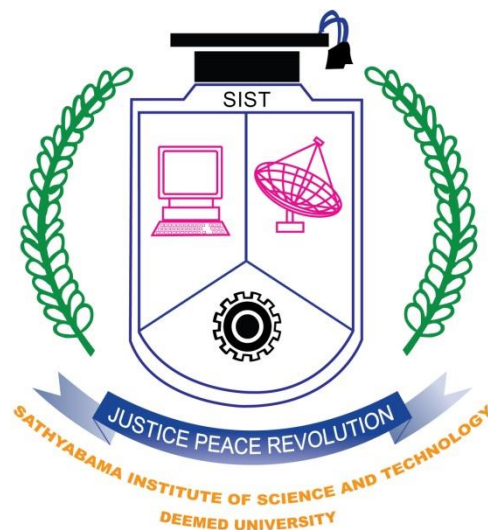


SMART ENERGY METER

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

DEVARAKONDA ARUN RAO (Register No. 37140024)

SIRIGI REDDY NIKHILESWAR REDDY (Register No. 37140081)



**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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APRIL 2021



SATHYABAMA

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of **DEVERAKONDA ARUN RAO (Reg.No.37140024)** and **SIRIGI REDDY NIKHILESWAR REDDY (Reg.No.37140081)** who carried out the project entitled "**SMART ENERGY METER**" done by us under the guidance of **Dr. S. RADHIKA** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electrical and Electronics Engineering.

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Signature:

DECLARATION

We **DEVARAKONDA ARUN RAO(REG.NO 37140024)** and **SIRIGI REDDY NIKHILESWAR REDDY(37140081)** hereby declare that the Project Report entitled “**SMART ENERGY METER**” done by us under the guidance of **Dr. S. RADHIKA** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Electrical and Electronics Engineering.

1.

A rectangular box containing a blue ink signature that appears to read "Arun Rao".

DATE:

2. *S. Nikhiles war Reddy..*

PLACE:

SIGNATURE OF THE CANDIDATES

ACKNOWLEDGEMENT

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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ABSTRACT

The demand for the facility has augmented exponentially with time one avenue through that today's energy drawback are often address through the reduction energy usage in households. This has augmented the stress on the requirement of correct and economic strategies of power measuring. The goal of providing such knowledge to optimize and cut back the facility consumption. In this presents a sensible energy meter for Associate in automation of power consumption on our day after day. Over current relay is style of protecting relay that operates once the load current exceeds a preset values. This is often to style IDMT (Inverse Definite minimum Time) over current relay exploitation IOT. The mixing of NODEMCU extrasensory perception 8266 and ACS-712 sensors. The planned energy meter will operate all told hundreds and collect the consumed power in watts AND gate cutoff is placed once it crosses planned values.

During this project shift hundreds instead of manually hundreds are often operated through our mobiles. the most feature that have inspired the look and development of IOT based mostly good energy meter ar their economy, compartness , responsibility , flexibility and improved performance over standard relays.

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CHAPTER-1

INTRODUCTION

The security and dependability of the electricity infrastructure is of necessary importance nowadays quite ever, given the degree to that electric-powered technology has become embedded altogether human activities. Protective the electrical power provide system against interruptions due to varied faults is so a main analysis concern. One of the parts concerned in power-system protection is that the breaker, that is chargeable for closing the system once a fault or anomaly happens thus on guard the electrical instrumentality.

In today's world, the technological trend of implementing "smart" technologies, fostered by the emergence of Cloud Computing and so the net of Things (IoT), semiconductor diode to a transfiguration of standard devices and environments to "smart" entities. Throughout this context, ancient electrical protection devices additionally tend to transcend and become "smart", and consequently supply improved fault-detection and protection, remote observation and event notification. By changing into sensible, a home is embedded with omnipresent computing instrumentality that connects all the home devices to a minimum of each other and so the net.

A smart town conjointly embeds among the urban landscape computers, sensors, cameras and alternative sensitive instrumentation operative among the background. In these circumstances, protective the ability offer grid against faults becomes even additional necessary, given the increasing variety of sensitive devices connected among the rising sensible world. Moreover, the traditional electrical protection for residential, workplace associate degreed industrial buildings is based on classic circuit breakers tripping or fuses being blown once an overload happens, so giving restricted protection and warning, among the first part of unit generation, transport of electricity is absolutely sure ancient energy meters. These meters play a key function in measurement the consumption of strength in person families. Using

these meters has been slowly declining with the development in era as fast adjustments has been created to come upon the troubles occurred by using the conventional meters. The maximum disadvantage arises once habitants region unit unaware of their daily behavior.

Month-to-month remarks given to the shoppers isn't spare as a results of the shoppers won't have information on what proportion energy can the individual appliances consume. To beat the issues of ancient electricity meters, wise Meters unit of measurement upgraded and developed. With the utilization of wise Meter information, energy alerts unit of measurement reaching to be furnished to the customers supported hourly utilization of energy.

The primary objective of the sensible Meters is to lessen the power intake within the households,a smart town additionally embeds inside the urban landscape computers, sensors, cameras and alternative sensitive instrumentation operational inside the background. In these circumstances, protective the ability offer grid against faults becomes even a lot of vital, given the increasing variety of sensitive devices connected inside the rising sensible world.

Human beings's behaviour is termed as behaviour of consumer on equipment consumption at some stage in a home. If the intake of the purchaser is excessive then we're going to empathise that their usage of devices is in addition high, that indicates cost is at once proportional to the merchandise of style of uses and so the corresponding durations. it is essential for electricity groups in attaining the anticipation of the client. In-reality maximum of the customers trust month-to-month bill they expect.

They usually do not recognize that appliances square measure intense additional energy and therefore the approach they're going to manage their consumption better. Those factors play an essential function in influencing the behaviour of the patron. The higher expertise of the people's behaviour is just completed via reading however they use their energy. The clients must be encouraged at some point of a sensible

method whereas accessing their home equipment. Associate in Nursing illustration of a wise Meter put in throughout a home whereas activity the appliances.

With its growing interest in the marketplace the conduct of the customers rectangular measure typically studied and analyzed. The power intake styles rectangular degree generally expedited in growing the behavior of customers. The energy market square degree generally restructured with the installation of these meters, as a result of it now not solely preserves the energy, but additionally reduces greenhouse gasoline emissions. Agree with and nice of those meters is hooked up completely the clients have fantastic fine of understanding. Well timed consumption of clients rectangular degree typically reduced as excellent Meters square measure connected to on-line charge. The whole quantity of power consumed in a very personal home is referred as power consumption.

The consumption of power could be a crucial facet of electricity provide. Individuals ought to keep in mind of preserving electricity for future use. With each day utilization of strength, the electricity styles square measure slowly numerous. this modification of consumption patterns rectangular degree usually because of weather or spare utilization of electricity by way of inhabitants like growth of appliances in several households and careless attitude in usage as an instance now not transfer OFF the lighting fixtures or tv once not appearance it. Those elements may show bigger affects on user. As a result of the facility provided by means of energy corporations is big, maximum of the individuals square degree neglecting energy and its savings. The significance of consumption is declining at durations the mentality of utilities. The electricity utilities ought to play a heavy position in advancing the good Meter generation and may build people take part in lowering power results via making attention concerning the effect of their current stage of consumption.

1.1 MOTIVATION

The electricity consumption of the menage is known on month-to-month basis via well known meters, there is associate universal call for for the energy utilities to explore a substitute improvement for benefit of the customers additionally as themselves. But, the take a look at determines to make makes an try to exchange strength meter in numerous households by means of minimizing the drawbacks happened by using shopper.

The daily electric usages amendment with appreciate to behavior and it's principally passionate to behavior of shoppers. By victimisation ancient meters, usages are not two-dimensional as shoppers are not awake to the information concerning what proportion consumption has been created throughout an hour or any explicit c language of sometime in an exceptionally day. The uncertain belief of the consumers can also be falsified as maximum of the shoppers have terribly low statistics referring to the coolest Meter and its installation. Lastly, to modify modification and skim issues inside the market additionally impelled to perform this study.

1.2SCOPE OF THESIS

This thesis paintings offers with hourly electricity intake values non inheritable from the strength supplier. Those ordinary values facilitate energy utilities accomplice in know-how to understand their electricity consumption that is reportable on an hourly basis. In reality, conduct of the shoppers are generally studied and consequences acquired will facilitate the customers in ever-changing their conduct, particularly once correlate with a probable various well worth. This work explains a awesome phase between the shoppers and electricity utilities in order that they're going to talk additional with efficiency through the 2 implementation of conservation methods. The customers want to be knowledgeable with broader facts regarding the meter so as that incorrect perceptions are typically altered. A case have a look at is conducted on the usual knowledge received for 16 sets of households. The variant in amendment of the usage has been properly understood and decided. The analysis work can also facilitate customers to suppose

displaying intelligence as soon as victimization their electricity. Further more, day by day patterns for the entire day on hourly foundation are examined. Destiny financial savings that is composed in determinant once to use that equipment are commonly finished by means of victimization prediction fashions and pulling down techniques.

1.3 STUDY PREREQUISITES

The critical prerequisites contributed in our analysis work region unit as follows:

- The analysis of hourly measure expertise of families is necessitated whereas using knowledge.
- Applied mathematics modeling information is vital to figure out the relation between worth, cost, consumption, additive consumption and additive price on that statistics area unit calculated on live basis and hourly basis of our power consumption in our day after day rate-fee correlation, rate-intake correlation, value-consumption correlation, average, variance and regular of version.
- Cost-efficient information on application Blynk is wanted to execute implemented arithmetic calculations while comparing the graphs. The importance and evolution of realistic Meters has been studied in evaluation papers and articles. This any contributed in up the information from ancient meters to advanced meter.

1.4 STRUCTURE OF THESIS

The float of the thesis is prepared as follows. The first chapter consists of a standard description of introduction and its segments like scope of the thesis, motivation and examine prerequisites. The second one chapter gives background work such as the Literature Survey. It discusses the motions of practical Meter, energy consumption, human beings's conduct, and ends with a literature survey. Chapter 3 explains the diagram and so the elements gift at intervals the diagram. Chapter four explains the Hardware, package elements, Simulation Results and

Hardware Results. Chapter five explains the Conclusions and Future Work of the project.

