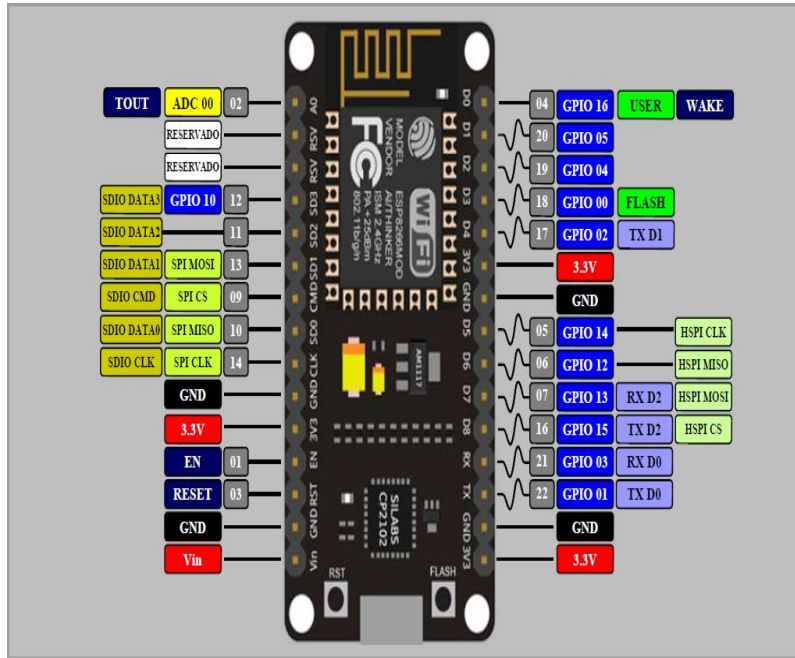


FIG NO : 4.2

4.3.3 WHERE TO USE ESP8266-01

The ESP8266 is an extremely easy to use and ease gadget to give web availability to your activities. The module can work both as an Access point (can make HOTSPOT) and as a station (can interface with Wi-Fi), henceforth it can easily fetch information and transfer it to the web making Internet of Things as simple as could really be expected. It can likewise bring information from web utilizing API' S subsequently your venture could get to any data that is accessible in the web, accordingly making it more astute. Another energizing element of this module is that it very well may be modified utilizing the Arduino IDE which makes it much more easy to use. Anyway this variant of the module has just 2 GPIO pins (you can hack it to utilize UPTO 4) so you need to utilize it alongside another miniature regulator like Arduino, else you can look onto the more independent ESP-12 or ESP-32 renditions. So on the off chance that you are searching for a module to begin with IOT or to give web availability to your venture then this module is the correct decision for you.

4.3.4 HOW TO USE THE ESP8266-01:

There are such countless techniques and IDE accessible to with ESP modules, however the most ordinarily utilized on is the Arduino IDE. So let us examine just about that further underneath.

The ESP8266 module works with 3.3V just, anything over 3.7V would slaughter the module thus be alerts with your circuits. The most ideal approach to program an ESP-01 is by utilizing the FTDI board that upholds 3.3V programming. On the off chance that you don't have one it is prescribed to get one or for time being you can likewise utilize an Arduino load up. One ordinary issue that each one countenances with ESP-01 is the driving up issue. The module is a digit power hungry while programming and henceforth you can control it with a 3.3V pin on Arduino or simply utilize a possible divider. So it is imperative to make a little voltage controller for 3.31v that could supply at least 500mA. One suggested controller is the LM317 which could deal with the work without any problem. A worked on circuit graph for utilizing the ESP8266-01 module is given underneath.

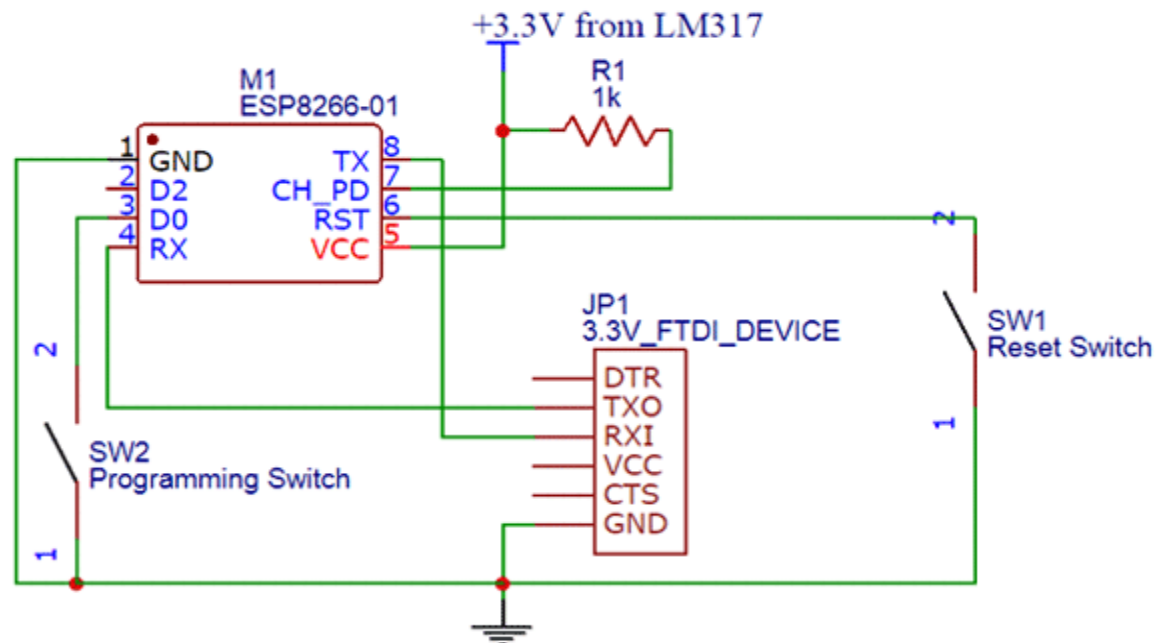


FIG NO : 4.3

The switch SW2 (Programming Switch) ought to be held squeezed to hold the GPIO-0 pin to ground. This way we can go into the programming mode and transfer the code. When the code is delivered the switch can be delivered.

4.3.5 GPIO PINS:

NODEMCU Development pack gives admittance to these GPIO,s of ESP8266. The solitary thing to take care is that NODEMCU pack pins are numbered uniquely in contrast to interior GPIO documentations of ESP8266 as demonstrated in beneath figure and table. For instance, the D0 nail to the NODEMCU unit is planned to the interior GPIO pin 16 of ESP8266.

The Internet of Things (IOT) has been a moving field in the realm of innovation. It as changed the manner in which we work. Actual items and the advanced world are associated now like never before.

Remembering this, Expressive Systems (A Shanghai-based Semiconductor Company) has delivered a cute, scaled down Wi-Fi empowered miniature regulator – ESP8266, it can monitor and control things from anyplace on the planet.

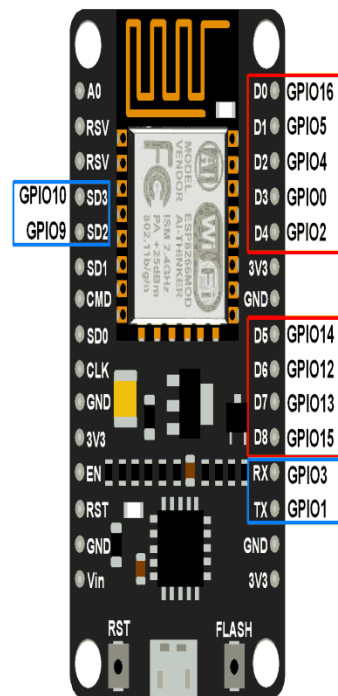


FIG NO : 4.4

4.3.6 NODEMCU GPIOS

Pin Names on NODEMCU Development Kit	ESP8266 Internal GPIO Pin number
D0	GPIO16
D1	GPIO5
D2	GPIO4
D3	GPIO0
D4	GPIO2
D5	GPIO14
D6	GPIO12
D7	GPIO13
D8	GPIO15
D9/RX	GPIO3
D10/TX	GPIO1
D11/SD2	GPIO9
D12/SD3	GPIO10

TABLE NO : 4.1

The GPIOS appeared in blue box (1, 3, 9, 10) are generally not utilized for GPIO reason on DEV Kit

ESP8266 is a framework on a chip (SOC) plan with parts like the processor chip. The processor has around 16 GPIO lines, some of which are utilized inside to interface with different segments of the SOC, similar to streak memory.

Since a few lines are utilized inside the ESP8266 SOC, we have around 11 GPIO pins staying for GPIO reason.

Presently again 2 pins out of 11 are for the most part saved for RX and TX to speak with a host PC from which accumulated article code is downloaded.

Subsequently at last, this leaves only 9 broadly useful I/O pins for example D0 to D8.

As demonstrated in above figure of NODEMCU DEV Kit. We can see RX, TX, SD2, SD3 pins are not for the most part utilized as GPIOS since they are utilized for other

inside measure. However, we can attempt with SD3 (D12) pin which generally prefer to react for GPIO/PWM/intrude on like capacities.

Note that D0/GPIO16 pin can be just utilized as GPIO read/compose, no exceptional capacities are upheld on it.

4.3.7 ESP-12E MODULE

The advancement load up prepares the ESP-12E module containing ESP8266 chip having TENSILICAXTENZA® 32-digit LX106 RISC microchip which works at 80 to 160 MHz customizable clock recurrence and supports RTOS.

4.3.8 ESP-12E CHIP

- 80 to 160 MHz Clock Freq.
- 128kB internal RAM
- 4MB external flash
- 802.11b/g/n Wi-Fi transceiver

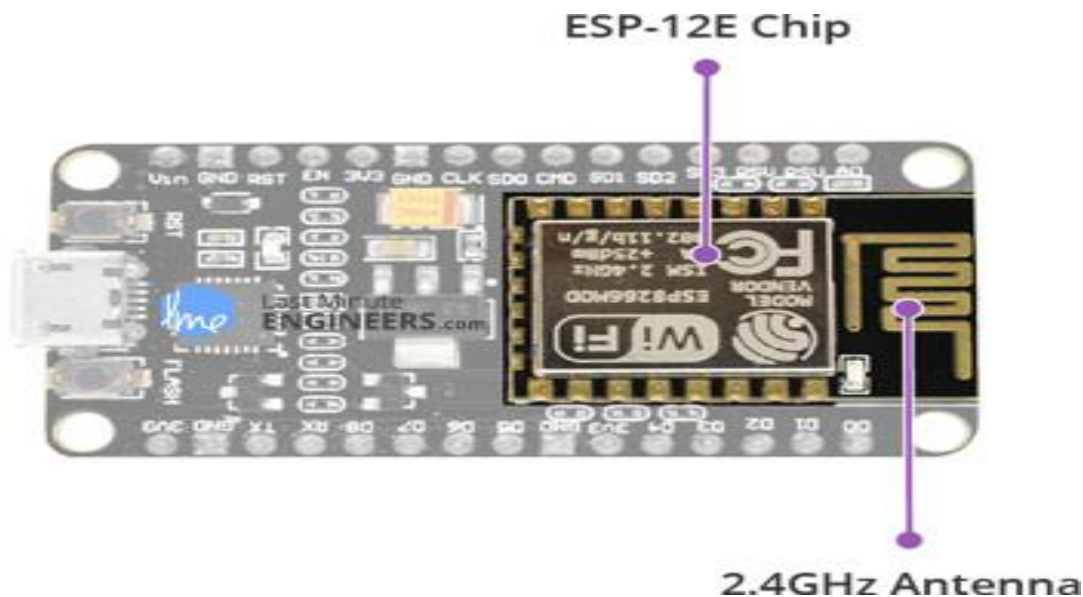


FIG NO : 4.4

There's additionally 128 KB RAM and 4MB of Flash memory (for program and information stockpiling) barely to adapt to the enormous strings that make up website pages, JSON/XML information, and all that we toss at IOT gadgets these days.

The ESP8266 Integrates 802.11b/g/n HT40 Wi-Fi handset, so it can not just interface with a WiFi organize and associate with the Internet, however it can likewise set up its very own organization, permitting different gadgets to associate straightforwardly to it. This makes the ESP8266 NODEMCU significantly more flexible.

4.3.9 POWER REQUIREMENT

As the operating voltage range of ESP8266 is 3V to 3.6V, the board comes with a LDO voltage regulator to keep the voltage steady at 3.3V. It can reliably supply up to 600mA, which should be more than enough when ESP8266 pulls as much as 80mA during RF transmissions. The output of the regulator is also broken out to one of the sides of the board and labeled as 3V3. This pin can be used to supply power to external components.

- Operating Voltage: 2.5V to 3.6V
- On-board 3.3V 600mA regulator
- 80mA Operating Current
- 20 μ A during Sleep Mode

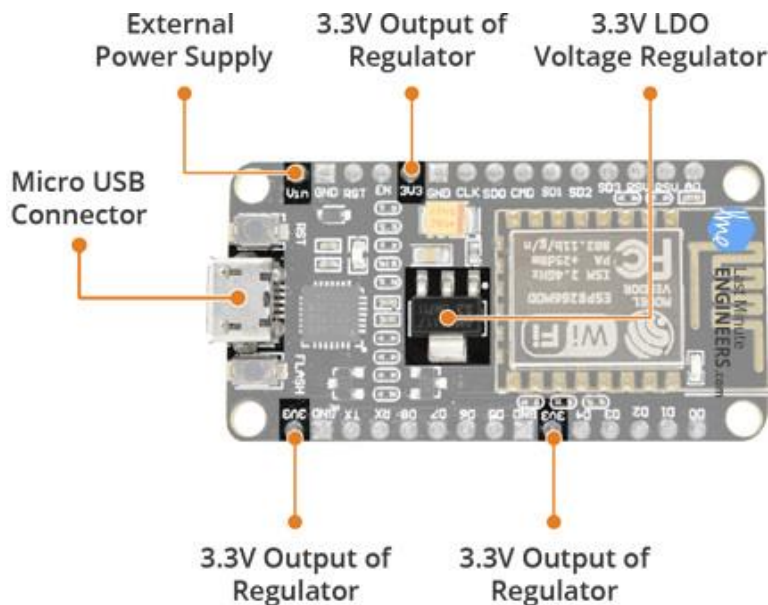


FIG NO : 4.5

Capacity to the ESP8266 NODEMCU is provided through the on-board Micro USB connector. On the other hand, in the event that you have a managed 5V voltage source, the VIN pin can be utilized to straightforwardly supply the ESP8266 and its peripherals.

4.3.10 WARNING:

The ESP8266 requires a 3.3V force supply and 3.3V rationale levels for correspondence. The GPIO pins are not 5V-open minded! In the event that you need to interface the board with 5V (or higher) parts, you'll need to do some level moving.

4.4 PERIPHERALS AND I/O:

The ESP8266 NODEMCU has all out 17 GPIO pins broken out to the pin headers on the two sides of the improvement board. These pins can be appointed to a wide range of fringe obligations, including:

- ❑ ADC channel – A 10-cycle ADC channel.
- ❑ UART interface – UART interface is utilized to stack code sequentially.
- ❑ PWM yields – PWM pins for diminishing LED or controlling motors. SPI, I2C and I2S interface – SPI and I2C interface to connect a wide range of sensors and peripherals.
- ❑ I2S interface – I2S interface in the event that you need to add sound to your venture.