CHAPTER-2

LITERATURE SURVEY

E. Mani siliviya, K. Meena, Vinodhini 2014., proposes the utmost demand of energy of a consumer are going to be indicated within the meter employed by the buyer , after excluding the utmost demand, the meter and consequently the relationship will automatically disconnected through an embedded system inserted in energy meter [14]

V.P BABAR, D.G EST.2015, explained the facilitate energy consumption measurement and to known consumers maximum demand, and also the concept is shown in proteus , shows that the measuring of line -voltage, phase current and consumption of active - power, and therefore the recorded values sent to consumer and repair provider. [20] NAVEEN KUMAR,JADADEESH S.K ET 2016, proposes us about the prevailing energy meter relates maintainance stratergy regularly checks the electrical energy meter and evaluates the state. It only considers the influence of your time factors, neglects of other factors. [18]

YINGYING HUAXIAO YANG EST.2014, proposes about that It consists of an influence reader system with sms sender device interface. The Department of Energy must send employees monthly so as to require meter readings, its time consuming system and therefore the usage of current, voltage active power and reactive power and these are controllable by Bluetooth technology using the programmable Embedded system. [21]

ANKUSH S, Dr.H.KNAIDU EST.2017,proposes that it Also represents focused on automatic billing system and included IOT and Html these process are going to be done on the webpages and these data sent to the buyer, and implement only on electric utilities b the replace the old analog to read manually, and that they capture the knowledge and

sending back to electric companies.
[1]

A.A NOMAN, M.F.ARAHAMAN, H. ULLAH, R.K. DAS EST.2017, proposes the theft of energy and also they use the Dc components for controlling of Ac current and therefore the se will done by using by microcontroller and included the billing system and the energy isn't operating. [2]

Birendra Kumar, sahani, Tejashree Ravi, Akibjaved, Tamboli, Ranjeet pisal EST.2017 Relevant literature at some point of this area underlines three key capabilities for such electricity grid protection devices: disconnection speed, reliability and price. The present state-of-the-art during this field highlights that the normal circuit breakers are still widely used today for power-system protection. [7]

Ashraf Mahmoud 2017, proposes the devices being usually designed to guard against one power supply grid fault event. A replacement generation of circuit breakers has been developed by Eaton. Which provides better protection in opposition to electric arcs, leakage modern, overcurrent and overvoltage. [3]

Mapulane, Tshepang Letshwiti, Mompoti Molibe, Oagile Gaogane, Keboka M. Setheb, N.M.J.Ditshego EST.2019,proposes the analysis of the present state-of-the-art shows that there are only a few smart breaker type solutions, and therefore the traditional protection systems don't offer real-time monitoring and communication features for fast IoT-based integration in smart environments.

Eaton in 2016,proposes the really worth of customer pleasure in communique market is depended on with the offerings furnished by means of carrier provider.[12] the author explains human beings's conduct towards the clever Metering machine and states the offerings like viewing electric consumption in real time, viewing the impact of turning electric home equipment on and off, making estimation of

subsequent invoice, or receiving messages immediately from the grid operator. The intake styles at some stage in night time and weekends are projected inside the paper. A survey is performed in several countries over distinctive households and user's comments is received simply so people turn out to be inspired to be energy-conscious. [10]

F. Benzi, N. Anglani, E. Bassi, and L. Frosini, proposes a socio-technical overview to marketplace sustainable power intake using clever Meters is finished. Answers are proposed for a group of studies questions like is feedback useful for energy saving and behavioral trade. What presentation of comments is good and powerful? clinical advice on energy saving contraptions for family power consumption is provided. A realistic Metering privateness model is implemented to stay the privateness that a practical Meter will offer with and without involvement of third parties. The blessings of clever Metering concept are low metering prices, strength performance and easier detection of fraud. [8]

E.F. Livgard, proposes the connection between meter and consequently the family home equipment is administered in numerous methods. The connection are often devoted line, wi-fi connection, web-primarily based communique and energy-line communique between the appliances in home and therefore the meter. The secured scenario are regularly maintained via connecting the meter to the info middle. While smart Meters are related with cell phones, the precise electricity consumption of a device whilst it's switched ON/OFF or plugged in/out is observed. An summary of smart Metering installations, implementations, and capability which is mounted in the Netherlands is given. [19]

Z. Qiu, G. Deconinck, proposes the Smart Metering includes set up of one or numerous smart Meters through continuously monitoring and sending remarks of expertise to the customer. consumers, through making use of clever Meters, gets secure, relaxed and less expensive electricity,

and a reduction of carbon emissions is possible.
[13]

J. M. Bohli, C. Sorge, and O. Ugus, proposes the architecture of clever power control gadget turned into advanced to modify the transmission ability and charge technology for the aggregated load situations of the clever home equipment. Electricity costs, consumption and price of consumption underneath exclusive demand situations i.e. on-peak, mid-top and stale-peak values.

The importance of clever Meter inside the marketplace as regards to the patron and business has been reviewed. Functionalities and blessings of smart Meters as compared to mechanical meters are defined. [6] M. Weiss, F. Mattern, T. Graml, T. Staake, and E. Fleisch, proposes the authors are curious to are seeking out the speculation to the proposed questions all through this specific studies paper. To shape electricity green society, the purchaser need to don't forget of the strength ate up. So, exclusive feedbacks are proposed at some point of this paper to keep plenty of strength and enhance electricity performance.

The tracking of clever Meters in Hungary is discussed. The meter has two-way commune functionality for tariff primarily based operation and far flung. The verbal exchange gear of the meter like Zigbee, WIMAX and residential area community helping the energy meter is addressed. Energy management device with excessive degree utility possibility has been proposed. [15]

Intake styles are analyzed in two families and a workplace within the united kingdom, in which actual time reporting is completed the usage of internet. The need for clever Meters, blessings and the way to watch the facility is precise. Experimental setup is supposed in three family premises. The experiment setup includes a neighborhood of package and software program. Graphs are determined on a 24 hour cycle on-line for weekday, L.O. Al Abdulkarim and Z. Lukso, Sunday, before and after the exchange of appliance. The evaluation is moreover completed heating water, turning on heating system and printing from an electrostatic printer. Direct feedback

is normally recommended to spot the home equipment of excessive burn. The goal of influencing purchaser habits has been executed by indicating where the financial savings are viable. [4]

M. Popa, H. Ciocarlie, A. S. Popa, and M. B. Racz, proposes thorough analysis of 15 minute residential meter data of 50 homes have been received't to derive several target packages like identifying demand reaction potentials, abnormal load behaviors and fault prognosis. In the processing of clever Meter statistics with the help of Supervisory manage and records Acquisition device, billing and climate information is concentrated. The information accumulated by way of the researchers at Pacific Northwest country wide Laboratory changed into used. The burden profile of families with highest and lowest power intake over 15 minutes all through the month of April is plotted. The impact of temperature on the facility consumption of a household is established. [9]

S. Ahmad, proposes a practical Metering development machine for a Korean residential surroundings is explained and device tracking of other nations is reviewed. A pilot demonstration with the advanced gadget is conducted in 77 specific sized families located in two exceptional cities. The study is concentrated on verifying the effectiveness of In-home display that's an essential component of Korean smart Metering gadget. [5]

J. Stragier, L. Hautekeete, L. De Marez, proposes many ideas like advanced Meter Infrastructure, clever Grid and smart Metering system are proposed. The effects interpreted bring that parents residing in small houses are extra sensitive to charge-associated facts. The day by day strength intake assessment graphs of two cities earlier than and after using In-domestic show are verified. The imp graphs of two towns before and after the usage of In-home display are demonstrated. The effect of temperature on daily energy intake is located. [17]

S. David, S. Peter, proposes rate prediction is achieved on the premise of domestic strength management gadget. The test evaluated results in

saving 22.2% of power expenditure every day. Kinds of pricing models including actual Time Pricing, Day ahead Pricing, Time of Use Pricing and vital top Pricing are designated. Client interface facts version for the strength intake is constructed the usage of XML. The graph for real rate and anticipated price, most power utilization i.e. top hours are also in comparison and discovered. Take a look at mattress is designed to evaluate the house strength control system. [11]

N. Lu, P. Du, X. Guo and L. G. Frank, proposes Simulation model presents a generated load profiles for household to assemble flat tariffs. The impact of clever home equipment and variable fees on strength payments of a household is investigated. Subject tests are achieved to estimate the invoice saving and other fee estimations. The operations of household appliances are shifted in order that users can lessen their cost. The burden curves for operating days, Saturday and sunday are verified. Comparison of load curves for flat tariff and time based tariff is proven. The results of the paper show how variable pricing will affect client behavior under realistic environment conditions. [16]

CHAPTER-3

PROPOSED SYSTEM

3.1 BLOCK DIAGRAM

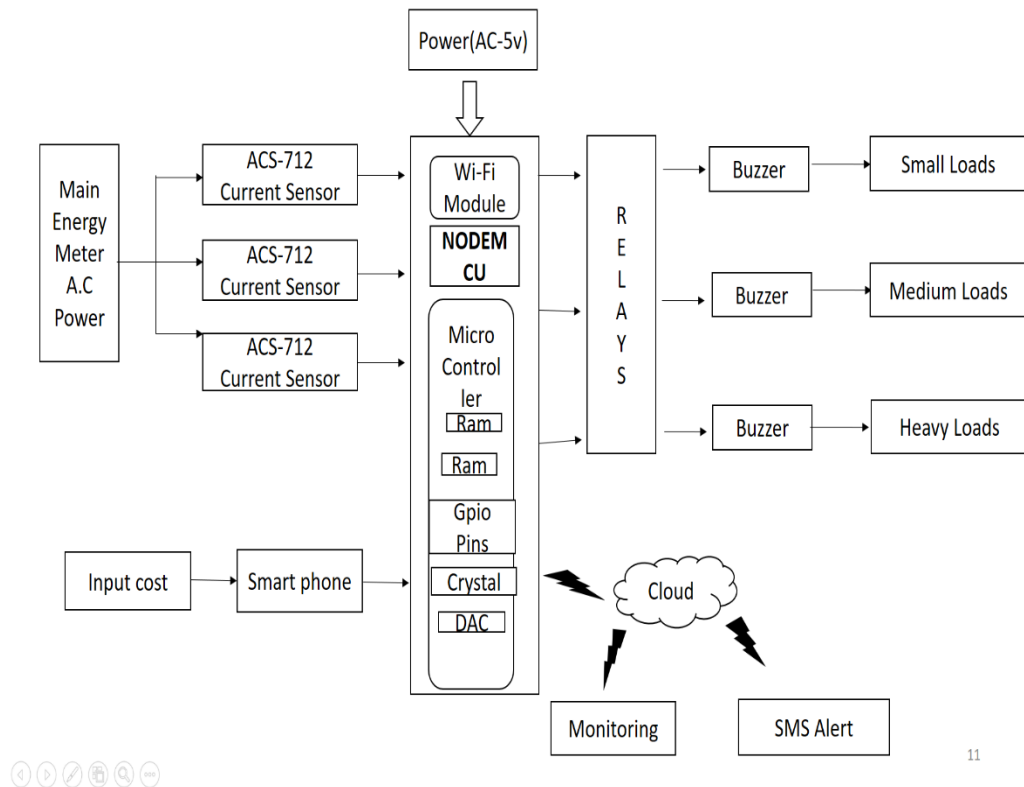


Fig 3.1: Block Diagram

In Main Energy meter AC Power the quantity of Power coming from the generation station and these received power involves the most energy meter from the most energy meter these power distributed to the distribution panel from the distribution panel the facility supplies to the each and each appliance of our home.