4.4.1 MULTIPLEXED I/Os:

- 1 ADC channels
- 2 UART interfaces
- 4 PWM outputs
- SPI, I2C & I2S interface

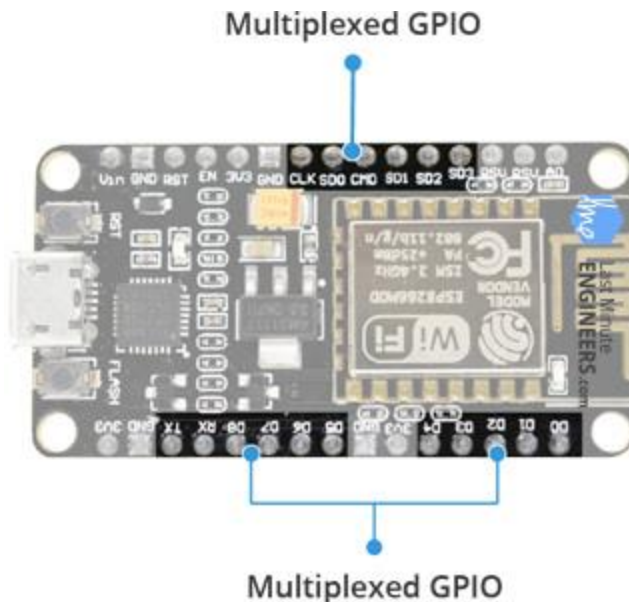


FIG NO : 4.6

the ESP8266's pin multiplexing feature (Multiple peripherals multiplexed on a single GPIO pin). Meaning a single GPIO pin can act as PWM/UART/SPI.

4.4.2 ONBOARD SWITCHES & LED INDICATOR:

The ESP8266 NODEMCU highlights two catches. One set apart as RST situated on the upper left corner is the Reset button, utilized obviously to reset the ESP8266 chip. The other FLASH catch on the base left corner is the download button utilized while redesigning firmware.

4.4.3 SWITCHES AND INDICATORS

- RST – Reset the ESP8266 chip
- FLASH – Download new programs
- Blue LED – User Programmable

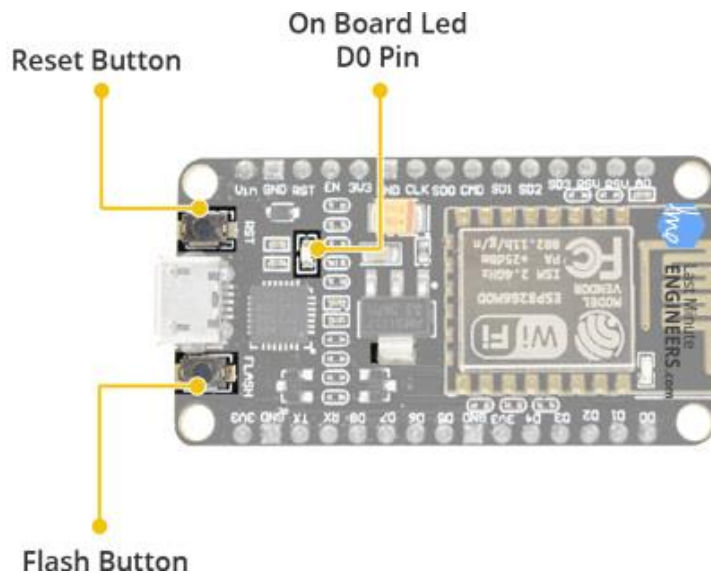


FIG NO: 4.7

The board also has a LED indicator which is user programmable and is connected to the D0 pin of the board.

4.4.4 SERIAL COMMUNICATION

USB To TTL Converter
CP2102

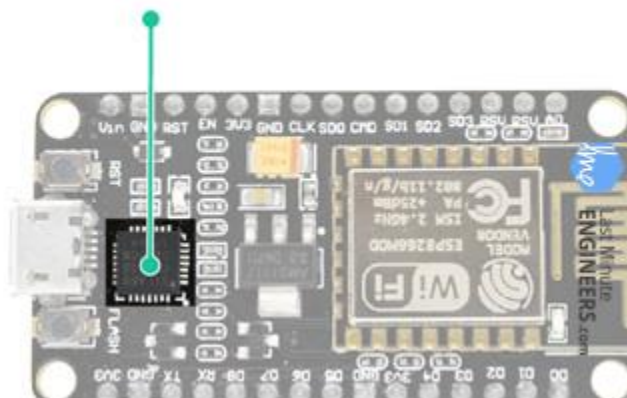


FIG NO : 4.8

If you have an older version of CP2102 driver installed on your PC, we recommend upgrading now.

4.4.4.1 ESP8266 NODEMCU PIN OUT

The ESP8266 NODEMCU has total 30 pins that interface it to the outside world. The connections are as follows:

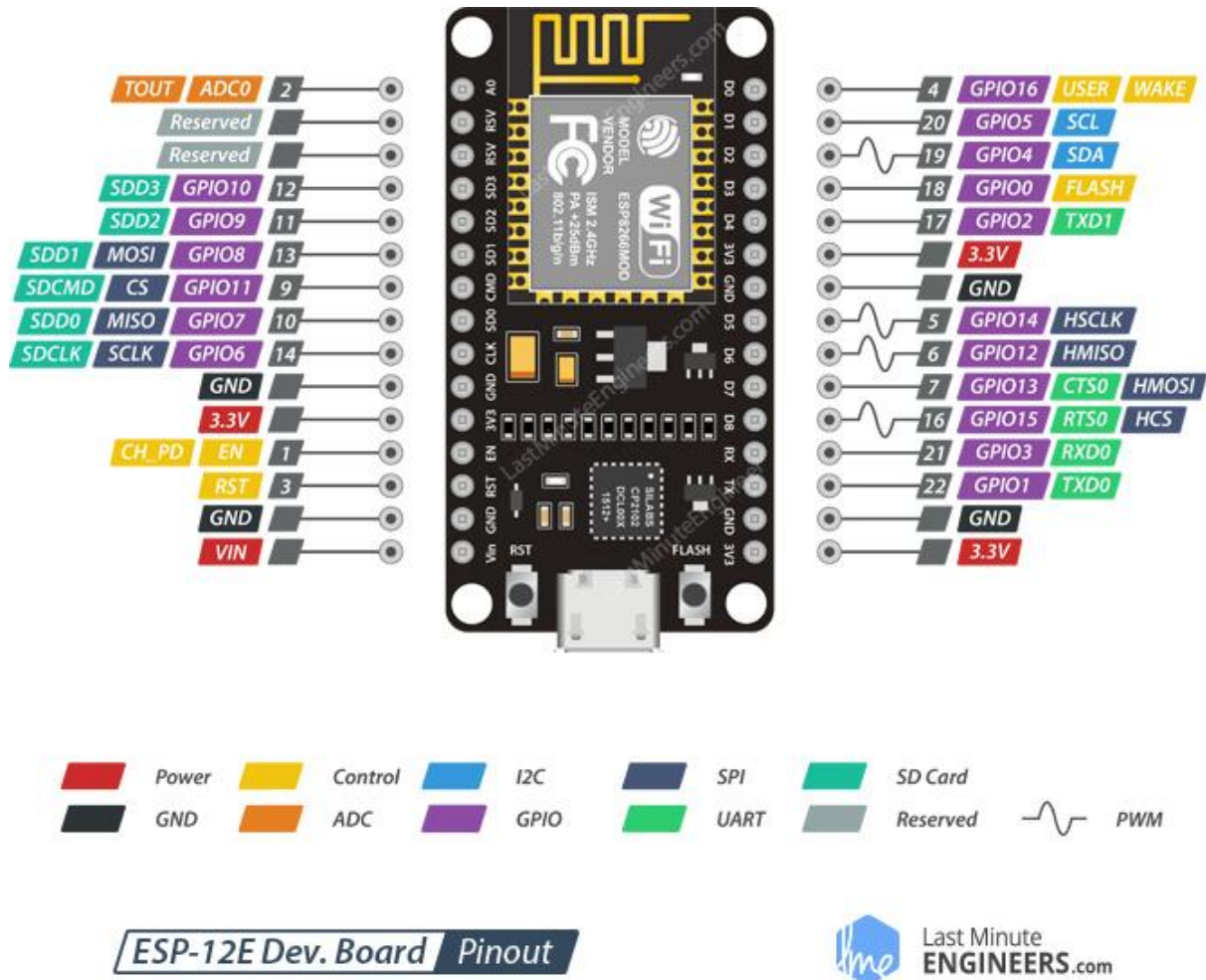


FIG NO : 4.9

For the sake of simplicity, we will make groups of pins with similar functionalities.

4.4.5 POWER PINS

There are four power pins viz. one VIN pin and three 3.3V pins. The VIN pin can be utilized to straightforwardly supply the ESP8266 and its peripherals, on the off chance

that you have a managed 5V voltage source. The 3.3V pins are the yield of an on-board voltage controller. These pins can be utilized to supply capacity to outer segments.

4.4.6 GND

GND is a ground pin of ESP8266 NODEMCU development board.

4.5 PINS

4.5.1 I2C PINS

I2C Pins are utilized to attach a wide range of I2C sensors and peripherals in your undertaking. Both I2C Master and I2C Slave are upheld. I2C interface usefulness can be acknowledged program, and the clock recurrence is 100 kHz at a most extreme. It ought to be noticed that I2C clock recurrence ought to be higher than the slowest clock recurrence of the slave gadget.

4.5.2 GPIO PINS

ESP8266 NODEMCU has 17 GPIO pins which can be allotted to different capacities, for example, I2C, I2S, UART, PWM, IR Remote Control, LED Light and Button program. Each computerized empowered GPIO can be designed to inward draw up or pull-down, or set to high impedance. At the point when designed as an information, it can likewise be set to edge-trigger or level-trigger to create CPU interferences.

4.5.3 ADC CHANNEL

The NODEMCU is installed with a 10-bit exactness SAR ADC. The two capacities can be executed utilizing ADC viz. Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. In any case, they can't be executed simultaneously.

4.5.4 UART PINS

ESP8266 NODEMCU has 2 UART interfaces, for example UART0 and UART1, which give offbeat correspondence (RS232 and RS485), and can convey at up to 4.5 MBP. UART0 (TXD0, RXD0, RST0 and CTS0 pins) can be utilized for correspondence. It upholds liquid control. Notwithstanding, UART1 (TXD1 pin) includes just information communicate signal in this way, it is typically utilized for printing log.

4.5.5 SPI PINS

6 features two SPI (SPI and HSPI) in slave and master modes. These SPI also support the following general-purpose SPI features:

- 4 timing modes of the SPI format transfer
- Up to 80 MHz and the divided clocks of 80 MHz
- Up to 64-Byte FIFO

4.5.6 SDIO PINS

ESP8266 highlights Secure Digital Input/Output Interface (SDIO) which is utilized to straightforwardly interface SD cards. 4-cycle 25 MHz SDIO v1.1 and 4-digit 50 MHz SDIO v2.0 are upheld.

4.5.7 PWM PINS

The board has 4 channels of Pulse Width Modulation (PWM). The PWM yield can be carried out program and utilized for driving computerized engines and LED. PWM recurrence range is movable from 1000 miniature second to 10000 miniature second, i.e., between 100 Hz and 1 kHz.

4.5.8 CONTROL PINS

Control Pins are utilized to control ESP8266. These pins incorporate Chip Enable pin (EN), Reset pin (RST) and WAKE pin.

□ EN pin – The ESP8266 chip is empowered when EN pin is pulled HIGH. At the point when pulled LOW the chip works at least force.

□ RST pin – RST pin is utilized to reset the ESP8266 chip.

□ WAKE pin – Wake pin is utilized to wake the chip from profound rest.

4.6 ESP8266 DEVELOPMENT PLATFORMS

Presently, how about we proceed onward to the fascinating stuff!

There are an assortment of advancement stages that can be prepared to program the ESP8266. You can go with Arduino – JavaScript SDK and firmware intently imitating Node, or use Mongoose OS – A working framework for IOT gadgets (suggested stage by Expressive Systems and Google Cloud IOT) or utilize a product improvement unit (SDK) given by Expressive or one of the stages recorded on wiki PEDIA

Luckily, the stunning ESP8266 people group made the IDE determination a stride further by making an Arduino add-on. In case you're simply beginning programming the ESP8266, this is the climate we suggest starting with, and the one we'll report in this instructional exercise.

This ESP8266 add-on for Arduino depends on the astonishing work by Ivan and the remainder of the ESP8266 people group. Look at the ESP8266 Arduino GitHub vault for more data.

We should continue with introducing ESP8266 Arduino center.

4.6.1

The principal thing is having most recent Arduino IDE (Arduino 1.6.4 or higher) introduced on your PC. On the off chance that don't have it, we suggest updating now.

4.6.2 Latest Arduino IDE

To begin, we'll need to update the board manager with a custom URL. Open up Arduino IDE and go to File > Preferences. Then, copy below URL into the Additional Board Manager URLs text box situated on the bottom of the window:
http://arduino.esp8266.com/stable/package_esp8266com_index.json

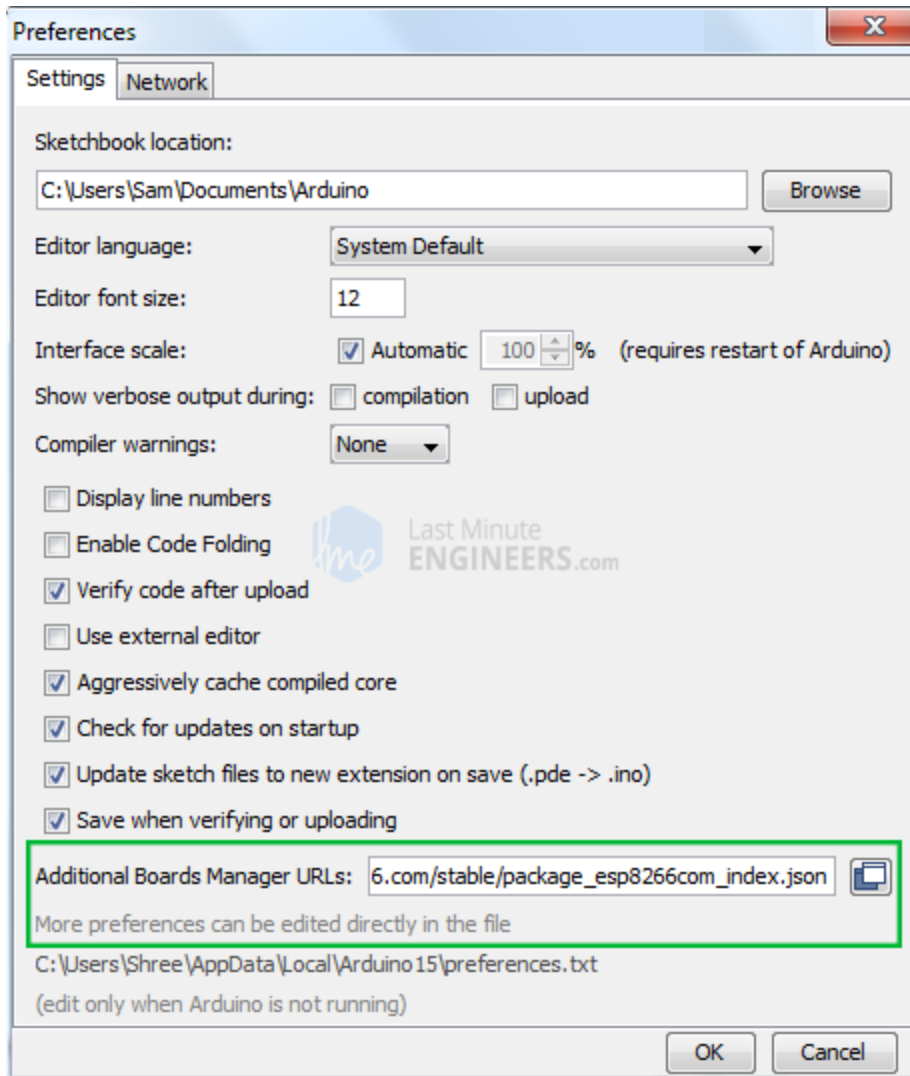


FIG NO : 4.10

Hit OK. Then navigate to the Board Manager by going to Tools > Boards > Boards Manager. There should be a couple new entries in addition to the standard Arduino boards. Filter your search by typing esp8266. Click on that entry and select Install.