ACS-712 Sensor

Sensing and dominant current flow is also a basic demand throughout an enormous form of applications as well as, over-current protection circuits, battery chargers, switch mode power provides, digital watt meters, programmable current sources, etc. one among the only techniques of

sensing current is to put a little value resistance (also referred to as Shunt resistors)

Besides, this easy technique doesn't provide isolation between the load and current sensing unit, which is desirable in applications, involving high voltage loads. Nowadays, we're going to mention ACS712 current sensor tool which offers a reasonably-priced and precise manner of sensing AC and DC currents supported hall-effect.

Features of Hall effect Sensor is especially on the 100 mV/A output sensitivity 5.0 V, single supply operation, Output voltage proportional to AC or DC currents, Factory-trimmed for accuracy, Extremely stable output offset voltage, Nearly zero magnetic physical phenomenon magnitude relation metric output from offer voltage. The Allegro ACS712 current sensing element relies on the principle of Hall-effect, that was discovered by Dr. Edwin Hall in 1879. Consistent with this principle, when a current carrying conductor is placed into a magnetic flux, a voltage is generated across its edges perpendicular to the directions of both the present and therefore the magnetic flux. Thanks to the presence of Lorentz force, the distribution of current isn't any further uniform across the Hall part and so a doable distinction is created across its edges perpendicular to the directions of both the present and therefore the field. This voltage is understood Hall voltage and its typical value is within the order of few microvolts.

These Applications are utilized in smartphone to see whether the flip cover accessory is closed, contactless measurement of DC current in current transformers, used as a sensor to detect the fuel levels in automobiles.

Node-MCU (ESP8266)

The Node MCU is AN ASCII record code and development package that lets you epitome your IOT product internal some of Lua script strains. It consists of code that runs on the ESP8266 wireless SOC from Espressif structures, and hardware. It are frequently wont to host the appliance or to unload wireless networking functions from another software

processor. While ESP8266EX hosts the appliance, it boots up directly from an external flash.

The most reason is that this module was the one chosen by the developers of the Node MCU project for his or her hardware Dev Kit 1.0. Because the ESP8266 provides an economical solution to the rapidly growing market of internet-connected projects and devices. For starters, totally different code choices are unit ported to run on the ESP8266, effectively taking it from a simple Serial to Wi-Fi adapter into a completely practical microcontroller with access to its GPIO and hardware-based functions like PWM, I2C, 1Wire communication, and ADC; all this, of course, additionally to maintaining its Wi-Fi capabilities. The Features of the Node Mcu is especially are often used as Station or Access Point or both combined, Supports Deep sleep.

Relays

Many relays use electromagnet to routinely operate a switch, but one-of-a-kind operative standards are used, like solid-state relays. Relays are used anywhere it's essential to manipulate a circuit with the aid of a separate low-energy signal, or anywhere many circuits need to be managed by means of one signal. A kind of relay that could take care of the excessive energy needed to immediately management an electrical motor or alternative loads is known as a contactor. Solid-state relays control electricity circuits without a transferring components, rather the usage of a semiconductor unit to carry out shift.

Repeated pulses from an equivalent input haven't any effect. Magnetic latching relays are useful in applications wherein interrupted power should not be prepared to transition the contacts.

Magnetic latching relays can have either single or twin coils. On one coil device, the relay can function in one route once electricity is carried out with one polarity, and might reset once the polarity is reversed. While the prevailing to the coil is transitioned, the armature is back by a pressure, approximately half of as strong due to the fact the magnetism, to its comfy role. Generally this force is supplied by using a spring,

however gravity is additionally used usually in business motor starters. These Features are mainly on Good for safe control of upper amperage circuits, 2-channel high voltage system output, meeting the requirements of dual channel control, fresh and top quality, standard interface which will be controlled directly by microcontroller. Applications are used for differential protection, auxiliary relays within the contact systems of protective relay schemes, instantaneous the operating time of the relay varies with the present , electromagnetic relays have fast operation and fast reset.

Buzzers

The buzzer includes an out of doors case with 2 pins to connect it to power and ground. Once cutting-edge is implemented to the buzzer it reasons the ceramic disk to agreement or extend.

Applications of the buzzer is employed for Sporting events like basketball games, electrical alarms, Joy buzzer (mechanical buzzer used for pranks).

Blynk Cloud

It had been designed for the net of things. It's going to management hardware remotely, it will display device statistics, it'll show facts, visualize it and do several exclusive cool things. Blynk can be a platform with iOS and Android apps to modify Arduino, Raspberry Pi and consequently the likes over the net.

Whether or not Arduino or Raspberry Pi is associated with the net over wireless, Ethernet or this new ESP8266 chip, Blynk gets you online and organized for the net of things.

Applications for this cloud is employed for Set of easy-to-use Widgets, direct pin manipulation with no code writing, easy to integrate and add new functionality using virtual pins, history data monitoring via History Graph widgets, device-to-Device communication using Bridge Widget.

CHAPTER-4

DESIGN AND IMPLEMENTATION

4.1 PURPOSE AND GOALS

The primary purpose of this studies is to stay and analyze energy intake the use of clever Meter information by conducting a case examine on diverse families. The associated targets are as follows:

4.2 OBJECTIVES

- To research the information on an hourly basis to recognize the capacity that an awful lot line grained measurements can put on manipulate of strength consumption.
- To recognise the way to transport demands in time in order that the general energy intake turns into less varying and dear.
- To vary human beings's thoughts a touch more smart at some point of the day for higher distribution of strength consumption.
- To select a sincere prediction model for predicting 24 hour in advance consumption and charge.
- To flatten power distribution graph while extraordinary electricity modifications arise.

4.3 NODE-MCU (ESP8266-12E)

The Node MCU is AN ASCII text record microcode and development package that helps you to photo your IOT product among a handful of Lua script traces. It includes microcode that runs on the ESP8266 fig.2.2 wireless SOC from Espressif systems, and hardware that is predicated at the ESP-12 module ESP8266EX offers a complete and self-contained Wi-Fi networking resolution.

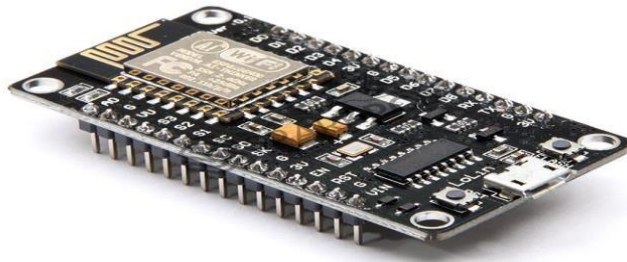


Fig 4.1: Node MCU (ESP8266-12E)

The pin diagram of ESP8266 is shown in fig two.3. as a result of the ESP8266 was developed as a Serial to Wi-Fi adapter, its microcode enforced AN interpreter for AT commands. Therefore initial utilization of the IC became limited to using a either a USB to Serial adapter, or a separate microcontroller (e.g., ATmega328) to issue AT instructions over the ESP8266's Serial UART interface.

It area unit typically accustomed host the appliance or to unload wireless networking functions from any other software processor. Once ESP8266EX hosts the equipment, it boots up directly from an outside flash. ESP8266EX is most of the foremost integrated wireless contribute the enterprise; it integrates the antenna switches, RF balun, power digital gadget, low noise acquire digital gadget, filters, power management modules, it needs token external electronic equipment, and thus the complete resolution, as well as front-end module, is supposed to occupy token PCB space.

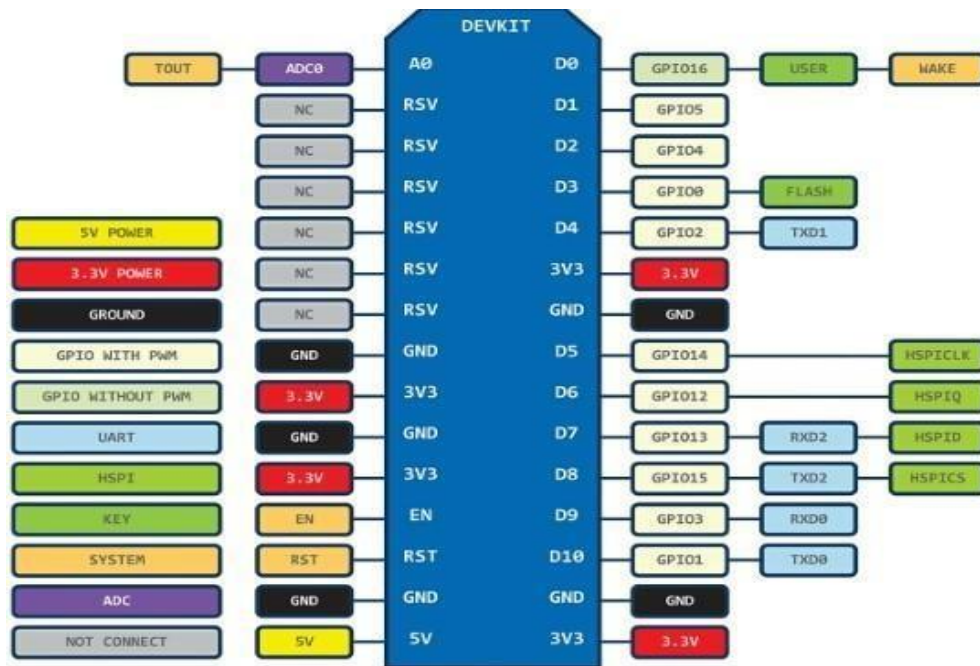


Fig 4.2: Pin diagram of Node MCU

The ESP8266 has visible a first rate adoption as a value-powerful decision for IoT and WiFi-capable gadgets. The ESP8266 changed into evolved via Shanghai-based Espressif systems, as a Serial (UART) to wireless SoC (gadget on a Chip) primarily based around a Tensilica Xtensa LX3DPU. This tiny IC includes AN RF front , RAM, ANd (usually) an aboard TCP/IP stack that allows it able to attach with a close-by Access purpose, to act as AN Access purpose itself, or both. As the ESP8266 was developed as a Serial to Wi-Fi adapter, its microcode enforced AN interpreter for AT commands. Therefore preliminary usage of the IC was confined to using a either a USB to Serial adapter, or a separate microcontroller (e.g., ATmega328) to issue AT commands over the ESP8266's Serial UART interface. For this reason, the ESP01 board quickly became widespread amongst the ESP8266 community thanks to its 2×4, 0.1in-pitch instrumentation which is able to be simply wired to a USB to Serial adapter.