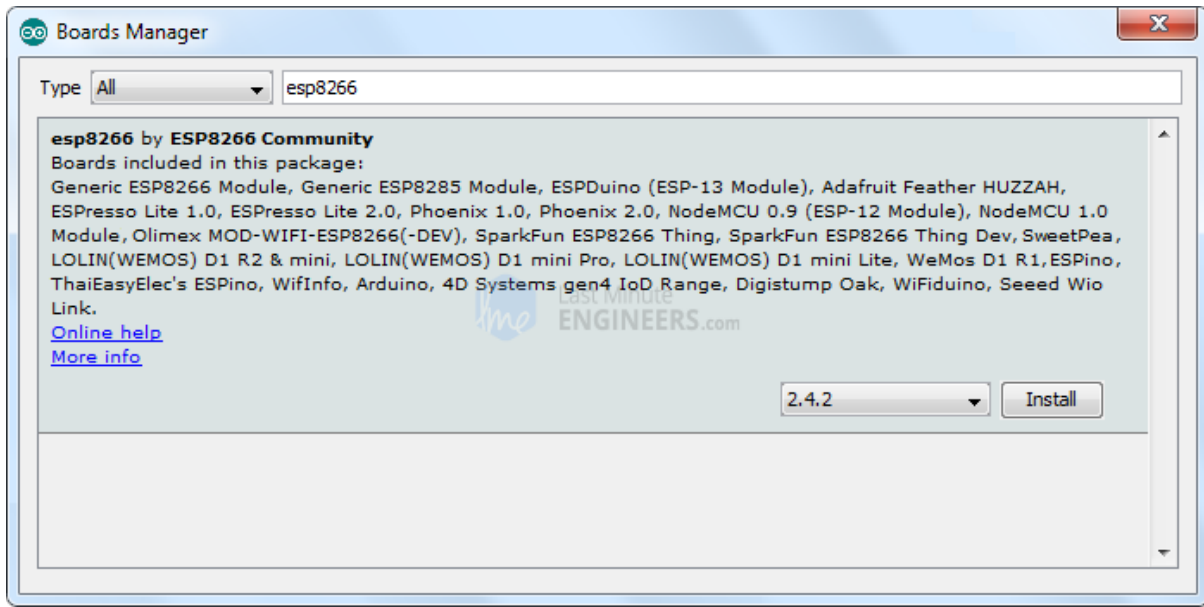


FIG NO : 4.10

The board definitions and instruments for the ESP8266 incorporate a totally different arrangement of g++, and other sensibly huge, aggregated doubles, so it might require a couple of moments to download and introduce (the documented record is ~110MB). When the establishment has finished, a little INSTALLED text will show up close to the section. You would now be able to close the Board Manager.

4.6.3 Arduino Example: Blink

To ensure ESP8266 Arduino center and the NODEMCU are appropriately set up, we'll transfer the least difficult sketch of all – The Blink!

We will utilize the on-board LED for this test. As referenced before in this instructional exercise, D0 pin of the board is associated with on-board Blue LED and is client programmable. Great!

Before we get to transferring sketch and playing with LED, we need to ensure that the board is chosen appropriately in Arduino IDE. Open Arduino IDE and select NODEMCU 0.9 (ESP-12 Module) choice under your Arduino IDE > Tools > Board menu.

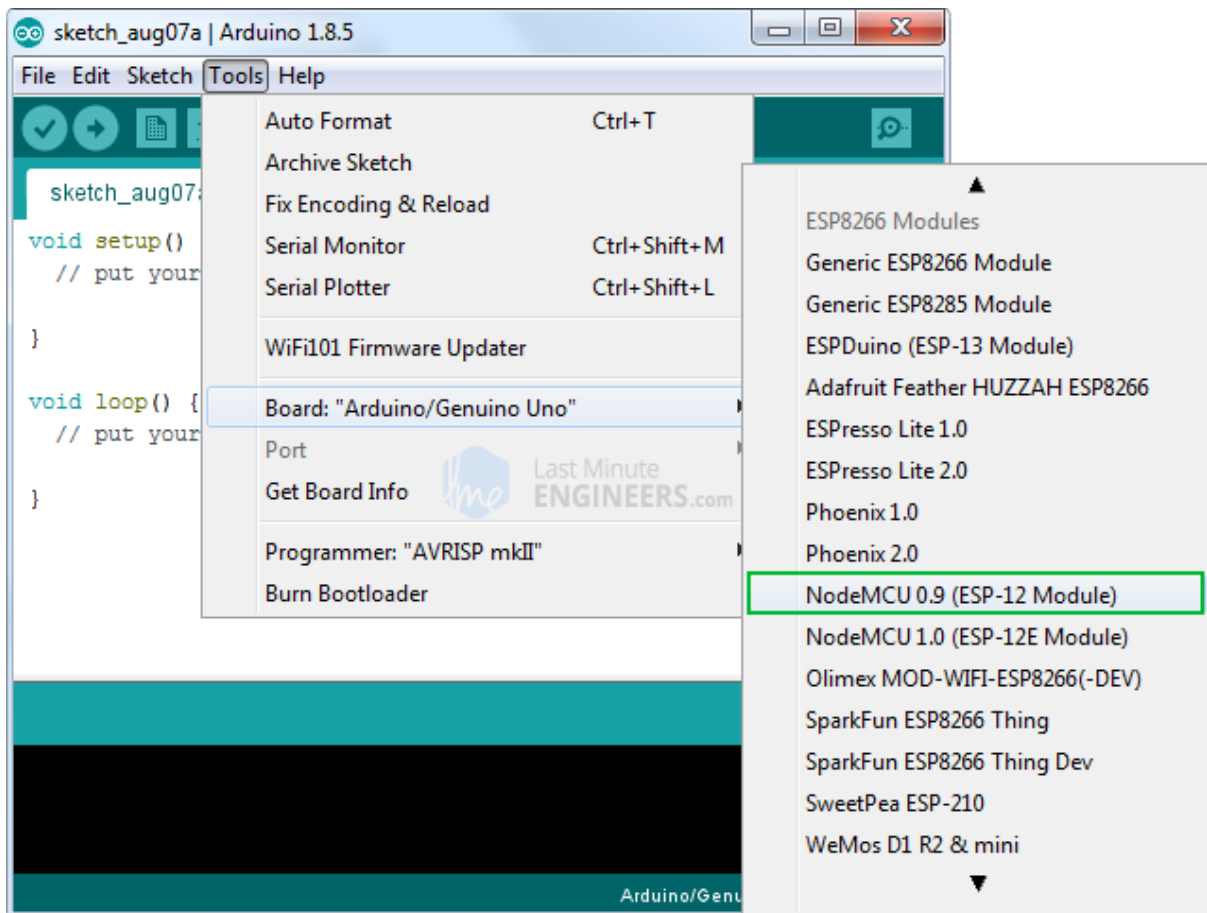


FIG NO : 4.11

Presently, plug your ESP8266 NODEMCU into your PC by means of miniature B USB link. When the board is connected, it ought to be appointed a one of a kind COM port. On Windows machines, this will be something like COM#, and on Mac/Linux PCs it will come in the structure . Select this sequential port under the Arduino IDE > Tools > Port menu. Likewise select the Upload Speed : 115200

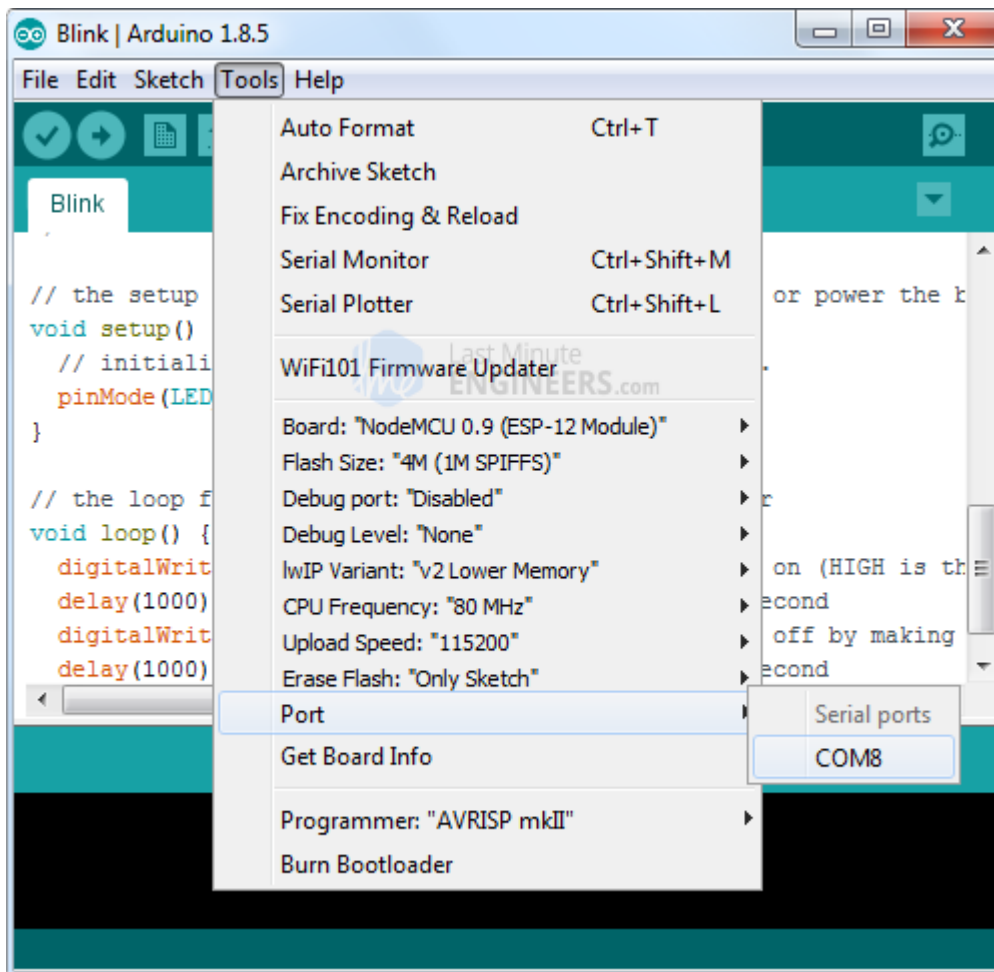


FIG NO : 4.11

4.6.4 WARNING

More consideration should be given to choosing board, picking COM port and choosing Upload speed. You may get upload_error while transferring new outlines, whenever neglected to do as such.

Whenever you are done, attempt the model sketch underneath.

```
void arrangement()
{
  PINMODE(D0, OUTPUT);
}

void circle()
{
```

```

Computerized Write(D0, HIGH);

delay(500);

Computerized Write(D0, LOW);

delay(500);

}

```

When the code is transferred, LED will begin squinting. You may have to tap the RST catch to get your ESP8266 to start running the sketch.

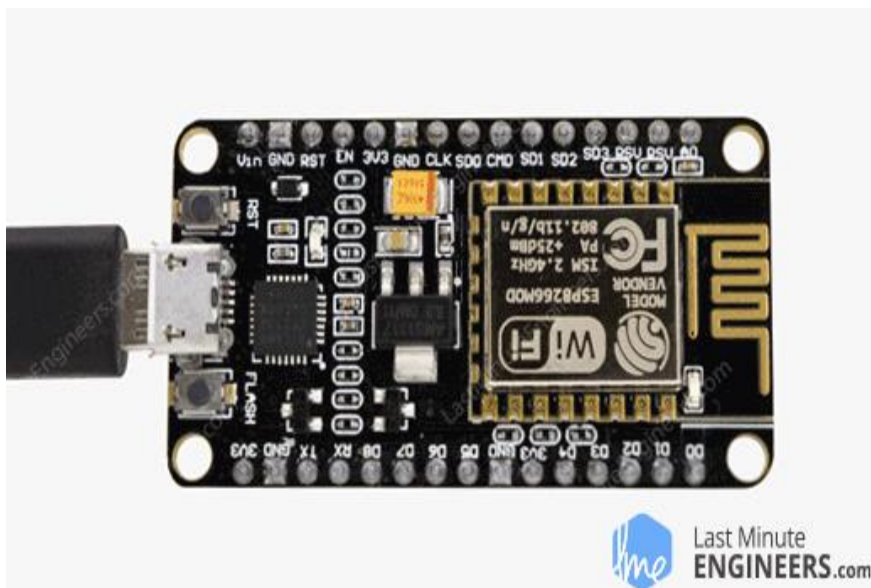


FIG NO : 4.12

4.6.5 ESP8266-0

Low cost, smaller and amazing Wi-Fi Module

Power Supply: +3.3V as it were

Current Consumption: 100mA

I/O Voltage: 3.6V (max)

I/O source current: 12mA (max)

Built-in low force 32-bit MCU @ 80MHz

512kB Flash Memory

Can be utilized as Station or Access Point or both consolidated

Supports Deep rest (<10uA)

Supports sequential correspondence consequently viable with numerous advancement stage like Arduino

Can be modified utilizing Arduino IDE or AT-orders

4.6.6 Applications

- IOT Projects
- Access Point Portals
- Wireless Data logging
- Smart Home Automation
- Learn basics of networking
- Portable Electronics
- Smart bulbs and Sockets

4.7 PROGRAM

```
#include <ESP8266WiFi.h>
```

```
#include <MCP3008.h>
```

```
#define CAYENNE_PRINT Serial
```

```
#include <CayenneMQTTESP8266.h>
```

```
// WiFi network info.
```

```
char ssid[] = "Arvina";
```

```
char wifiPassword[] = "palanivelk";
```

```
// Cayenne authentication info. This should be obtained from the Cayenne Dashboard.
```

```
char username[] = "a95aa390-7d99-11eb-8779-7d56e82df461";
```

```
char password[] = "8995fa03029c399f22c8ad651c1d7c1d4e5ebc7b";
```

```
char clientID[] = "3705bcc0-7da9-11eb-a2e4-b32ea624e442";
```

```
#define CS_PIN D8
```

```
#define CLOCK_PIN D5
```

```
#define MOSI_PIN D7
```

```
#define MISO_PIN D6
```

```
MCP3008 adc(CLOCK_PIN, MOSI_PIN, MISO_PIN, CS_PIN);
```

```
float Voltage_Value,Current_Value;
```

```
float V,I,P;
```

```
float energy;
```

```
float energy1 = 0;
```

```
float amt;
```

```
String data;
```

```
void setup() {
```

```
    pinMode(D2,OUTPUT);
```

```
    pinMode(D1,OUTPUT);
```

```
    Serial.begin(9600);
```

```
    //    digitalWrite(D2,LOW);
```

```

//    digitalWrite(D3,LOW);

    Cayenne.begin(username, password, clientID, ssid, wifiPassword);

}

void loop() {

    Cayenne.loop();

    Voltage_Value = adc.readADC(0);

//    Serial.print("Voltage_Value:");

//    Serial.println(Voltage_Value);

    Current_Value = adc.readADC(1);

//    Serial.print("Current_Value:");

//    Serial.println(Current_Value);

    long milisec1 = millis(); // calculate time in milisec

    long time1=milisec1/1000; // convert time to sec

//    Serial.print("time1:");

//    Serial.println(time1);

    I = Current_Value*0.0052;

    Serial.print("Amp:");

    Serial.println(I);