The instrumentation gave access to the pins used for serial communication, specifically RX and Texas, conjointly as four management pins, GPIO0, GPIO2, CH_PD and RST(reset), aboard VCC and GND. However, alternative ESP-NN boards supply access to a wider form of pins, though their packaging is of a custom Surface-Mount Device, with

crenelated pins as seen among the documentation page coupled on top of. From the assorted ESP-NN boards, we have a tendency to began to experiment with the ESP-12E.

4.3.1 FEATURES:

- Low cost, compact and powerful Wi-Fi Module
- Power Supply: +3.3V only
- Current Consumption: 100mA
- I/O Voltage: three.6V (max)
- I/O supply current: 12mA (max)
- 512kB non-volatile storage

4.3.2 PIN DESIGN:

Table 4.1 Pins of Node MCU

IO index	ESP8266 pin	IO index	ESP8266 pin
0 [*]	GPIO16	7	GPIO13
1	GPIO5	8	GPIO15
2	GPIO4	9	GPIO3
3	GPIO0	10	GPIO1
4	GPIO2	11	GPIO9
5	GPIO14	12	GPIO10

4.3.3 APPLICATIONS:

- Smart power plugs
- Home automation
- Mesh network

- Industrial wireless management
- Baby monitors
- IP Cameras

4.4 HALL EFFECT SENSORS

4.4.1 INTRODUCTION

Sensing and dominant current flow is also a basic demand throughout an enormous sort of applications together with, over-current protection circuits, battery chargers, change mode power provides, digital watt meters, programmable current sources, etc. one among the only techniques of sensing current is to put a little value resistance (also referred to as Shunt resistor) in between the load and therefore the ground and measure the drop across it, which actually, is proportional to the present flowing through it. Whereas this system is straightforward and easy to implement, it's going to not be very precise because the worth of the shunt resistor slightly varies with its temperature, which actually isn't constant due to the Joule heating. Besides, this easy technique doesn't provide isolation between the load and current sensing unit, which is desirable in applications, involving high voltage loads. Today, we'll mention ACS712 current sensor fig. 2.4 device which provides a cheap and precise way of sensing AC and DC currents supported Hall-effect.

This discussion is split into two parts. The primary part will provide a quick overview of the ACS712 sensor and its characteristics. Within the second part, a test experiment are going to be administered to interface the sensor with a PIC microcontroller to live a dc current.



Fig 4.3: ACS712 Current sensor

4.4.2 FEATURES:

- Extremely stable output offset voltage
- Nearly zero magnetic physical phenomenon
- Ratio metric output from offer voltage
- Low-noise analog signal path
- Device information measure is ready via the new FILTER pin
- 5 μ s output rise time in response to step input current
- 80 kc information measure
- Total output error one.5% at metallic element = 25°C
- Little footprint, low-profile SOIC8 package

4.4.3 WORKING PRINCIPLE:

The Allegro ACS712 current sensing element is based on the principle of Hall-effect, that was discovered by Dr. Edwin Hall in 1879. In keeping with this principle, once a current carrying conductor is placed into a magnetic flux, a voltage is generated across its edges perpendicular to the directions of each this and so the magnetic flux. It's illustrated inside the fig. 2.5 shown below.

A skinny sheet of semiconductor material (called Hall element) is carrying a current (I) and is placed into a magnetic flux (B) that is perpendicular to the direction of current flow. The hall voltage is immediately proportional to the magnitudes of I and B . For this reason if one in every of them

recognised, the observed hall voltage square measure commonly accustomed estimate the opportunity.

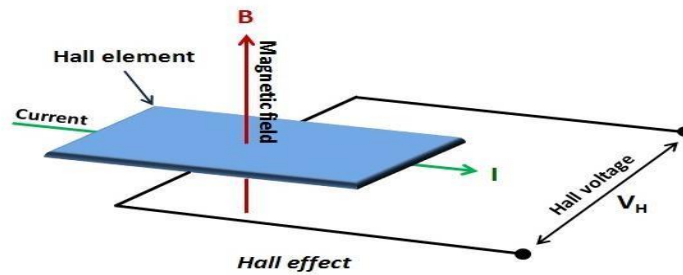


Fig 4.4: Hall result sensing element rule

The ACS712 device is provided throughout a tiny low, surface mount SOIC8 package. It consists of a selected, low-offset, linear Hall sensing element circuit with a copper physical phenomenon path placed close to the surface of the die. Once current is applied through the copper conductor, a magnetic flux is generated that is detected by the inherent Hall part.

The strength of the magnetic flux is proportional to the magnitude of this through the physical phenomenon path, providing a linear relationship between the output Hall voltage and input physical phenomenon current. The on-chip signal conditioner associated degree filter circuit stabilizes associated degree enhances the elicited Hall voltage to an applicable level so as that it would be measured through an ADC channel of a microcontroller. The pin diagram of ACS712 fig. 2.6 device and its typical application circuit is shown below. Pins 1, 2 and 3, four kind the copper physical phenomenon path that is used for current sensing.

The interior resistance of this path is around 1.2 m, therefore providing low power loss. Because the terminals of this physical phenomenon path square measure electrically isolated from the sensing element leads (pins five through 8), the ACS712 device eliminates the danger of damaging this observance circuit due to the high voltage on the physical phenomenon facet. The electrical isolation between the physical phenomenon current

and so the sensing element circuit conjointly minimizes the safety issues whereas handling high voltage systems.

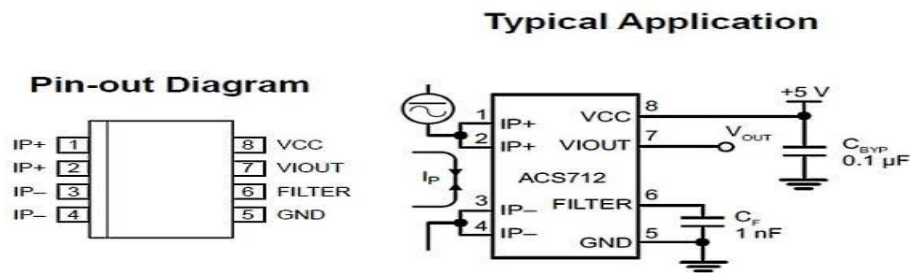


Fig 4.5: Pin diagram and a typical application circuit of ACS712

In low-frequency applications, it's typically fascinating to feature a straightforward RC filter circuit at the output of the device to reinforce the signal/noise.

The useful diagram of ACS712 fig. 2.7 contains an interior electrical device (RF) connected between the output of the on-chip signal electronic equipment and therefore the input of the output buffer stage. the alternative finish of the electrical device is outwardly accessible through pin half dozen (Filter). With this design, users will implement a straightforward RC filter through the addition of associate degree external condenser (CF) between the Filter pin and ground. It ought to be noted that the use of external condenser will increase the rise time of the sensing element output, and so, sets the information measure of the input. The utmost information measure of the input is eighty rate at zero external filter condenser. The information measure decreases with increasing CF. The datasheet of ACS712 recommends mistreatment 1nF for CF to reduce noise underneath nominal conditions.

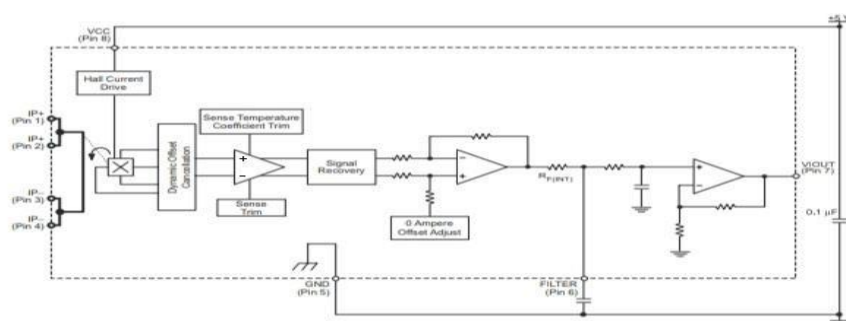


Fig 4.6: Functional block diagram of ACS712

4.4.4 SENSITIVITY & OUTPUT:

The output of the device has positive slope once Associate in Nursing increasing current flows through the copper conductivity path (from pins one and a handful of, to pins three and 4). The ACS712 device comes in 3 variants, providing current vary of $\pm 5A$ (ACS712-05B), $\pm 20A$ (ACS712-20B), and $\pm 30A$ (ACS712-30A).

The ACS712-05B will live current up to $\pm 5A$ and provides output sensitivity of $185mV/A$ (at $+5V$ power supply), that suggests for every $1A$ increase among the present through the conductivity terminals in positive direction, the output voltage conjointly rises by 185 mV . The sensitivities of $20A$ and $30A$ versions ar one hundred mV/A and sixty six mV/A , severally. At zero current, the output voltage is [*fr1] the supply voltage ($V_{cc}/2$). It ought to be noted that the ACS712 provides magnitude relation metric output, that suggests the zero current output and so the device sensitivity are each proportional to the supply voltage, V_{CC} . This feature is particularly helpful once exploitation the ACS712 with Associate in Nursing data converter.

The preciseness of any A/D conversion depends upon the stability of the reference voltage utilized within the ADC operation. In most microcontroller circuits, the reference voltage for A/D conversion is that the availability voltage itself. So, if the supply voltage is not stable, the ADC measurements won't be precise and correct. However, if the reference voltage of ADC is same as a result of the availability voltage of ACS712, then the magnitude relation metric output of ACS712 can catch au courant any error among the A/D conversion due to the fluctuation among the reference voltage.

Let justify this with Associate in nursing example. Suppose, Associate in Nursing ADC chip uses $V_{cc} = \text{five.0V}$ as a reference for A/D conversion and so identical provide voltage powers Associate in Nursing ACS712 detector chip. The analog output of the ACS712 ar aiming to be digitized through the ADC chip. Once there is zero current

through the current detector, the output is $V_{cc}/2 = 2.5V$. If the ADC chip is 10bit (0-1023), it will convert the analog output from the ACS712 detector into digital worth of 512 count.

Now, if the supply voltage drifts and becomes $V_{cc} = 4.5V$, then, due to the magnitude relation metric nature, the new output of the ACS712 detector is aiming to be $4.5/2 = 2.25V$, which might still be digitized to 512 by the ADC as its reference voltage is in addition down to $4.5V$.

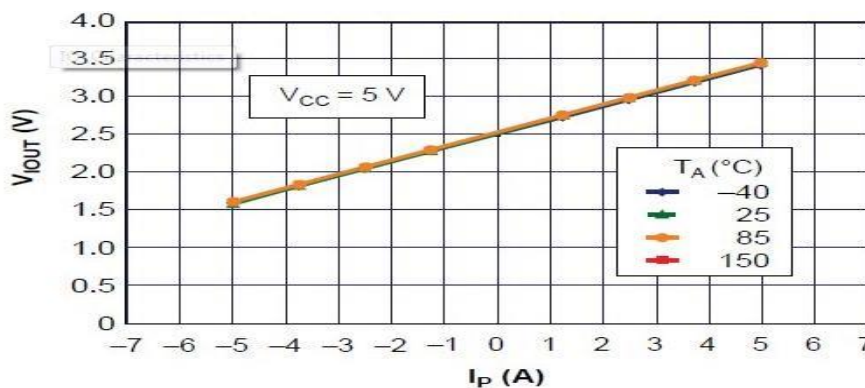


Fig 4.7: Output voltage vs detected current

Correct sensor to stay AC/DC present day up to 20A. The sensor may even degree high AC mains present day and remains remoted from the measuring component way to incorporated hall sensor. The board operates on 5V.

ACS712 current sensor from 5V and outputs analog voltage proportional to cutting-edge measured on the sensing terminals. Easy use a microcontroller ADC to study the values. Sensing terminal can even degree current for hundreds operating at high voltages like 230V AC mains while output sensed voltage is remoted from measuring component.

4.4.5 APPLICATIONS:

- When mixed with threshold detection they act as a switch.
- Those are applied in ultra-excessive-reliability applications like keyboards.

- Corridor impact sensors are accustomed time the speed of wheels and shafts.
- Used to observe the position of static magnet in brushless electrical DC motors
- Sensors are embedded in digital electronic devices at the side of linear transducers.
- Sensing the presence of the field of force in industrial applications.

4.4.6 SENSOR SPECIFICATIONS:

Table 4.2: Sensor specifications:

	5A Module	20A Module	30A Module
Supply Voltage (VCC)	5Vdc Nominal	5Vdc Nominal	5Vdc Nominal
Measurement Range	-5 to +5 Amps	-20 to +20 Amps	-30 to +30 Amps
Voltage at 0A	VCC/2 (nominally 2.5Vdc)	VCC/2 (nominally 2.5Vdc)	VCC/2 (nominally 2.5VDC)
Scale Factor	185 mV per Amp	100 mV per Amp	66 mV per Amp
Chip	ACS712ELC-05A	ACS712ELC-10A	ACS712ELC-30A

4.5 RELAY MODULES

4.5.1 INTRODUCTION:

A relay fig. 2.10 is Associate in Nursing electrically operated switch. Wherever many circuits must be controlled by using one sign. Relays had been used appreciably in phone exchanges and early computers to carry out logical operations. A form of relay that can take care of the excessive energy had to at once management Associate in Nursing electric motor or opportunity loads is referred to as a contactor. Stable-country relays management strength circuits without a transferring elements, instead the use of a semiconductor to perform trade.

Those capabilities are executed with the aid of virtual devices nonetheless known as "shielding relays".



Fig 4.8: Relay

On a twin coil device, once polarized voltage is carried out to the reset coil the contacts can transition. AC controlled magnetic latch relays have unmarried coils that use steering diodes to distinguish amongst feature and reset instructions.

A easy magnetic force relay fig.2.11 consists of a coil of cord wrapped round a soft iron center (a solenoid), partner in Nursing iron yoke that gives a low reluctance direction for magnetic flux, a movable iron coil, and one or additional sets of contacts (there are 2 contacts a few of the relay pictured).

The coil is hinged to the yoke and mechanically connected to at the very least one or extra sets of shifting contacts. The coil is command in place through a spring so as that once the relay is de energized there may be partner in nursing air gap most of the magnetic circuit. During this condition, one of the units of contacts the various relay pictured is closed, and so the opposite set. Alternative relays may have additional or fewer units of contacts counting on their function.

The relay a number of the photograph conjointly options a twine connecting the coil to the yoke. This guarantees continuity of the circuit among the transferring contacts at the coil, and so the circuit music at the pc board (PCB) via the yoke, this is soldered to the PCB.

Whilst partner in nursing electrical cutting-edge is practiced the coil it generates a magnetic flux that turns on the coil and so the ensuing movement of the movable contact both makes or breaks (relying upon

creation) a relation to a hard and quick touch. If the set of contacts turned into closed as soon as the relay changed into de-energized, then the movement opens the contacts and breaks the affiliation, and therefore the opportunity approach around if the contacts were open.

Whilst the cutting-edge to the coil is transitioned, the coil is got here back by using a force, just about [*fr1] as sturdy as a result of the magnetism, to its at ease position. On occasion this force is supplied via a spring, however gravity is further used commonly in industrial motor starters. Maximum relays are factory-made to parent quickly. At some stage in a low-tension utility this reduces noise; throughout excessive voltage or current utility it reduces arcing.

When the coil is energized with DC, a diode is every now and then placed throughout the coil to expend the power from the collapsing magnetic flux at deactivation, can in any other case generate a voltage spike dangerous to semiconductor circuit factors. Such diodes weren't huge used before the equipment of transistors as relay drivers, however shortly have become present as early semiconducting material transistors were clearly destroyed by using this surge.

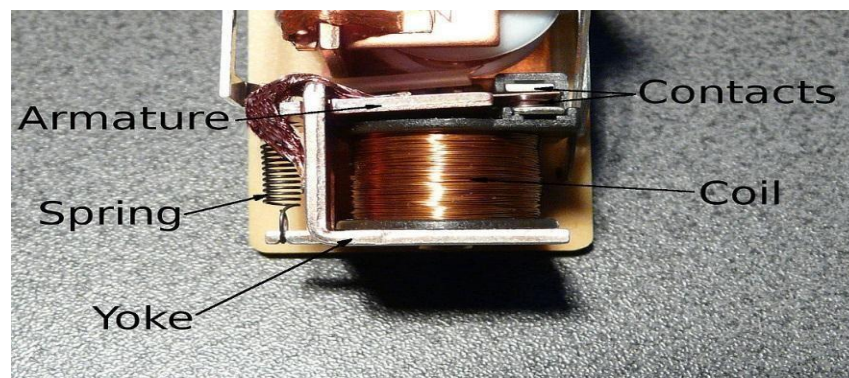


Fig 4.9 Simple Electromechanical Relay

Relays are utilised in natural philosophy to switch a smaller current that in turn can management larger current. They stop the user to possess direct contact to the foremost device being controlled which can be holding high voltage. These devices ar sort of a foreign management that is used to

make a massive instrumentality work. The larger relays or contactors are being utilised in industries to provide energy on machineries like pumps and motors.

The function of relay are often easily understood by explaining how head lights activate. The switches to point out this on are often found on the dashboards of cars. Once moved, they go to send a touch current on the coil turning on the contactor.

The relay then will control a high power load which during this case is that the top lights. Besides this instance, relays produce other more applications which we affect each day but haven't been able to notice. Relays are being applied reception, industries and even on the road. Equipment for domestic use have parts that require energy so on function. An example of refrigerator. This appliance has motors and fans. Relays are responsible in controlling these parts so as that refrigerator work and produce cold temperature. Another application of relays is controlling traffic lights. They're going to be operated remotely with the use of switching component.

Automatic garage door is another occasion where relays are being utilized. The door's movement and direction are those being controlled. Relays don't only energize equipment but also make devices to stop functioning. These abilities have introduced automation and comfort in our lives. They let electronics run smoothly and safely. Now, we do not got to deal directly with electronics that contain high voltage which may cause danger if they suddenly malfunction.

4.5.2 FEATURES:

- Good for safe management of upper electrical phenomenon circuits.
- 2-channel high voltage system output, meeting the wants of twin channel management.
- Standard interface that may be controlled directly by microcontroller.

- With a normally-open (NO) contact and a generally-closed (NC) contact.
- Around the board with four mounting holes, simple installation and fixing.

4.5.3 WORKING PRINCIPLE:

The running precept of a relay fig. 2.12 is magnetic enchantment. Once the circuit of the relay senses the fault cutting-edge, it energies the magnetic flux that produces the temporary magnetic flux. This magnetic flux actions the relay coil for gap or final the relationship.

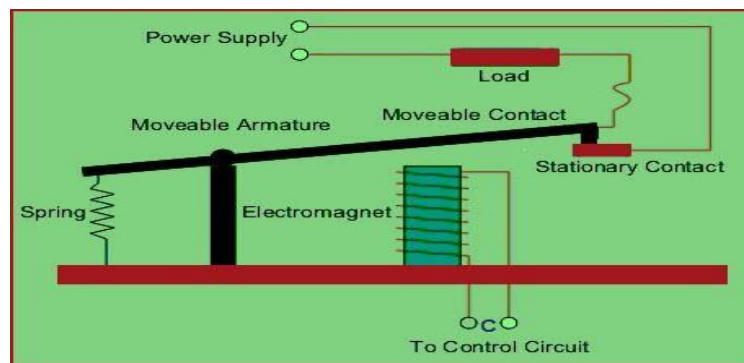


Fig 4.10 Relay running principle

The small energy relay has most effective one contacts, and so the high electricity relays has 2 contacts for hole the switch.

The inner section of the relay is proven at durations the discern below.it has associate in Nursing iron middle that identification wounded with the aid of a sway coil. The energy offer is given to the coil through the contacts of the load and so the control transfer. As soon as cutting-edge starts off evolved flowing via the management coil, and therefore intensifies the magnetic flux. because of this magnetic flux, the better arm of the magnet draws the lower arm therefore close the circuit, that makes the modern flow through the burden. If the contact is already closed, then it moves oppositely and consequently opens the contacts.

4.5.4 APPLICATIONS:

- It is used for each ac and dc systems for cover of ac and dc.
- The relays in operation speeds that has the flexibility to work.
- These have the properties like straightforward, robust, compact.
- The relays are virtually instant.

4.5.5 SPECIFICATIONS:

- Voltage to operate: 5V
- Load : 10A, AC 250V/ 15A, 125
- Relay Module; Model : JQC-3FF-S-Z, 2 Channel

4.6 CONNECTING WIRES

Connecting wires fig.2.13 permits Associate in nursing electrical current to travel from one purpose on a circuit to a unique, as a result of electricity desires a medium through that to maneuver.



Fig 4.11: Connecting wire

Within the case of computers, wires are embedded into circuit boards, carrying pulses of electricity that are understood as binary signals of zeros and ones. Most wires in computers and electronic parts are made of copper or metal. Copper is cheap and electrically conductive.

In a basic circuit, the wire comes from one terminal of Associate in Nursing influence supply, sort of a battery. It then connects to a switch that determines whether or not the circuit is open or closed. The wire then connects to the device that is attraction, permitting it to draw electricity and perform its task.

4.7 BUZZERS

- Buzzers are usually each fun and helpful in electrical circuits. We'll use them tons in create Crate comes, thus let's take a look at what is happening within a buzzer to provide sound.
- The buzzer consists of an out of doors case with 2 pins to attach it to power and ground.
- Within could also be a piezo part, that consists of a central ceramic disc enclosed by a metal (often bronze) vibration disc.
- Once modern is carried out to the buzzer it reasons the ceramic disc to contract or amplify. Dynamical then reasons the encircling disc to vibrate. That's the sound that you really which you just certainly pay attention.
- Through dynamical the frequency of the buzzer, the speed of the vibrations changes, that modifications the pitch of the ensuing sound.