```

```
V = Voltage_Value*0.50;
```

```
Serial.print("volt:");
```

```
Serial.println(V);
```

```
delay(1000);
```

```
P = V*I;
```

```
Serial.print("power:");
```

```
Serial.println(P);
```

```
long milisec2 = millis(); // calculate time in milisec
```

```
long time2=milisec2/1000; // convert time to sec
```

```
// Serial.print("time2:");
```

```
// Serial.println(time2);
```

```
float T = time2 - time1;
```

```
// Serial.print("Time:");
```

```
// Serial.println(T);
```

```
float energy = P*T;
```

```
// Serial.print("energy:");
```

```
// Serial.println(energy);
```

```

    energy1 += energy;

    Serial.print("energy:");

    Serial.println(energy);


    amt = energy1*.1;

    Serial.print("Amount:");

    Serial.println(amt);


    Cayenne.virtualWrite(V3,I);

    Cayenne.virtualWrite(V4,V);

    Cayenne.virtualWrite(V5,amt);

    Cayenne.virtualWrite(V6,P);


}

CAYENNE_IN(V1)

{

    int pinValue = getValue.asInt();


    if (pinValue == 1)

    {

        digitalWrite(D2, HIGH); // Turn LED on.

        Serial.println("Light1 on");

    }

```

```

else

{

    digitalWrite(D2, LOW); // Turn LED off.

    Serial.println("Light1 off");

}

}

```

```

CAYENNE_IN(V2)

{

    int pinValue1 = getValue.asInt();

    if (pinValue1 == 1)

    {

        digitalWrite(D1, HIGH); // Turn LED on.

        Serial.println("Light2 on");

    }

    else

    {

        digitalWrite(D1, LOW); // Turn LED off.

        Serial.println("Light2 off");

    }

    //  delay(500);

}

```

Software tools:

- Arduino IDE
- Embedded C

4.8 ARDUINO SOFTWARE (IDE)

- Writing Sketches

- File
- Edit
- Sketch
- Tools
- Help

- Sketchbook
- Tabs, Multiple Files, and Compilation
- Uploading
- Libraries
- Third-Party Hardware
- Serial Monitor
- Preferences
- Language Support
- Boards

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Arduino hardware to upload programs and communicate with them.

4.8.1 WRITING SKETCHES

written in the word processor and are saved with the document expansion .ino. The proofreader has highlights for cutting/sticking and for looking/supplanting text. The message territory gives criticism while saving and trading and furthermore shows blunders. The comfort shows text yield by the Arduino Software (IDE), including total blunder messages and other data. The base right hand corner of the window shows the designed board and sequential port. The toolbar catches permit you to check and transfer programs, make, open, and save draws, and open the chronic screen. Projects composed utilizing Arduino Software (IDE) are called sketches. These portrayals are

NB: Versions of the Arduino Software (IDE) preceding 1.0 saved portrayals with the expansion .PDE. It is feasible to open these documents with adaptation 1.0, you will be provoked to save the sketch with the .INO augmentation on save.



Verify

Checks your code for errors compiling it.



Upload

Compiles your code and uploads it to the configured board.
See [uploadingbelow](#) for details.

Note: If you are using an external programmer with your board, you can hold down the "shift" key on your computer when using this icon. The text will change to "Upload using Programmer"



New

Creates a new sketch.

Additional commands are found within the five menus: File, Edit, Sketch, Tools, Help. The menus are context sensitive, which means only those items relevant to the work currently being carried out are available.

4.8.2 FILE

Save as... New

Makes another occasion of the proofreader, with the absolute minimum construction of a sketch effectively set up.

Open

Permits to stack a sketch document perusing the PC drives and organizers.

Open Recent

Gives a short rundown of the latest representations, fit to be opened.

Sketchbook

Shows the current representations inside the sketchbook organizer structure; tapping on any name opens the comparing sketch in another manager case.

Examples

Any model given by the Arduino Software (IDE) or library appears in this menu thing. Every one of the models are organized in a tree that permits simple access by subject or library.

Close

Shuts the occasion of the Arduino Software from which it is clicked.

Save

Recoveries the sketch with the current name. On the off chance that the document hasn't been named previously, a name will be given in a "Save as.." window.

Permits to save the current sketch with an alternate name.

Page Setup

It shows the Page Setup window for printing.

Print

Sends the current sketch to the printer as indicated by the settings characterized in Page Setup.

Preferences

Opens the Preferences window where a few settings of the IDE might be tweaked, as the language of the IDE interface.

Quit Closes all IDE windows. Similar portrayals open when Quit was picked will be naturally resumed the following time you start the IDE.

4.8.3 EDIT

- **Undo/Redo**
Goes back of one or more steps you did while editing; when you go back, you may go forward with Redo.
- **Cut**
Removes the selected text from the editor and places it into the clipboard.
- **Copy**
Duplicates the selected text in the editor and places it into the clipboard.
- **Copy for Forum**
Copies the code of your sketch to the clipboard in a form suitable for posting to the forum, complete with syntax coloring.
- **Copy as HTML**
Copies the code of your sketch to the clipboard as HTML, suitable for embedding in web pages.
- **Paste**
Puts the contents of the clipboard at the cursor position, in the editor.
- **Select All**
Selects and highlights the whole content of the editor.
- **Comment/UN comment**
Puts or removes the // comment marker at the beginning of each selected line.
- **Increase/Decrease Indent**
Adds or subtracts a space at the beginning of each selected line, moving the text one space on the right or eliminating a space at the beginning.
- **Find**
Opens the Find and Replace window where you can specify text to search inside the current sketch according to several options.
- **Find Next**
Highlights the next occurrence - if any - of the string specified as the search item in the Find window, relative to the cursor position.
- **Find Previous**
Highlights the previous occurrence - if any - of the string specified as the search item in the Find window relative to the cursor position.

4.8.4 SKETCH

- **Adds a source file to the sketch** (it will be copied from its current location). The new file appears in a new tab in the sketch window. Files can be removed from the sketch using **Verify/Compile**
Checks your sketch for errors compiling it; it will report memory usage for code and variables in the console area.

- **Upload**
Compiles and loads the binary file onto the configured board through the configured Port.
- **Upload Using Programmer**
This will overwrite the boot loader on the board; you will need to use Tools > Burn Boot loader to restore it and be able to Upload to USB serial port again. However, it allows you to use the full capacity of the Flash memory for your sketch. Please note that this command will NOT burn the fuses. To do so a Tools -> Burn Boot loader command must be executed.
- **Export Compiled Binary**
Saves a .hex file that may be kept as archive or sent to the board using other tools.
- **Show Sketch Folder**
Opens the current sketch folder.
- **Include Library**
Adds a library to your sketch by inserting #include statements at the start of your code. For more details, see libraries below. Additionally, from this menu item you can access the Library Manager and import new libraries from .zip files.
- **Add File...**
the tab menu accessible clicking on the small triangle icon below the serial monitor one on the right side of the toolbar.

4.8.5 TOOLS

- **Auto Format**
This formats your code nicely: i.e. indents it so that opening and closing curly braces line up, and that the statements inside curly braces are indented more.
- **Archive Sketch**
Archives a copy of the current sketch in .zip format. The archive is placed in the same directory as the sketch.
- **Fixes possible discrepancies between the editor char map encoding and other operating systems char maps.**
- **Serial Monitor**
Opens the serial monitor window and initiates the exchange of data with any connected board on the currently selected Port. This usually resets the board, if the board supports Reset over serial port opening.
- **Board**
Select the board that you're using. See below for descriptions of the various boards.
- **Port**
This menu contains all the serial devices (real or virtual) on your machine. It should automatically refresh every time you open the top-level tools menu.
- **Programmer**
For selecting a hardware programmer when programming a board or chip and not using

the onboard USB-serial connection. Normally you won't need this, but if you're burning a bootloader to a new micro controller, you will use this.

- **Burn Boot loader**

The items in this menu allow you to burn a bootloader onto the micro controller on an Arduino board. This is not required for normal use of an Arduino board but is useful if you purchase a new AT mega micro controller (which normally come without a boot loader). Ensure that you've selected the correct board from the Boards menu before burning the boot loader on the target board. This command also set the right fuses.

4.8.6 HELP

Software (IDE). You have access to Getting Started, Reference, this guide to the IDE and other documents locally, without an internet connection. The documents are a local copy of the online ones and may link back to our online website.

Find in RHere you find easy access to a number of documents that come with the ☐ Save as... New

Makes another occasion of the proofreader, with the absolute minimum construction of a sketch effectively set up.

☐ **Open**

Permits to stack a sketch document perusing the PC drives and organizers.

☐ **Open Recent**

Gives a short rundown of the latest representations, fit to be opened.

Sketchbook

Shows the current representations inside the sketchbook organizer structure; tapping on any name opens the comparing sketch in another manager case.

Examples

Any model given by the Arduino Software (IDE) or library appears in this menu thing. Every one of the models are organized in a tree that permits simple access by subject or library.

Close

Closes the event of the Arduino Software from which it is clicked.

Save

Recuperations the sketch with the current name. If the report hasn't been named beforehand, a name will be given in a "Save as.." window.

Grants to save the current sketch with a substitute name.

Page Setup

It shows the Page Setup window for printing.

Print

Sends the current sketch to the printer as indicated by the settings characterized in Page Setup.

Inclinations

Opens the Preferences window where a couple of settings of the IDE may be changed, as the language of the IDE interface.

Stop Closes all IDE windows. Comparable depictions open when Quit was picked will be normally continued the accompanying time you start the IDE. nction or order under the cursor.

4.8.7 SKETCH BOOK

The Arduino Software (IDE) utilizes the idea of a sketchbook: a standard spot to store your projects (or outlines). The representations in your sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar. The first occasion when you run the Arduino programming, it will naturally make an index for your sketchbook. You can view or change the area of the sketchbook area from with the Preferences dialog.

Starting with variant 1.0, documents are saved with a .INO record augmentation. Past forms utilize the .PDE augmentation. You may in any case open .PDE named records in adaptation 1.0 and later, the product will naturally rename the expansion to .INO.

4.8.8 TABS, MULTIPLE FILES AND COMPILATION

Permits you to oversee portrays with more than one record (every one of which shows up in its own tab). These can be typical Arduino code documents (no noticeable augmentation), C records (.c expansion), C++ documents , or header documents, Multiple Files, and Compilation.

4.8.9 UPLOADING

Prior to transferring your sketch, you need to choose the right things from the Tools > Board and Tools > Port menus. The boards are portrayed beneath. On the Mac, the sequential port is presumably something like.usbmodem241 (for a Mega2560 or Leonardo) or us sequential 1B1 (for a prior USB board), or USA19QW1b1P1.1 (for a sequential board associated with a USB-to-Serial connector). On Windows, it's probably COM1 or COM2 (for a sequential board) or COM4, COM5, COM7, or higher (for a USB board) - to discover, you search for USB sequential gadget in the ports part of the Windows Device Manager. On Linux, it ought to be comparable. Whenever you've chosen the right sequential port and board, press the transfer button in the toolbar or select the Upload item from the Sketch menu. Current Arduino reset consequently and start the transfer. With more established sheets that need auto-reset, you'll need to press the reset button on the board not long prior to beginning the transfer. On most sheets, you'll consider the To be and TX LED blink as the sketch is transferred. The Arduino Software (IDE) will show a message when the transfer is finished, or show a mistake.

At the point when you transfer a sketch, you're utilizing the Arduino boot loader, a little program that has been stacked on to the miniature regulator on your board. It permits you to transfer code without utilizing any extra equipment. The boot loader is dynamic for a couple of moments when the board resets; at that point it begins whichever sketch was most as of late transferred to the miniature regulator. The boot loader will flicker the ready (pin 13) LED when it begins (for example at the point when the board resets).

4.8.10 LIBRARIES

Libraries give additional usefulness to use in portrays, for example working with equipment or controlling information. To utilize a library in a sketch, select it from the Sketch > Import Library menu. This will embed one or more #include statements at the highest point of the portray and order the library with your sketch. Since libraries are transferred to the board with your sketch, they increment the measure of room it takes up. In the event that a sketch not, at this point needs a library, basically erase its #include articulations from the highest point of your code.

There is a list of libraries in the reference. A few libraries are incorporated with the Arduino programming. Others can be downloaded from an assortment of sources or through the Library Manager. Beginning with adaptation 1.0.5 of the IDE, you do can import a library from a compress document and use it in an open sketch. See these instructions for introducing an outsider library.

To compose your own library, see this instructional exercise.

4.8.11 THIRD -PARTY HARDWARE

Backing for outsider equipment can be added to the hardware directory of your sketchbook catalog. Stages introduced there may incorporate board definitions (which show up in the board menu), center libraries, boot loaders, and developer definitions. To introduce, make the hardware directory, at that point unfasten the outsider stage into its own sub-registry. (Try not to utilize "Arduino" as the sub-index name or you'll supersede the underlying Arduino stage.) To uninstall, just erase its registry.

For subtleties on making bundles for outsider equipment, see the Arduino IDE 1.5 outsider Hardware particular.

4.8.12 SERIAL MONITOR

Showcases sequential information being sent from the Arduino board (USB or sequential board). To send information to the board, enter text and snap on the "send" catch or press enter. Pick the baud rate starting from the drop that coordinates with the rate passed to Serial.begin in your sketch. Note that on Windows, Mac or Linux, the Arduino board will reset (rerun your sketch execution to the start) when you associate with the chronic screen.

You can likewise converse with the board from Processing, Flash, MAXMSP, and so forth (see the interfacing page for subtleties).

4.8.13 Preferences

Some preferences can be set in the preferences dialog (found under the Arduino menu on the Mac, or File on Windows and Linux). The rest can be found in the preferences file, whose location is shown in the preference dialog.