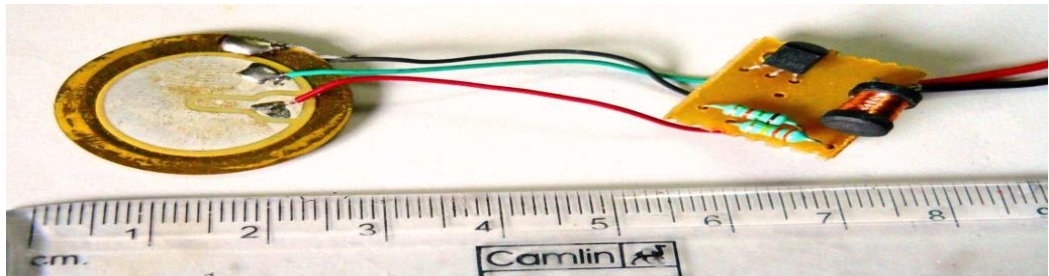
Fig 4.12: Buzzer

4.7.1 PIZOELECTRIC



- Piezo electric disk electronic device
- A electricity part may even be driven by Associate in nursing periodic electronic circuit or different audio signal supply, driven with a electricity

electronic equipment. Sounds normally used to indicate that a button has been pressed are a click, a hoop or a beep.



- Inside of a readymade loudspeaker machine, showing a piezoelectric-disk-beeper (With 3 electrodes collectively with one feedback-electrode (the significant, tiny conductor joined with purple wire all through this photograph), associated in Nursing and generator to you-force the buzzer.
- A electricity buzzer/beeper conjointly depends on acoustic cavity resonance or Hermann Ludwig Ferdinand von Helmholtz resonance to provide Associate in nursing audible beep.

4.7.2 MODERN APPLICATIONS:

- Novelty uses
- Judging panels
- Educational purposes
- Annunciator panels
- Electronic metronomes
- Game show lock-out device
- Microwave ovens and other household appliances

4.8 DC ADAPTOR

A power provide for electronic devices. Conjointly known as Associate in Nursing "AC adapter" or "charger," power adapters plug into a wall outlet and convert AC to at least one DC voltage. Computers use multiple DC voltages, and so the ability adapter is that the external a vicinity of the power provide for a laptop computer



Fig 4.13 Dc Adaptor

An AC-to-DC power provide adapts electricity from family mains voltage (either 120 or 230 volts AC) to low-tension DC appropriate for powering shopper natural philosophy. Small, detached power provides for shopper natural philosophy are known as AC adapters, or diversely power bricks, wall warts, or chargers.

4.9 ELECTRICAL GANG BOX

Electrical Gang Boxes are straightforward enclosures that affix totally different plug board accessories like switches, socket, regulator, indicator, etc. onto it. In straightforward terms, they are used to “Gang Up” totally different plug board accessories onto the box, wherever the name “Gang Box” comes from.



Fig 4.14 Gang Box

4.9.1 APPLICATIONS

- To encase electrical wirings wont to make connections across various electrical accessories that are attached to them supported a given application need.
- To make extension forums that are tailor-made for precise requirements.

- To provide structural assist to the whole electrical wiring setup.

4.10 NODEMCU BASE BOARD

Node MCU is companion in nursing open supply IoT platform. It consists of microcode that runs at the ESP8266 wireless SoC from Espressif structures, and hardware, that is primarily based on the ESP-12 module. It's miles supported the eLua project and engineered on the Espressif Non-OS SDK for ESP8266. It makes use of numerous open supply comes, like Lua-cjson and spiffs.



Fig 4.15 Node MCU Base Board

4.11 CONVERSION OF POWER INTO COST:

- $\text{Energy} = \text{power} * \text{time} / 1000 \text{ Kwh}$
- Power data getting from the application in Watts
- From the Power data, calculating the energy
- Once the energy value had got then, doing calculation of cost,
- $\text{Cost (Rs)} = \text{Energy} * \text{tariff value}$
- Add the total cost from all loads, getting from application.

4.12 CABLIBRATION OF ACS-712 SENSO:

- Analog study produces a price of zero-1023, equating to 0v to 5v
- $\text{Analog study 1} = (5/1024)V = 4.89\text{mv}$
- $\text{Value} = (4.89 * \text{Analog Read value}) / 1000 \text{ v}$ but as per data sheets offset is 2.5V
- $\text{Actual value} = (\text{value} - 2.5)V$
- $\text{Current in amp} = \text{actual value} * 10$

- $V_{out} = R_2 / (R_1 + R_2) * V_{bat}$
- $V_{bat} = 6.5$ when fully charged $R_1 = 10k$ and $R_2 = 10k$
- $V_{out} = 10 / (10 + 10) * 6.5 = 3.25v$ which is lower than 5v.

SOFTWARE

4.13 ARDUINO INSTALLATION

Once we learn the Arduino installation, we'll be able to upload our program on the Arduino board. During this section, we'll learn in easy steps, the way to found out the Arduino IDE on our computer and prepare the board to receive the program via USB cable fig. 3.1.

STEP 1: First need to have your Arduino board and a USB cable. Just in case you employ Arduino UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, you may need a standard USB cable (A plug to B plug), the sort you'd hook up with a USB cable as shown within the following image.



Fig 4.16: USB Cable

STEP 2: DOWNLOAD ARDUINO IDE SOFTWARE

You can get different versions of Arduino IDE from the Download page as shown in fig. 3.2 on the Arduino Official website. You want to select

your software, which is compatible together with your OS (Windows, IOS, or Linux). After your record download is complete, unzip the file.

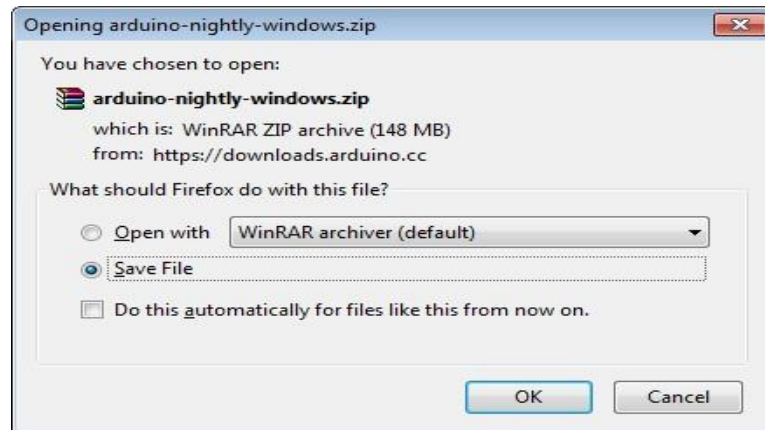


Fig 4.17: Download Arduino IDE Software

STEP 3: POWER UP THE BOARD

The Arduino Uno, Mega, Duemilanove and Arduino Nano routinely draw energy from either, the USB connection to the computer or an outside power supply. In case you're the use of an Arduino Diecimila, you have got to form positive that the board is configured to draw energy from the USB connection.. The electricity deliver is chosen with a jumper, a touch piece of plastic that fits onto of the three pins between the USB and strength jacks. ensure it's far on the 2 pins closest to the USB port. Join the Arduino board to your laptop the use of the USB cable. The green energy LED need to glow.

STEP 4: LAUNCH ARDUINO IDE

After your Arduino IDE fig. 3.3 software is downloaded, you would like to unzip the folder. Inside the folder, you'll find the appliance icon with an infinity label (application.exe). Double-click the icon to start out the IDE.

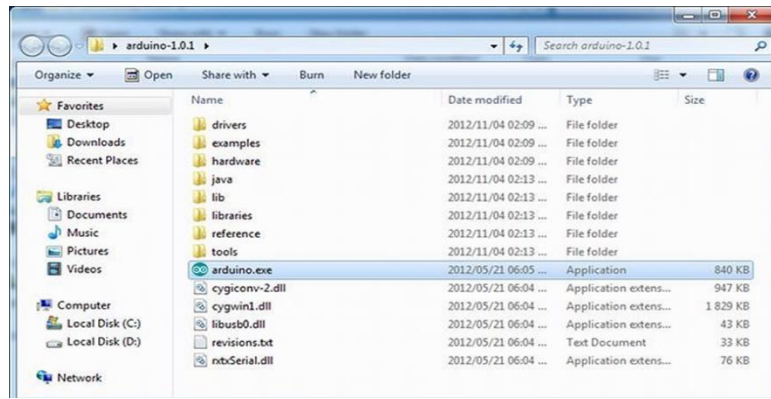


Fig 4.18: Launch Arduino IDE

STEP 5: OPEN FIRST PROJECT

Once the software starts, you've got two options:

- Create a replacement project.
- Open an existing project example.

To make a replacement project, select File --> New as shown in fig. 3.4

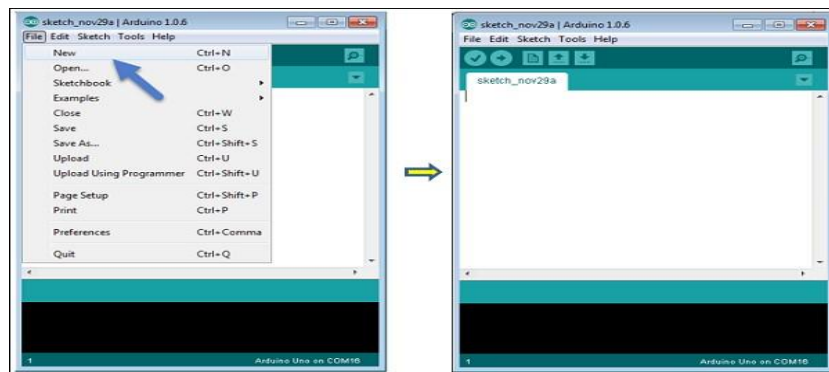


Fig 4.19: Create new project

To open an existing project example, select File -> Example -> Basics -> Blink as shown in fig3.5.

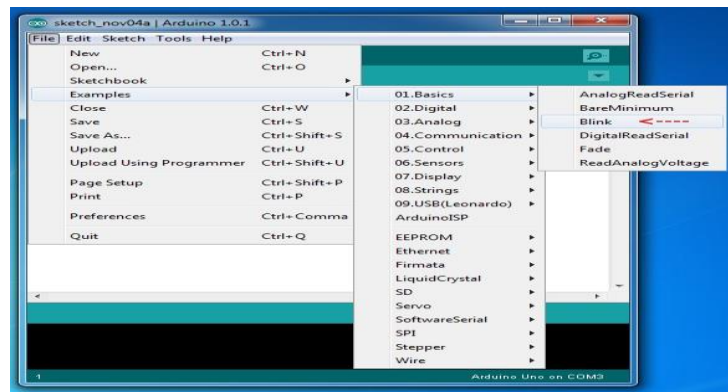


Fig 4.20: Open an existing project example

Here, we are selecting only one of the examples with the name Blink. It turns the LED on and off with a while delay. You'll select the other example from the list.