4.8.14 Language Support

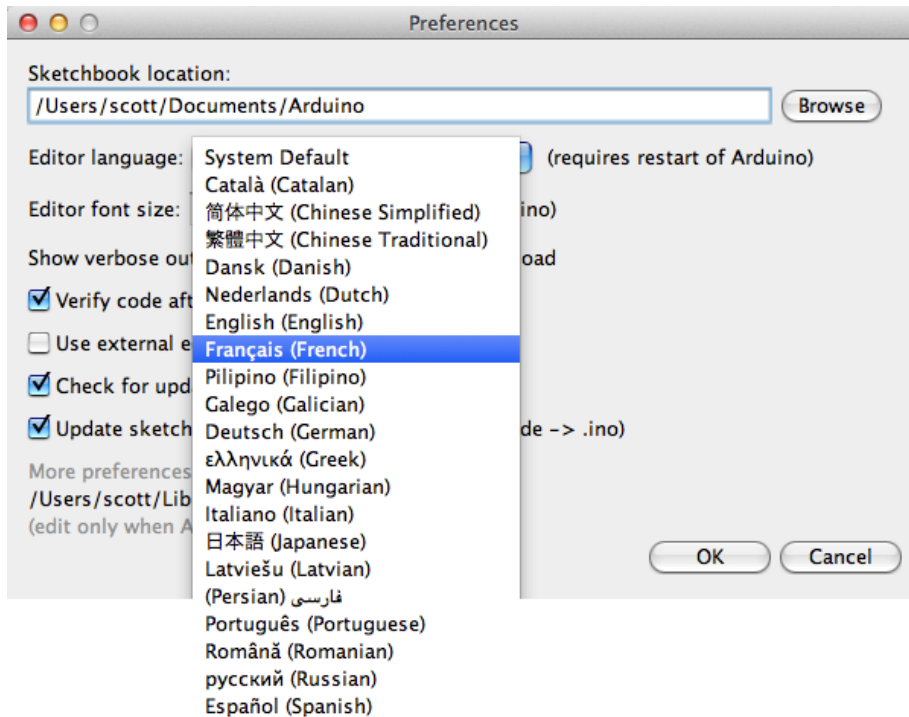


FIG NO : 13

Since adaptation 1.0.1 , the Arduino Software (IDE) has been converted into 30+ various dialects. As a matter of course, the IDE loads in the language chose by your working framework. (Note: on Windows and conceivably Linux, this is dictated by the region setting which controls cash and date designs, not by the language the working framework is shown in.)

On the off chance that you might want to change the language physically, start the Arduino Software (IDE) and open the Preferences window. Close to the Editor Language there is a drop down menu of as of now upheld dialects. Select your favored language from the menu, and restart the product to utilize the chose language. On the off chance that your working framework language isn't upheld, the Arduino Software (IDE) will default to English.

You can return the product to its default setting of choosing its language dependent on your working framework by selecting System Default from the Editor Language drop-down. This setting will produce results when you restart the Arduino Software (IDE). Likewise, subsequent to changing your working framework's settings, you should restart the Arduino Software (IDE) to refresh it to the new default language.

4.8.15 BOARDS

The board selection has two effects: it sets the parameters (e.g. CPU speed and baud rate) used when compiling and uploading sketches; and sets the file and fuse settings used by the burn boot loader command. Some of the board definitions differ only in the latter, so even if you've been uploading successfully with a particular selection you'll want to check it before burning the boot loader. You can find a comparison table between the various boards [here](#).

Arduino Software (IDE) includes the built in support for the boards in the following list, all based on the AVR Core. The Boards Manager included in the standard installation allows to add support for the growing number of new boards based on different cores like Arduino Due, Arduino Zero, Edison, Galileo and so on.

- **Arduino**
An ATmega32u4 running at 16 MHz with auto-reset, 12 Analog In, 20 Digital I/O and 7 PWM.
- **Arduino**
An ATmega328 running at 16 MHz with auto-reset, 6 Analog In, 14 Digital I/O and 6 PWM. An ATmega168 running at 16 MHz with auto-reset.
- **Arduino NANO w/ ATmega328**
An ATmega328 running at 16 MHz with auto-reset. Has eight analog inputs.
- **Arduino Mega 2560**
An ATmega2560 running at 16 MHz with auto-reset, 16 Analog In, 54 Digital I/O and 15 PWM.
- **Arduino Mega**
An ATmega1280 running at 16 MHz with auto-reset, 16 Analog In, 54 Digital I/O and 15 PWM.
- **Arduino Mega ADK**
An ATmega2560 running at 16 MHz with auto-reset, 16 Analog In, 54 Digital I/O and 15 PWM.
- **Arduino Leonardo**
An ATmega32u4 running at 16 MHz with auto-reset, 12 Analog In, 20 Digital I/O and 7 PWM.
- **Arduino Micro**
An ATmega32u4 running at 16 MHz with auto-reset, 12 Analog In, 20 Digital I/O and 7 PWM.
- **Arduino**
An ATmega32u4 running at 16 MHz with auto-reset.
- **Arduino Mini w/ ATmega328**
An ATmega328 running at 16 MHz with auto-reset, 8 Analog In, 14 Digital I/O and 6 PWM.
- **Arduino Ethernet**
Equivalent to Arduino UNO with an Ethernet shield: An ATmega328 running at 16 MHz with auto-reset, 6 Analog In, 14 Digital I/O and 6 PWM.

- **Arduino FIO**
An ATmega328 running at 8 MHz with auto-reset. Equivalent to Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega328, 6 Analog In, 14 Digital I/O and 6 PWM.
- **Arduino BT w/ ATmega328**
ATmega328 running at 16 MHz. The boot loader burned (4 KB) includes codes to initialize the on-board blue tooth module, 6 Analog In, 14 Digital I/O and 6 PWM..
- **Lily Pad Arduino USB**
An ATmega32u4 running at 8 MHz with auto-reset, 4 Analog In, 9 Digital I/O and 4 PWM.
- **Lily Pad Arduino**
An ATmega168 or ATmega132 running at 8 MHz with auto-reset, 6 Analog In, 14 Digital I/O and 6 PWM.
- **Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega328**
An ATmega328 running at 16 MHz with auto-reset. Equivalent to Arduino NANO w/ ATmega328; 6 Analog In, 14 Digital I/O and 6 PWM.
- **Arduino NG or older w/ ATmega168**
An ATmega168 running at 16 MHz without auto-reset. Compilation and upload is equivalent to Arduino ATmega168, but the boot loader burned has a slower timeout (and blinks the pin 13 LED three times on reset); 6 Analog In, 14 Digital I/O and 6 PWM.
- **Arduino Robot Control** An ATmega328 running at 16 MHz with auto-reset.
- **Arduino Robot Motor** An ATmega328 running at 16 MHz with auto-reset.
- **Arduino GAMA** An ATtiny85 running at 8 MHz with auto-reset, 1 Analog In, 3 Digital I/O and 2 PWM.

4.9 CLOUD

A cloud administration has three particular qualities that separate it from conventional web facilitating. It is sold on request, regularly continuously or the hour; it is flexible - a client can have so a lot or as little of a help as they need at some random time; and the assistance is completely overseen by the supplier (the shopper needs only a PC and Internet access). Huge advancements in virtualization and appropriated figuring, just as improved admittance to fast Internet, have sped up interest in distributed computing.

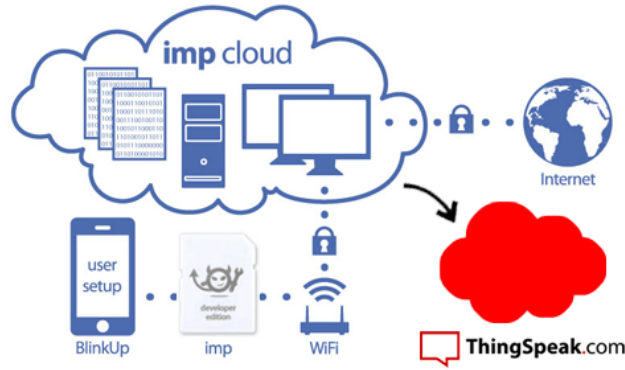


FIG NO : 14

THING SPEAK

Thing Speak is an Open-Source IOT application and API to store and recover information from Hardware gadgets and Sensors. It utilizes HTTP Protocol over the Internet or LAN for its correspondence. The MATLAB logical is incorporated to investigate and picture the information got from your Hardware or Sensor Devices.

We can make channels for every single sensor information. These channels can be set as private channels or you can share the information public through Public channels. The business highlights incorporate extra highlights. In any case, we will utilize the free form as we doing it for instructive reason.

Thing Speak is an IOT stage, that permits you to associate and save sensor information in the cloud and create IOT applications. Additionally, the stage gives applications that let you investigate and imagine information. MATLAB support assists you with following up on information. Sensor information can be effortlessly incorporated and sent from Arduino or Raspberry Pi or some other IOT door.

You can make projects like Weather Station, Tide Prediction, Counter and Many More.

In this instructional exercise, we will utilize a LDR to plot its light Intensity level on Thing Speak utilizing NODEMCU. We will program the NODEMCU to peruse and store the LDR information into a variable and afterward transfer it to Thing Speak utilizing its channel name and API key.

4.9.1 HOW TO CREATE AN ACCOUNT

Step 1: Go to <https://thingspeak.com/> and create your Thing Speak Account if you don't have. Login to Your Account.

Step 2: Create a Channel by clicking 'New Channel'.

The screenshot shows the ThingSpeak web interface. At the top is a navigation bar with links for Channels, Apps, Community, Support, Commercial Use, How to Buy, Account, and Sign Out. The main heading is 'My Channels'. Below this, a green 'New Channel' button is highlighted with an orange rectangle. To its right is a search bar labeled 'Search by tag'. Below the button is a table with columns 'Name', 'Created', and 'Updated'. The table contains one entry: 'Node LDR Test', created on '2017-12-20' and updated on '2017-12-28 17:13'. Below the table name are several tabs: Private, Public, Settings, Sharing, API Keys, and Data Import / Export. To the right of the table is a 'Help' section with instructions on how to create a channel and sort the table. Below the help section is an 'Examples' section with a list of links: Arduino, Arduino MKR1000, ESP8266, Raspberry Pi, and Netduino Plus.

Name	Created	Updated
Node LDR Test	2017-12-20	2017-12-28 17:13

FIG NO : 4.15

Step 3: Enter the channel details.

Name: Any Name

Description: Optional

Field 1: Light Intensity LDR – This will be displayed on the analytic graph. If you need more than 1 Channels you can create for additional Sensor Data.

Save this setting.

New Channel

Name

FactoryForward

Description

How Intense the Light

Field 1

Light Intensity LDR

☒

Field 2

☐

Field 3

☐

Field 4

☐

Field 5

☐

Help

Channels store all the data that a ThingSpeak application collects. Each channel includes eight fields that can hold any type of data, plus three fields for location data and one for status data. Once you collect data in a channel, you can use ThingSpeak apps to analyze and visualize it.

Channel Settings

- **Channel Name:** Enter a unique name for the ThingSpeak channel.
- **Description:** Enter a description of the ThingSpeak channel.
- **Field#:** Check the box to enable the field, and enter a field name. Each ThingSpeak channel can have up to 8 fields.
- **Metadata:** Enter information about channel data, including JSON, XML, or CSV data.
- **Tags:** Enter keywords that identify the channel. Separate tags with commas.
- **Link to External Site:** If you have a website that contains information about your ThingSpeak channel, specify the URL.

FIG NO : 4.15

Step 4: Now you can see the channels. Click on the 'API Keys' tab. Here you will get the Channel ID and API Keys. Note this down.

FactoryForward

Channel ID: 3714482

Author: sarathkumar341

Access: Private

How Intense the Light

Private View

Public View

Channel Settings

Sharing

API Keys

Data Import / Export

Write API Key

Key

3BA0DA23DFW5378

Generate New Write API Key

Help

API keys enable you to
keys are auto-generat

API Keys Seti

- **Write API Key:** L
been comprom
- **Read API Keys:**
feeds and chart

Step 5: Open Arduino IDE and Install the Thing Speak Library. To do this go to Sketch>Include Library>Manage Libraries. Search for Thing Speak and install the library.

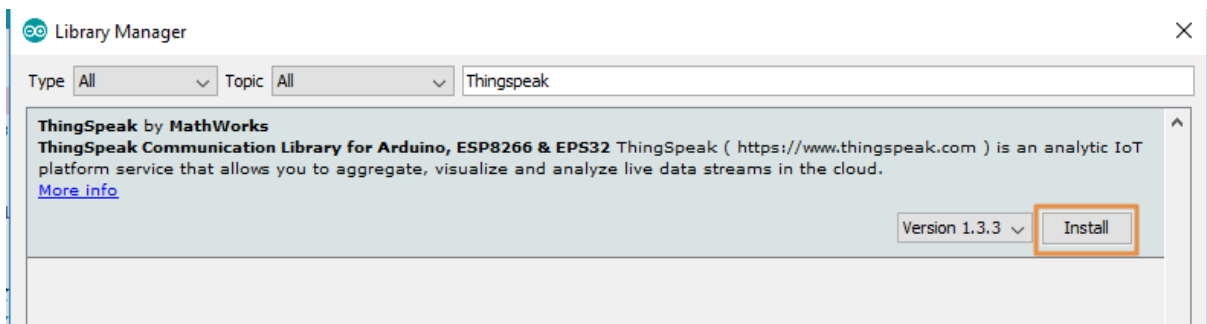


FIG NO : 4.15

Step 6: Click **Save Channel** at the bottom of the settings.

You now see these tabs:

Private View: This tab displays information about your channel that only you can see.

Public View: If you decide to make your channel openly accessible, utilize this tab to show chosen fields and channel representations.

Channel Settings: This tab shows all the channel alternatives you set at creation. You can alter, clear, or erase the channel from this tab.

Sharing: This tab shows channel sharing alternatives. You can set a channel as private, imparted to everybody (public), or imparted to explicit clients.

API Keys: This tab shows your channel API keys. Utilize the keys to peruse from and keep in touch with your channel.

Data Import/Export: This tab empowers you to import and fare channel information.

FEATURES

Collect information in private channels.

Share Data with Public Channels

REST API and MQTT APIS

MATLAB® Analytic and Visualizations.

Worldwide Community

4.9.2 FINAL RESULT



FIG NO : 4.16

4.9.3 APPLICATIONS

- Smart home
- Industrial energy management
- Street light fault detection

4.10 HARDWARE

4.10.1 CURRENT TRANSFORMER

Interestingly toThe Current Transformer (CT), is a sort of "instrument transformer" that is planned to make a trading stream in its discretionary winding which is relating to the stream being assessed in its primary. Current transformers reduce high voltage streams to a much lower regard and give an invaluable technique for safely checking the genuine electrical stream spilling in an AC transmission line using a standard ammeter. The head of action of a basic current transformer is to some degree not exactly equivalent to that of a standard voltage transformer.

Not in the least like the voltage or power transformer looked at effectively, the current transformer includes only one or not a lot of turns as its fundamental winding. This fundamental winding can be of either a single level turn, a circle of solid wire collapsed over the middle or essentially a channel or transport bar put through a central opening as showed up.

Due to this sort of plan, the current transformer is consistently implied too as a "course of action transformer" as the fundamental winding, which never has more than a very few turns, is in game plan with the current passing on conductor giving a store.

The assistant contorting regardless, may have incalculable circle turns curved on a covered focus of low-setback alluring material. This middle has a colossal cross-sectional district so the appealing movement thickness made is low using significantly more unobtrusive cross-sectional area wire, dependent upon how much the current ought to be wandered down as it endeavors to yield a consistent current, independent of the related burden.

The assistant winding will supply a current into either a short out, as an ammeter, or into a resistive weight until the voltage provoked in the discretionary is satisfactorily enormous to drench the middle or cause disillusionment from outrageous voltage breakdown.

a voltage transformer, the fundamental current of a current transformer isn't penniless of the discretionary weight current yet rather is compelled by an external weight. The helper current is by and large assessed at a standard 1 Ampere or 5 Amperes for greater fundamental current evaluations.

There are three major kinds of current transformers: wound, and bar.

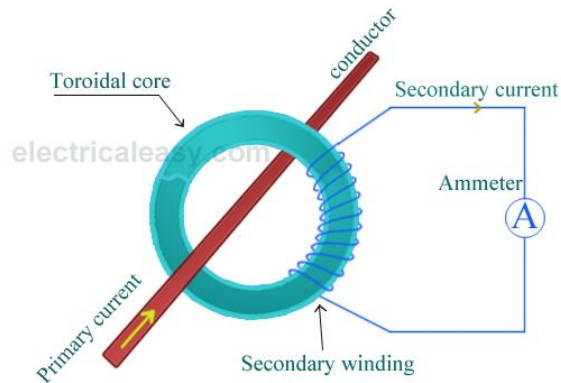
Wound Current Transformer – The transformers fundamental winding is genuinely related in plan with the conductor that passes on the purposeful current spilling in the circuit. The degree of the discretionary current is dependent on the turns extent of the transformer.

I Current Transformer – These don't contain a fundamental winding. Taking everything into account, the line that passes on the current gushing in the association is hung through a window or opening in the transformer. Some current transformers have a "split focus" which licenses it to be opened, presented, and shut, without isolating the circuit to which they are joined.

□ Bar-type Current Transformer – This sort of current transformer uses the certifiable connection or transport bar of the central circuit as the fundamental winding, which is indistinguishable from a lone turn. They are totally shielded from the high working voltage of the structure and are for the most part raced to the current passing on device.

Current transformers can decline or "step-down" current levels from an enormous number of amperes down to a standard yield of an acknowledged extent to either 5 Amps

or 1 Amp for normal action. As such, little and precise instruments and control devices can be used with CT's since they are shielded away from any high-voltage electrical links. There are a combination of metering applications and uses for current transformers, for instance, with WATTMETER, power factor meters, watt-hour meters, cautious exchanges, or as journey twists in alluring circuit breakers, or MCB.



Current Transformer

FIG NO : 4.17

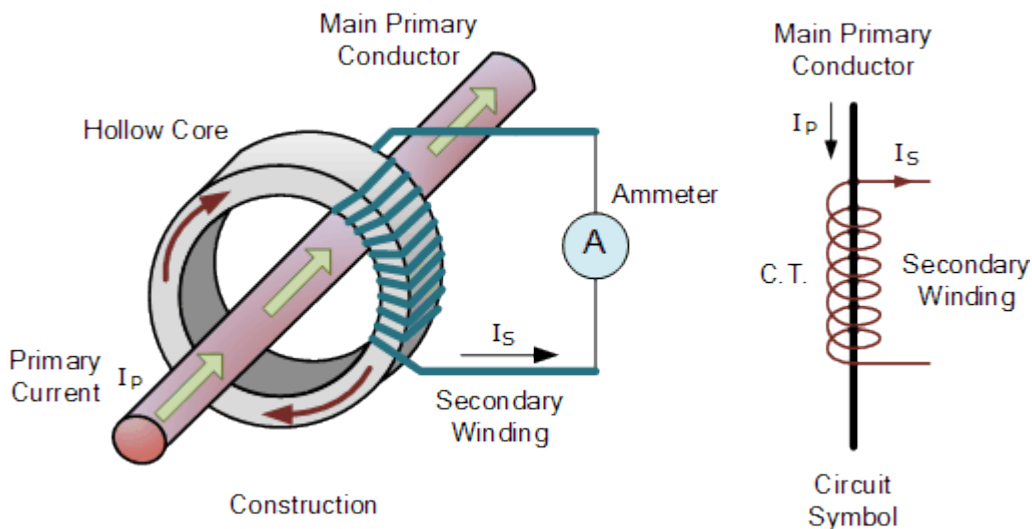


FIG NO : 4.17

Most current transformers have a the standard discretionary rating of 5 amps with the fundamental and assistant streams being imparted as an extent like 100/5. This suggests that the fundamental current is on different occasions more vital than the discretionary current so when 100 amps is gushing in the fundamental conductor it will achieve 5 amps spilling in the helper winding. A current transformer of say 500/5, will convey 5 amps in the assistant for 500 amps in the fundamental conductor, on numerous occasions more noticeable.

By growing the amount of discretionary winding, N_S , the helper current can be made much more unassuming than the current in the fundamental circuit being assessed in light of the fact that as N_S fabricates, I_S heads off to some place almost a relate current transformer, similar to some other transformer, should fulfill the amp-divert condition and we know from our instructional exercise on twofold total. Toward the finish of the amount of turns and the current in the fundamental and helper winding are associated by an opposite degree.

voltage transformers that this turns proportion is equivalent to:

$$\text{T.R.} = n = \frac{N_P}{N_S} = \frac{I_S}{I_P}$$

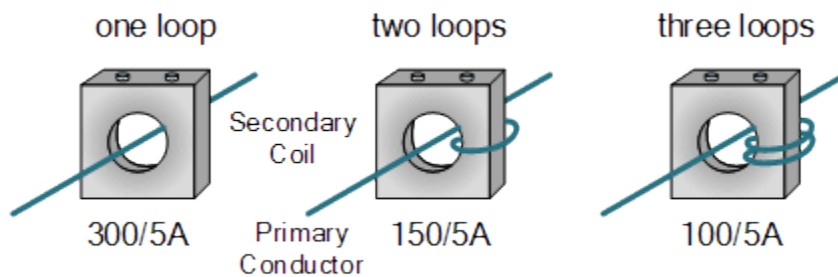
from which we get:

$$\text{secondary current, } I_S = I_P \left(\frac{N_P}{N_S} \right)$$

All around current transformers and ammeters are used all together pair in which the arrangement of the current transformer is, for instance, to give a most limit discretionary current identifying with a full-scale redirection on the ammeter. In most current transformers a harsh in reverse turns extent exists between the two streams in the fundamental and discretionary winding. This is the explanation arrangement of the CT is overall for a specific kind of ammeter.

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Current Transformer Primary Turns Ratio



4.10.2 Current Transformer Example No1

A bar-type current transformer which has 1 turn on its fundamental and 160 turns on its assistant is to be used with a standard extent of ammeters that have an internal resistance of 0.2Ω . The ammeter is expected to give a full scale redirection when the fundamental current is 800 Amps. Find out the best helper current and discretionary voltage across the ammeter.

Secondary Current:

$$I_S = I_P \left(\frac{N_P}{N_S} \right) = 800 \left(\frac{1}{160} \right) = 5A$$

Voltage across Ammeter:

$$V_S = I_S \times R_A = 5 \times 0.2 = 1.0 \text{ Volts}$$

Anyway Were We can see over that since the optional of the current transformer is associated across the ammeter, which has a little opposition, the voltage drop across the auxiliary winding is just 1.0 volts at full essential current.

, if the ammeter was eliminated, the auxiliary twisting viably gets open-circuited, and subsequently the transformer goes about as a stage up transformer. This due partially to the huge expansion in polarizing motion in the auxiliary center as the optional spillage reactance impacts the optional instigated voltage on the grounds that there is no restricting current in the auxiliary twisting to forestall this.

The outcomes is a high voltage instigated in the optional twisting equivalent to the proportion of: $VP(NS/Np)$ being created across the auxiliary winding. So for instance, expect our present transformer from above is utilized on a 480 volt to earth three-stage pointer.. Therefor

This high voltage is in light of the fact that the volts per turns extent is for all intents and purposes predictable in the fundamental and discretionary winding and as $V_s = NS*VP$ the assessments of NS and VP are superior calibers, so V_s is incredibly high.

Subsequently a current transformer should never be left open-circuited or worked with no-store joined when the central fundamental current is traveling through it correspondingly as a voltage transformer should never work into a short out. In case the ammeter (or weight) is to be taken out, a short out should be set across the discretionary terminals first to clear out the peril of paralyze.

This high voltage is in light of the fact that when the discretionary is open-circuited the iron focal point of the transformer works at a genuine degree of drenching and with nothing to stop it, it conveys a . peculiarly huge discretionary voltage, and in our clear model over, this was resolved at 76.8kV!. This high helper voltage could hurt the assurance or cause electric stagger if the CT's terminals are unintentionally reached.

4.10.3 HANDHELD CURRENT TRANSFORMERS



FIG NO :4.18

Subsequently a current transformers helper twisting should never be worked into an open circuit, correspondingly as a voltage transformer should never be worked into a short out. There are numerous specific sorts of current transformers now open. A standard and advantageous sort which can be used to check circuit stacking are assigned "cut meters" as showed up.

Snap meters open and close around a current passing on conductor and measure its current by choosing the alluring field around it, giving a smart assessment examining when in doubt on a modernized show without separating or opening the circuit.

Similarly as the handheld support type CT, split focus current transformers are available which has one end removable so the store conductor or transport bar shouldn't be withdrawn to present it. These are open for assessing streams from 100 up to 5000 amps, with square window sizes from 1" to over 12" (25-to-300mm).

By then to summarize, the Current Transformer, (CT) is a sort of instrument transformer used to change over a fundamental current into a helper current through an alluring medium. Its discretionary winding by then gives a much lessened current which can be used for distinguishing over current, affinity, top current, or ordinary current conditions.

A current transformers fundamental twist is continually related in plan with the central conductor achieving it similarly being suggested as a course of action transformer. The apparent helper current is assessed at 1A or 5A for effortlessness of assessment. Improvement can be one single fundamental turn as in Doughnut, or Bar types, several injury fundamental turns, for the most part for low current extents.

Current transformers are proposed to be used as relative current contraptions

High voltages will result from open circuiting the discretionary circuit of an engaged current transformer so their terminals ought to be shortcircuited if the ammeter is to be taken out or when a CT isn't being utilized before controlling up the system.

In the accompanying instructional exercise about Transformers we will perceive what happens when we partner together three individual transformers in a star or delta configuration to make a greater power transformer called a Three Phase Transformer used to supply 3-stage provider.

4.11 POTENTIAL TRANSFORMER

4.11.1 DEFINITION

The potential transformer might be characterized as an instrument transformer utilized for the change of voltage from a higher worth to the lower esteem. This transformer venture down the voltage to a protected breaking point esteem which can be effortlessly estimated by the customary low voltage instrument like a voltmeter, wattmeter and watt-hour meters, and so on



FIG NO :4.19

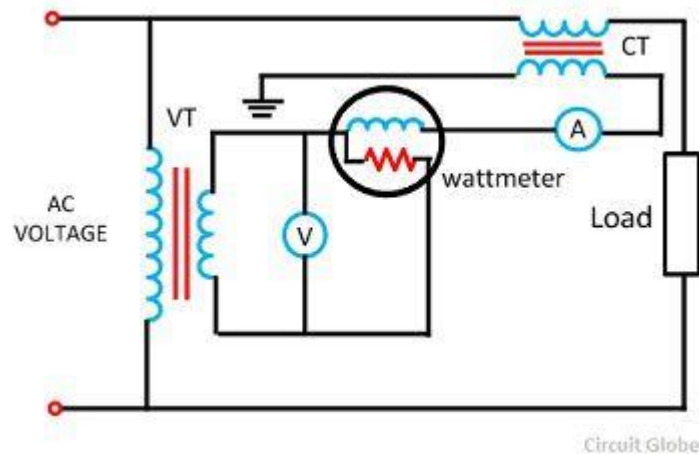
Construction of Potential Transformer

The potential transformer is made with excellent center working at low motion thickness so the polarizing current is little. The terminal of the transformer ought to be designed so the variety of the voltage proportion with load is least and the stage move between the information and yield voltage is additionally least.

The essential winding has an enormous number of turns, and the optional winding has a much modest number of turns. For diminishing the spillage reactance, the co-pivotal winding is utilized in the expected transformer. The protection cost is additionally diminished by separating the essential twisting into the sections which lessen the protection between the layers.

4.11.2 CONNECTION OF POTENTIAL TRANSFORMER

The potential transformer is associated in corresponding with the circuit. The essential twisting of the potential transformer are straightforwardly associated with the force circuit whose voltage is to be estimated. The auxiliary terminals of the potential transformer are associated with the estimating instrument like the voltmeter, WATTMETER, etc. The optional twisting of the potential transformer are attractively coupled through the attractive circuit of the essential winding.



4.11.3 TYPES OF POTENTIAL TRANSFORMER

The potential transformer is mainly classified into two types, i.e., the conventional wound types (electromagnetic types) and the capacitor voltage potential transformers. Conventional wound type transformer is very expensive because of the requirement of the insulation. Capacitor potential transformer is a combination of capacitor potential divider and a magnetic potential transformer of relatively small ratio.

The circuit diagram of the capacitor potential transformer is shown in the figure below. The stack of high voltage capacitor from the potential divider, the capacitors of two sections becomes C_1 and C_2 , and the Z is the burden.

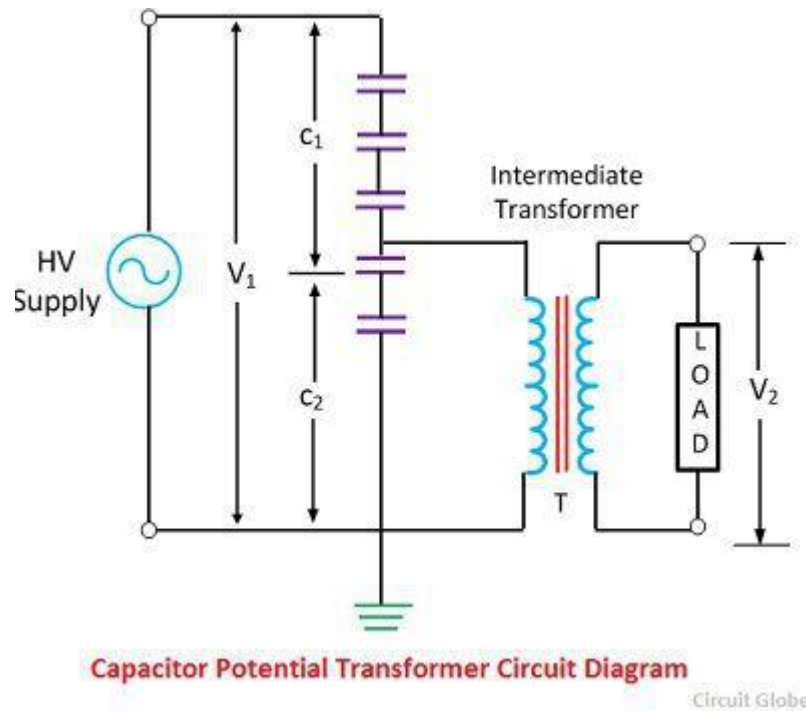


FIG NO :4.21

The voltage applied to the primary of the intermediate transformer is usually of the order 10kV. Both the potential divider and the intermediate transformer have the ratio and insulation requirement which are suitable for economical construction.

The intermediate transformer must be of very small ratio error, and phase angle gives the satisfactory performance of the complete unit. The secondary terminal voltage is given by the formula shown below.

$$V_2 = V_1 \times \frac{C_1}{C_1 + C_2}$$

Ratio and Phase Angle Errors of Potential Transformer

In an ideal potential transformer, the primary and the secondary voltage is exactly proportional to the primary voltage and exactly in phase opposition. But this cannot be achieved practically due to the primary and secondary voltage drops. Thus, both the primary and secondary voltage is introduced in the system.

voltage Ratio Error – The voltage ratio error is expressed in regarding measured voltage, and it is given by the formula as shown below.

$$\text{Ratio Error} = \frac{K_t I_s - I_p}{I_p}$$

Where K_n is the nominal ratio, i.e., the ratio of the rated primary voltage and the rated secondary voltage.