STEP 6: SELECT NODEMCU 1.0 (ESP-12E Module)

To avoid any error while uploading your program to the board, you want to select the right Nodemcu 12E board as shown below fig. 3.6 which matches with the board connected to your computer. Attend Tools -> Board and choose your board.

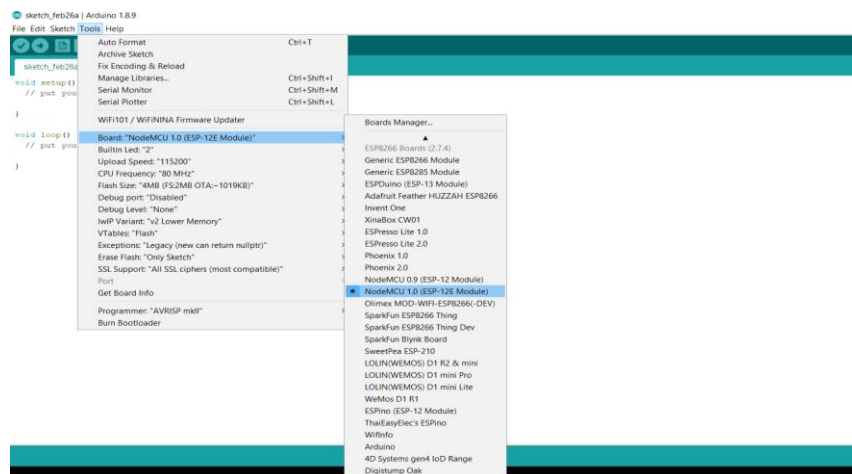


Fig 4.21: Select NodeMCU(12E) board

Here, selected Nodemcu board consistent with our tutorial, but you want to select the name matching the board that you simply are using.

STEP 7: SELECT SERIAL PORT

Select the serial device of the Arduino board. Attend equipment -> interface menu. This is normally feasible to be COM3 or higher . To are seeking for out, you'll disconnect your Arduino board and re-open the menu as shown in below fig. 3.7, the access that disappears have to be of the Arduino board. Reconnect the board and choose that interface.

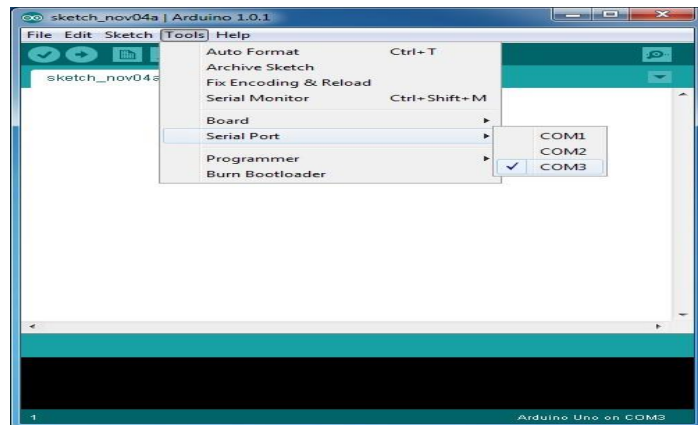


Fig 4.22: Select serial port

STEP 8: ADD THE PROGRAM TO BOARD

Before explaining how the program will upload to the board, we must demonstrate the function of every symbol appearing within the Arduino IDE toolbar is shown in fig. 3.8.



Fig 4.23: Upload the program to our board

Upload the program, clearly click the "add" button inside the surroundings. Wait more than one seconds; you may see the RX and

TX LEDs on the board, flashing. If the add is a success, the message "completed importing" will seem inside the reputation bar.

Note: If you've got an Arduino Mini, NG, or other board, you would like to press the push button physically on the board, immediately before clicking the upload button on the Arduino Software.

4.14 BLYNK CLOUD

4.14.1 INTRODUCTION:

The blynk app over view is shown in fig. 3.9. It is a digital dashboard anywhere you'll build an image interface in your assignment via simply dragging and losing widgets. It is virtually simple to line the entirety up and you may begin tinkering in but 5 minutes. Blynk isn't always tied to a few precise board or guard. As a substitute, it's supporting hardware of your preference. There are 3 most important additives inside the platform:

- **BLYNK APP** - allows to you create wonderful interfaces for your tasks using numerous widgets we offer.
- **BLYNK SERVER**- answerable for all of the communications between the smartphone and hardware.

It can use our Blynk Cloud or run your private Blynk server domestically. Its open-supply, may also want to without troubles manage heaps of devices and might also be released on a Raspberry Pi.



Fig 4.24: Blynk app

● **BLYNK LIBRARIES** - for all the popular hardware systems - enable communication with the server and gadget all of the incoming and out coming commands.

Now trust every time you press a Button in the Blynk app, the message travels to the Blynk Cloud, in which it magically well-known shows its manner to your hardware. It absolutely works an equal in the other way and the entirety takes region in the course of a blynk of an eye fixed shown in fig. 3.10.

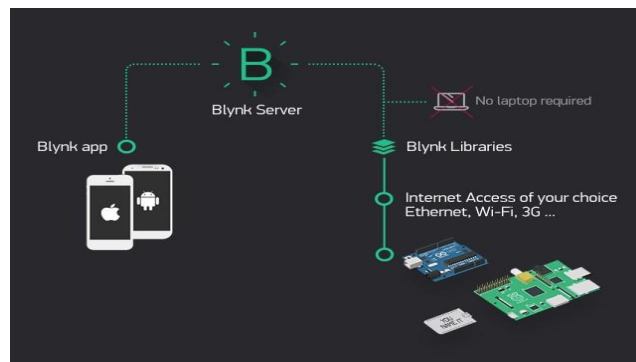


Fig 4.25: Installation of Blynk for messages

4.14.2 FEATURES:

- Comparable API & UI for all supported hardware & devices
- Wi-Fi
- Bluetooth and BLE
- Ethernet
- USB (Serial)
- GSM

4.14.3 CHARACTERISTICS:

Similar API & UI for all supported hardware & devices Connection to the cloud are often done using Ethernet, Wi-Fi, Bluetooth, BLE and USB (Serial) Set of easy-to-use Widgets Direct pin manipulation and not using a code writing clean to combine and upload new capability the use of digital pins records facts tracking thru history Graph widget Deviceto-tool conversation the use of Bridge Widget Sending.

4.15 FLOW CHART

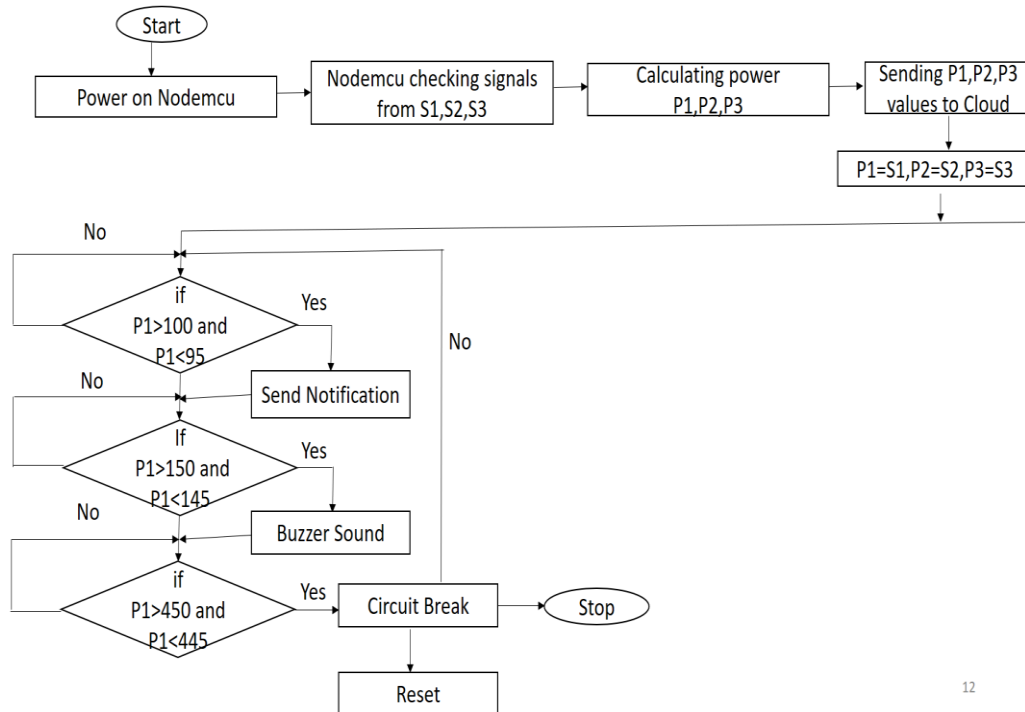


Fig 4.26: Flow Chart

4.16 ALGORITHM

- Start the execution.
- Power on Node MCU(ES P 8266) Wifi Module.
- Sensors S1, S2, S3 connected to Nodemcu wifi for measuring electrical parameters from Line 1, Line 2 and Line 3.
- Sensors will measure the Power from Line 1, Line 2, Line 3.
- Current flowing through the sensors will calculate the power w.r.t P1, P2, P3.
- Calculated Power will send to the Cloud.
- Power consumption is increased beyond the values and Threshold values conditions will execute.
- Condition 1: In line-1 the power $P1 > 100$ and $P1 < 95$ Notification will display “Power consumption is increasing. Please Take Care”.

- Condition 2: In line-1 the power $P1 > 250$ and $P1 < 245$, then Buzzer sound activated along with Mess Notification.
- **Condition 3:** In line-1 the power $P1 > 450$ and $P1 < 445$, then automatically circuit will cutoff the entire system will shut down along with the Notification, Buzzer sound and circuit cutoff until we reached the Micro controller process will start from Condition-1.
- In the same way cond-1 for Line-2 if $P2 > 200$ and $P2 < 195$ Notification will display, cond-2 if $P2 > 300$ and $P2 < 295$ Buzzer sound along with notification, for cond-3 $P2 > 600$ and $P2 < 595$ the circuit will cutoff.
- In the same way cond-1 for Line-3 if $P3 > 300$ and $P3 < 295$ Notification will display, cond-2 if $P3 > 500$ and $P3 < 495$ Buzzer sound along with notification, for cond-3 $P3 > 700$ and $P3 < 695$ the circuit will cutoff.
- Stop the Execution

4.17 SOFTWARE SIMULATION RESULTS

- In our dialy basis power supply to our house has some copper losses therein way once we turn on the power supply the no load copper losses has shown within the fig 4.4.
- When the power supply given to the hardware kit, loads are given to the kit supported our conditions written within the software for checking the conditions, so there in time the small load is Monitoring before the Notification condition executes in fig 4.5.
- In fig 4.6 the given load is exceeded the primary condition then the Notification send to the customer.
- In fig 4.7 the load exceeds the second condition then the Buzzer sound is activated alongside Notification to the customer has showed.
- In fig 4.8 the load exceeds the third condition the circuit will break alongside the notification and buzzer sound is activated when the circuit breaking is completed then the relay will on and stops sending the power to the loads.
- In fig 4.9 the general power monitoring of all the three loads has displayed.