Phase Angle Error – The stage point mistake is the blunder between the optional terminal voltage which is by and large in stage

The increases in the number of instruments in the relay connected to the secondary of the potential transformer will increase the errors in the potential transformers.

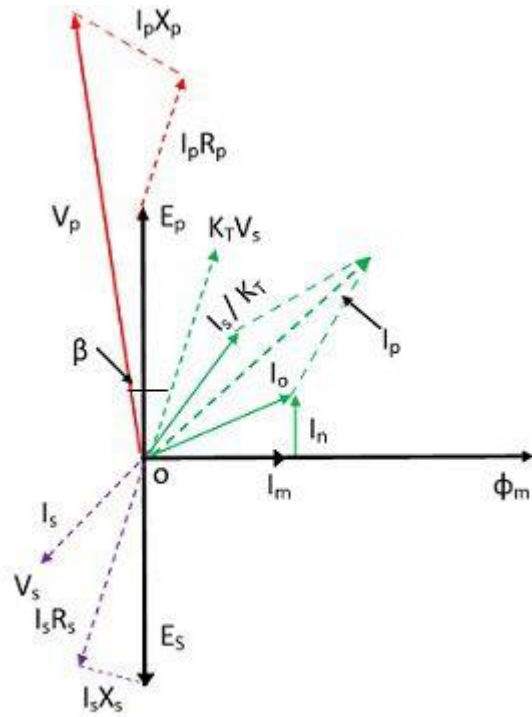
Burden of a Potential Transformer

The weight is the absolute outside volt-amp load on the auxiliary at appraised optional voltage. The evaluated weight of a PT is a

VA trouble which should not be surpassed if the transformer is to work with its evaluated accuracy. The appraised trouble is shown on the nameplate.

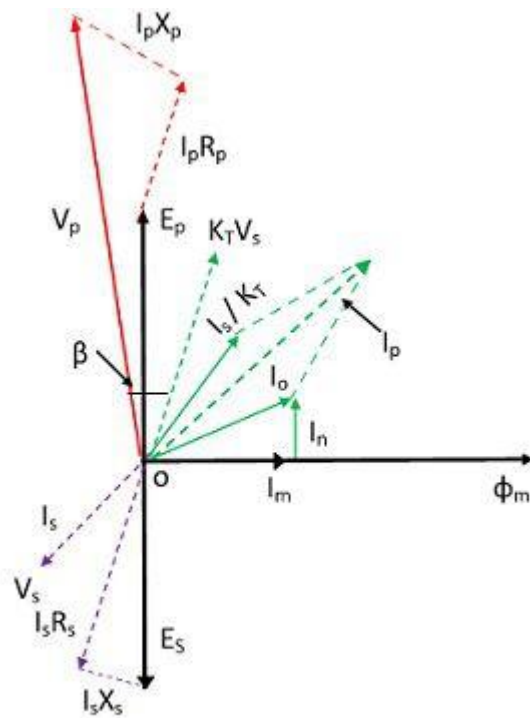
PHASOR Diagram of a Potential Transformer

The PHASOR diagram of the potential transformer is shown in the figure below.



Phasor Diagram of Potential Transformer

Circuit Globe



Phasor Diagram of Potential Transformer

Circuit Globe

FIG NO : 4.22

Where,

I_s –secondary current

E_s – secondary induced emf

V_s – secondary terminal voltage

R_s – secondary winding resistance

X_s – secondary winding reactance

I_p – Primary current

E_p – primarily induced emf

V_p – primary terminal voltage

R_p – primary winding resistance

X_p – primary winding reactance

K_t – turn ratio

I_o – excitation current

I_M – magnetizing component of I_o

I_W – core loss component of I_o

Φ – main flux

θ – phase angle error

The fundamental motion is taken as a source of perspective. In instrument transformer, the essential current is the vector amount of the excitation current I_o and the current equivalent to the inversion auxiliary current I_s multiplied by the proportion of $1/K_t$. The V_p is the voltage applied to the essential terminal of the possible transformer.

The voltage drops because of obstruction and reactance of essential twisting because of essential current is given by $I_p X_p$ and $I_p R_p$. At the point when the voltage drop takes away from the essential voltage of the possible transformer, the basically incited emf will show up across the terminals.

This essential emf of the transformer will change into auxiliary twisting by shared enlistment and changed over into optional initiated emfs. This emf will drop by the optional winding opposition and reactance, and the resultant voltage will show up across the auxiliary terminal voltage, and it is indicated by V_s .

Utilizations of Potential Transformer

- 1.It is utilized for a metering reason.
- 2.For the assurance of the feeders.
- 3.For ensuring the impedance of the generators.
- 4.For synchronizing the generators and feeders.

The potential transformers are utilized in the ensuring handing-off conspire on the grounds that the likely curls of the defensive gadget are not straightforwardly associated with the framework if there should arise an occurrence of the great voltage. Thusly, it is important to venture down the voltage and furthermore to protect the defensive hardware from the essential circuit.

CHAPTER 5

5.1 HARDWARE PICTURE

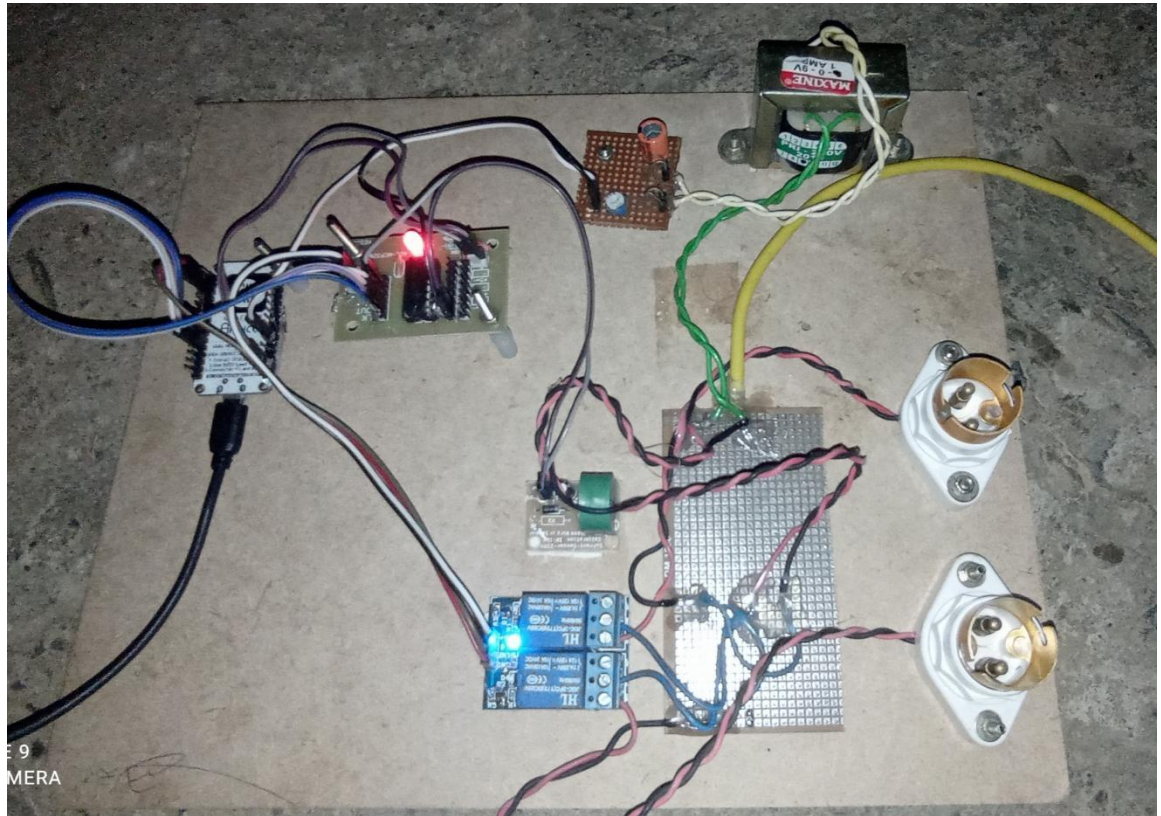
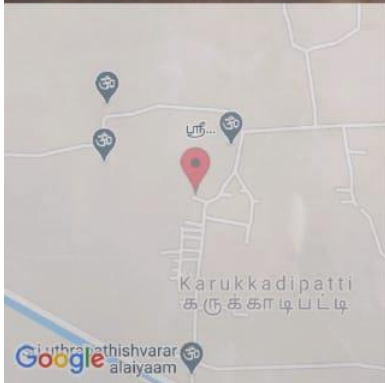
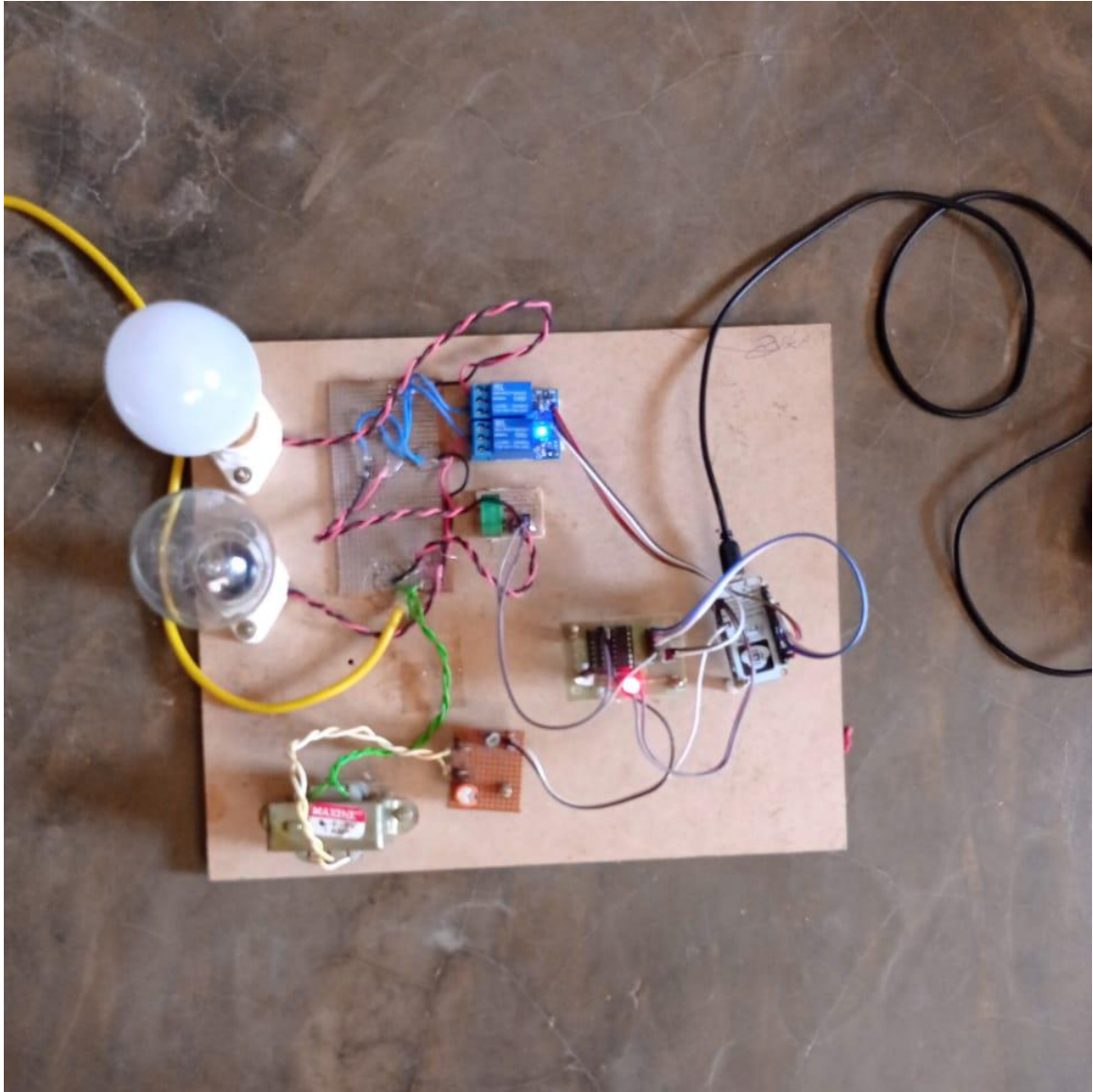


FIG NO : 5.1

GEOTAG PICTURE:





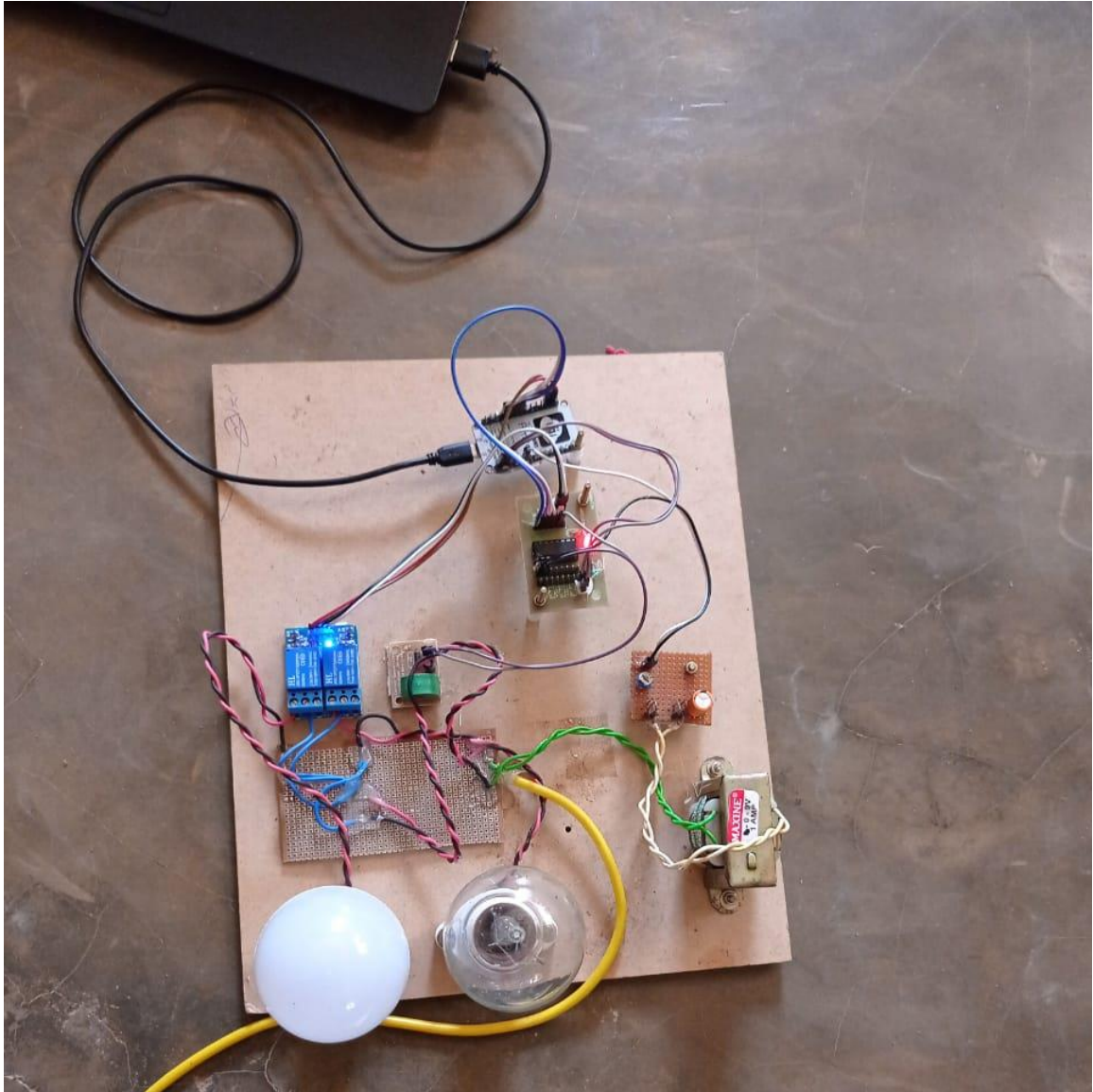
Unnamed Road, Karukkadiipatti, Tamil Nadu 614902, India

Karukkadiipatti
Tamil Nadu
India



38°C
100°F

2021-04-04(Sun) 02:21(pm)



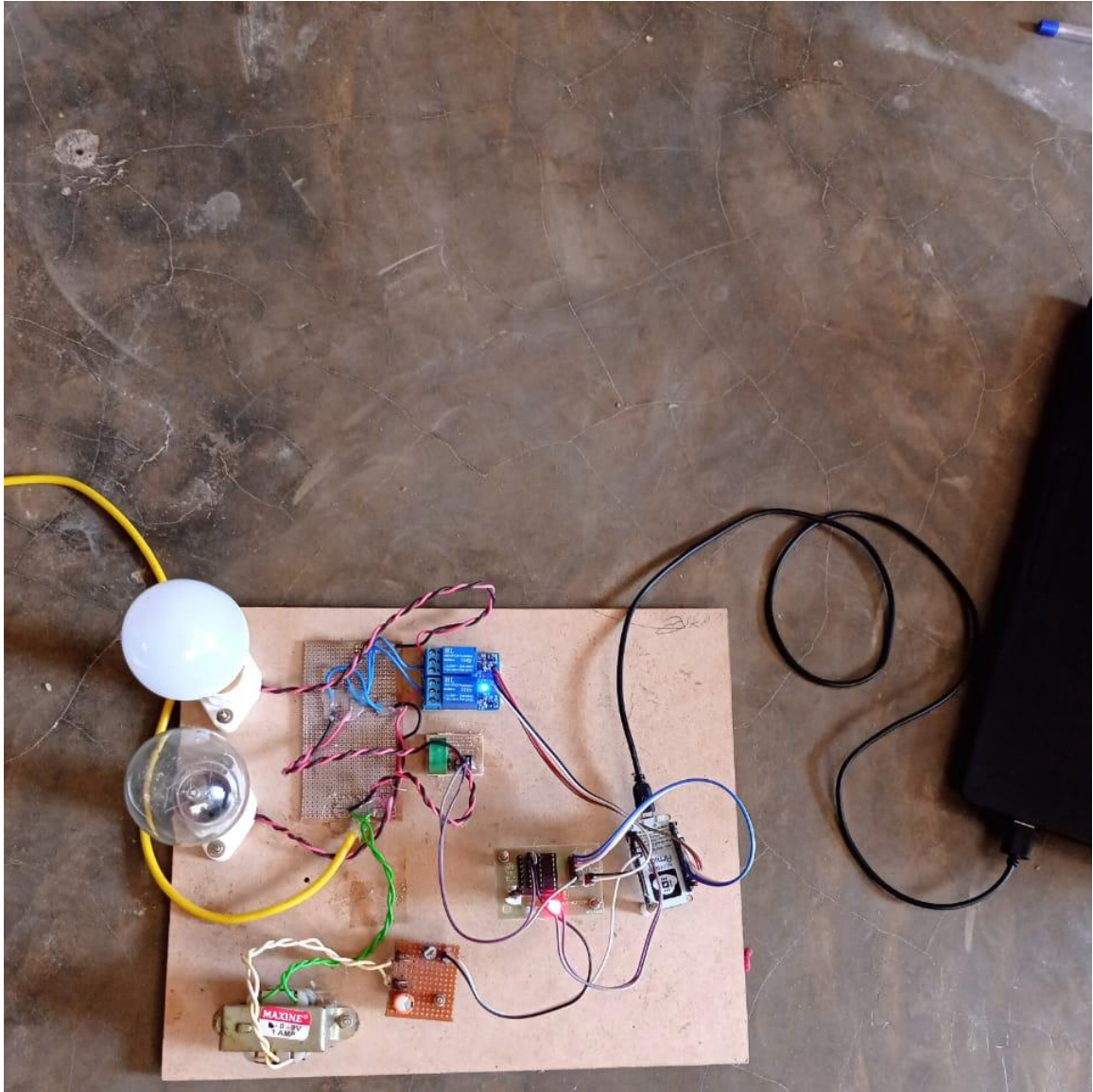
Unnamed Road, Karukkadiipatti, Tamil Nadu 614902, India

Karukkadiipatti
Tamil Nadu
India



38°C
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Unnamed Road, Karukkadipatti, Tamil Nadu 614902, India

Karukkadipatti
Tamil Nadu
India



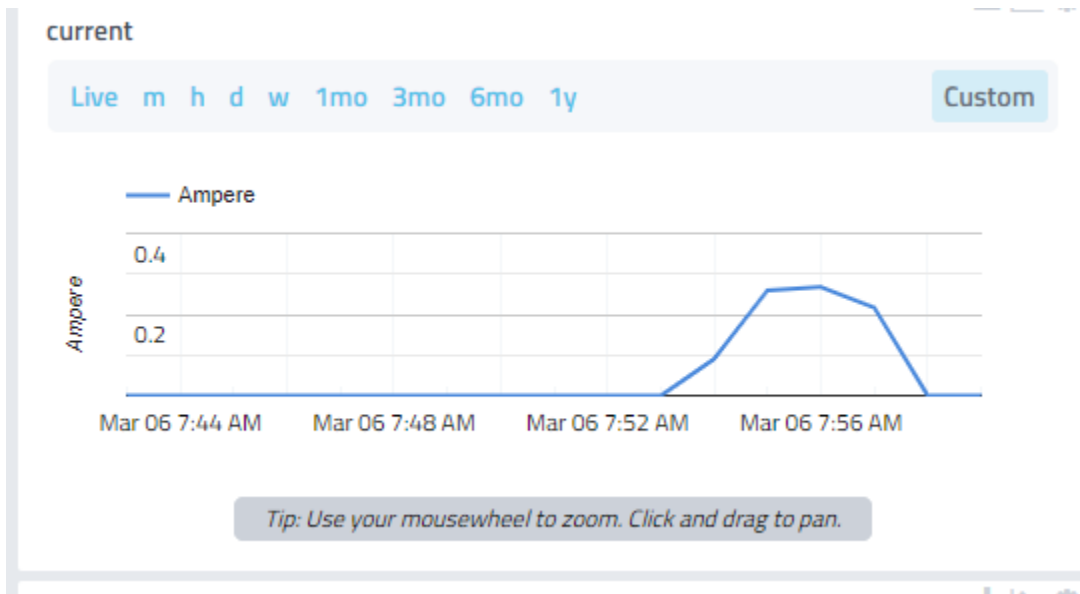
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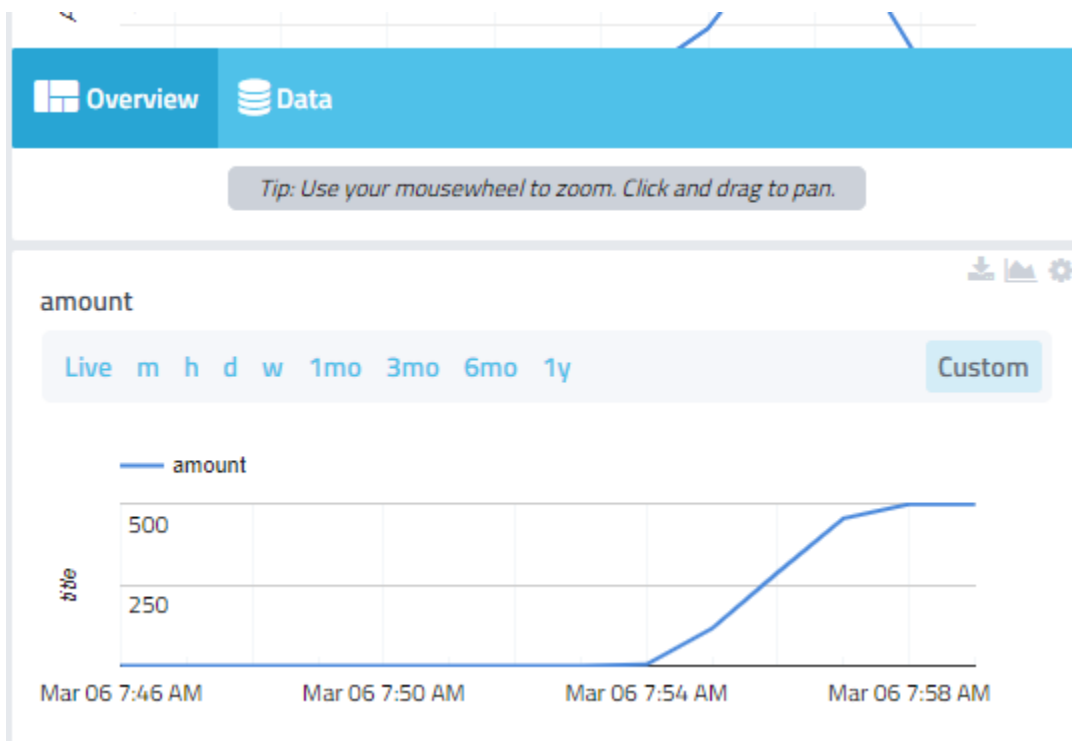
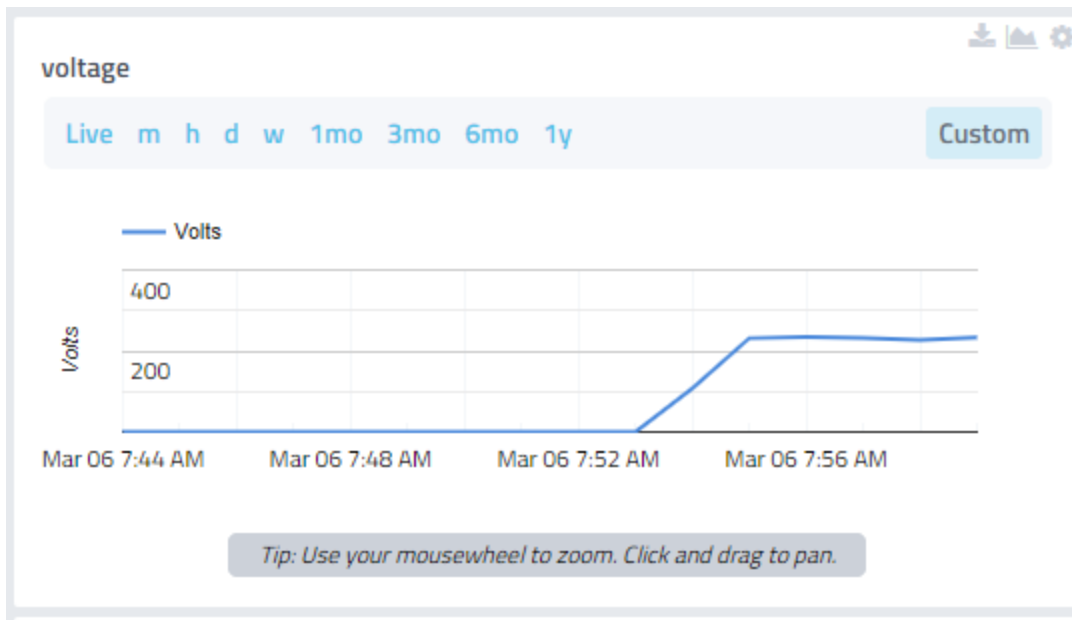
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FIG NO : 5.2

5.2 SOFTWARE OUTPUT





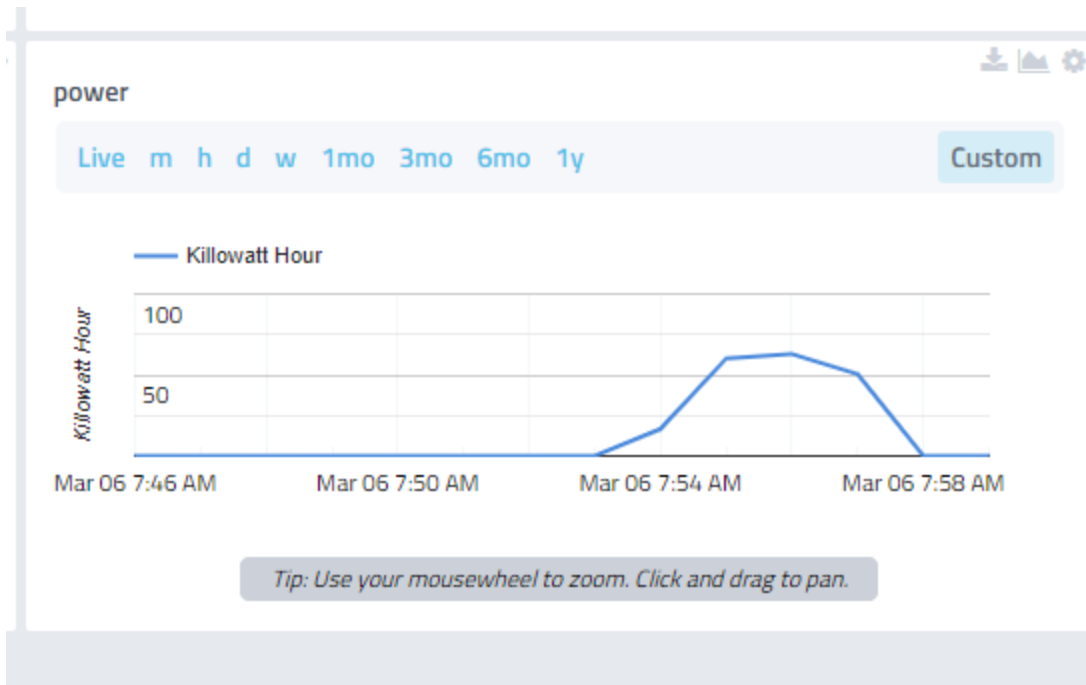


FIG NO : 5.3

CHAPTER 6

6.1 CONCLUSION

A minimal effort, secure, all around available, auto configurable, distantly controlled arrangement is proposed in here. The methodology is to control machines distantly utilizing the IOT innovation to interface frameworks, fulfilling client needs and necessities. The goal here is to save energy and appropriate administration of force dispersion, show the viable route for power use and protection, to make power utilization low and preservation more successful and to make keen and smart use of energy. It gives distant association with the structure door. It empowers gadget control and screen, improves security, and saves energy.

CHAPTER 7

7.1 REFERENCE:

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