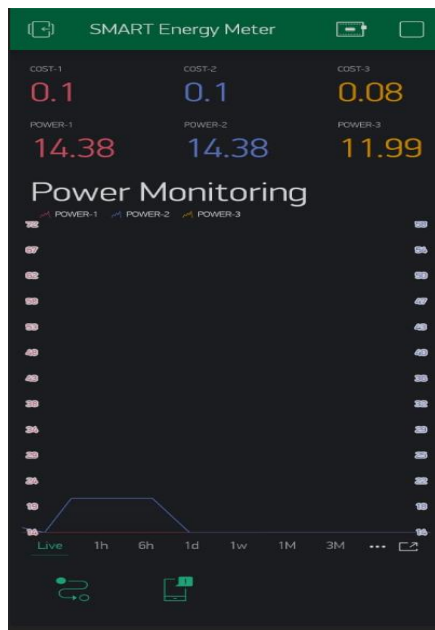


Fig 4.27 No load Copper Losses



Fig 4.28 Small Load Monitoring

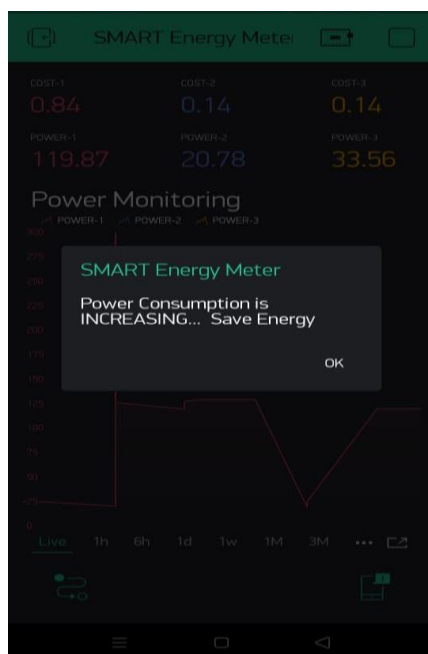


Fig 4.29 Notification Alert

In Small Load

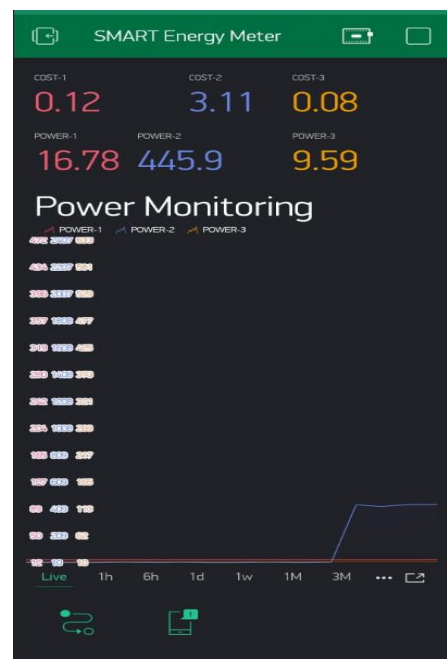


Fig 4.30 Buzzer Alert in Medium

Load



**Fig 4.31 Circuit Breaking In
High Load**



**Fig 4.32 Over-all Power Monitoring in
Three Loads**

4.18 HARDWARE RESULTS

Table 4.3 Hardware Output Results

S.no	Loads	Copper Loss (W)	Conditions	Power (W)	Energy (Kwh)	Cost (Rs)
1.			Normal	98.29	0.09829	0.68
	Low	14.38	Notification	119.87	0.11987	0.84
2.	Medium	14.38	Normal	177.34	0.17734	1.23
			Buzzer	445.09	0.44509	3.11
3.	High	11.99	Normal	189.86	0.18986	1.32
			Circuit Cut-off	685.64	0.68565	4.80
				Total	1.715	12.00

4.19 IMPLEMENTATION

4.19.1 WORKING:

Step 1: So as to determine connection between the client and therefore the server the Wi-Fi option within the Smartphone is enabled.

Step 2: It's connected to the Wi-Fi module of the system.

Step 3: Each electronic/electrical appliance within the system is connected to the digital pins on the node MCU board.

Step 4: A Relay is employed to interrupt the circuit if power exceeds the edge Values.

Step 5: A C-program is loaded on to the microprocessor chip on the node MCU Board which specifies what action is to be performed on receiving particular inputs.

Step 6: An Android Application has been developed which enables the top user to watch and control the appliances from any remote location.

Step 7: Through Blynk Application the command given to the node MCU.

Step 8: Successful controlling and monitoring of appliances.



Fig 4.33 Hardware kit



Fig 4.34 Hardware Kit in Supply Mode

Table 4.4 Conditions for Output Results

S.no	Loads	Condition-1	Condition-2	Condition-3
		Notification	Notification + Buzzer	Notification + Buzzer + C.B
1.	Low	If P1 > 100W	If P1 > 200W	If P1 > 450W
2.	Medium	If P2 > 200W	If P2 > 300W	If P2 > 500W
3.	High	If P3 > 300W	If P3 > 600W	If P3 > 700W

CHAPTER-5

CONCLUSION AND FUTURE WORK

5.1 CONCLUSIO

From the top user's point of view, Internet may be a means of Communication which is definitely available and affordable. Android Phones and Android applications are already a neighborhood of human life. Thus, a mixture of those technologies will make life more simple and straightforward to measure. The potential of the system are often improved to a greater extent by combining technologies like cloud computing, these technologies aren't new the Industry, combination of those technologies with the Internet of Things (IoT) will do miracles in human life. It's the automation of the house or household activity.

This paper described the planning, implementation and functional validation advanced Smart Energy meter with IoT-based support for integration in smart environments like Smart Homes or Smart Cities. This proposed system consists communicates employing a concentrator-type architecture with an internet server for reporting the recorded events. The system also provides a Web-based interface for monitoring the network of operating devices and also real-time event notification, Buzzer and circuit cutoff when the power exceeds the given limit.

Smart meters allow you to ascertain when you're using the foremost energy and the way much it's costing you. They eliminate the unpredictability of estimated billing, ensuring that you simply buy exactly what you employ. In truth, for several smaller families, installing Smart meters approach they see a reduction of their bills straightaway.

We know that this Smart meters are around for a short time but so far only around 35% of UK homes have already got a sensible meter installed. A sensible meter sends automatic meter readings straight to your supplier, also as showing you what energy you're using, where and when on an in-home display. This helps you manage your energy

usage also as ending estimated bills. During this way these system install in our nation, will reduce the power consumption and save for the future resources.

5.2 FUTURE WORK

Automation for residences become common place, the market will eventually be crowded with several players, multiple product offerings and competitive pricing with low margins. The products themselves will reach a 'plug and play' sort of usability.

If the collected data given to the Machine Learning and then trained a machine, then it'll predict that during which time and which part or appliances using the more power consumption takes place and reduce it, it also utilized in Power Auditing.

REFERENCES

- [1] Mr. Ankush S, Dr.H.K.Naidu in GSM International journal of Applied science and engineering Technology power meter billing plus load control using 2017.
- [2] A.A. Noman, M.F. Rahaman, H. Ullah, in National conference on Natural science and Technology R.K. Das Android Based Smart energy meter 2017.
- [3] Ceo of Arabia Ashraf Mahmoud in Smart Electric meters Group 2017.
- [4] D. O. Al Abdul karim and Z. Lukszo, in Fourth international convention on vital Infrastructures smart Metering for the destiny energy systems inside the Netherlands, 2016.
- [5] E. Ahmad, in global conference on emerging traits in Networks and laptop Communications (ETNCC) —clever Metering and domestic automation answers for the subsequent decade, 2016.
- [6] J. M. Bohli, C. Sorge, and O. Ugus, in IEEE international convention on Communications Workshops (ICC), —A privacy model for clever Metering, 2015.
- [7] Narendra Kumar, sahani, Tejashree Ravi, Akibjaved, Tamboli, Ranjeet paisal in IOT based smart energy meter International Research Journal of Engineering and Technology 2017.
- [8] N. Anglani, F. Benzi, E. Bassi, and L. Frosini, in , IEEE Transactions on industrial Electronics, vol. 58, no. 10, —power clever Meters Interfacing the families Oct. 2014
- [9] O. Popa, H. Ciocarlie, A. S. Popa, and M. B. Racz, in 14th international conference on sensible Engineering structures (INES), —smart Metering for monitoring domestic utilities 2015.
- [10] P. Qiu, G. Deconinck , in IEEE global conference on Networking, Sensing and control (ICNSC), "clever Meter's remarks and the ability for electricity savings in family area: A survey," April 2013.

- [11] S. Peter, S. David, in IET conference on Renewable electricity technology., Strood., Kent, —Characterisation of electricity intake in domestic households, Sept. 2017
- [12] Patrick Mapulane, Tshepang Letshwiti, Mompoti Molibe, Oagile Gaogane, Keboka M. Setheb, N.M.J.Ditshego Smart energy meter Bius Research and Innovation Symposium 2019.
- [13] Eaton in 2016: Arc Fault Detection Device (AFDD).
- [14] E. Mani siliviya, K. Meena, Vinodhini in International journal of advanced research Engineering and technology GSM based automatic energy meter system 2014.
- [15] T. Staake, M. Weiss, F. Mattern, T. Graml, and E. Fleisch, in eighth international conference on cellular and Ubiquitous Multimedia, Cambridge, uk, —reachable comments: Connecting smart Meters with mobile telephones, 11 Nov. 2015.
- [16] T. Lu, P. Du, X. Guo and L. G. Frank, in Transmission and Distribution conference and Exposition (T&D), —clever Meter statistics analysis, may. 2013.
- [17] Stragier.J , L. Hautekeete, L. De Marez, in IEEE conference on innovative technologies for an efficient and dependable energy supply (CITRES) "Introducing smart grids in residential contexts: customers' perception of smart family appliances, Sept. 2012.
- [18] S.K Jadadeesh ,Naveen Kumar, Smart Energy Meter International Journal of Technical Research and Applications 2016.
- [19] S. Livgard, in IEEE worldwide Symposium on commercial Electronics (ISIE), "energy clients' attitudes in the direction of smart Metering, July. 2014
- [20] V.P Babar, Mohale,D.G Ingenious Energy maintaining control and management of electrical supply Institute of engineering and technology 2015.

[21] Running state Evaluation of electric Energy Meter Workshop on electronics, computer and applications Yingying cheng Huaxiao Yang 2014.