

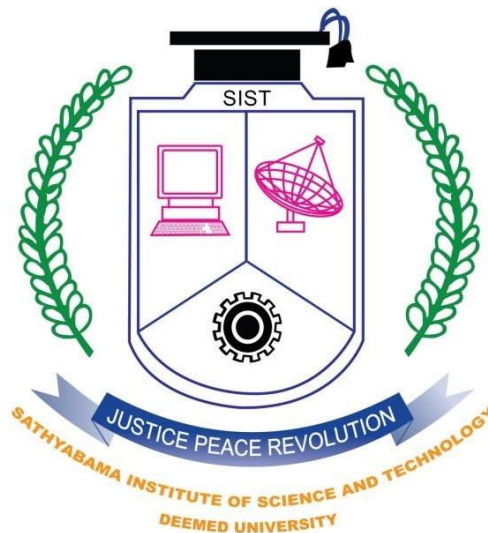
POWER THEFT DETECTION SYSTEM

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

by

G SAI BALAJI REDDY (Register No. 37140031)

CH SUSHANTH (Register No. 37140019)



**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
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

APRIL 2021



SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **G SAI BALAJI REDDY** (Reg. No. 37140031) and **CH SUSHANTH** (Reg. No. 37140019) who carried out the project entitled "**POWER THEFT DETECTION SYSTEM**" under our supervision from December 2020 to April 2021.

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Internal Guide**

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Submitted for Viva voce Examination held on _____

Name:

Signature:

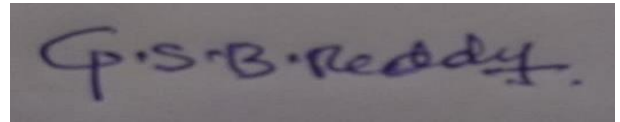
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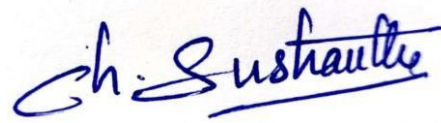
DECLARATION

We **G SAI BALAJI REDDY** (Reg. No. 37140031) and **CH SUSHANTH** (Reg. No. 37140019) hereby declare that the Project Report entitled “**POWER THEFT DETECTION SYSTEM**” done by us under the guidance of **Mrs.RAMYA.D** 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 handwritten signature in blue ink that reads "G.S.B.Reddy.".

2.

A rectangular box containing a handwritten signature in blue ink that reads "Ch. Sushanth" with a horizontal line underneath.

SIGNATURE OF THE CANDIDATES

DATE:

PLACE:

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.

We convey our thanks to **Dr. N. M. Nandhita., Dean, School of Electrical and Electronics Engineering** and **Dr. V. Sivachidambaranathan, Head of the Department, Dept. of Electrical and Electronics Engineering** for providing us necessary support and details at the right time during the progressive reviews.

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ABSTRACT

The power theft detection which aims to detect any theft related to electricity .Electrical energy is very important for everyday life. The objective of this project is to design a system to avoid the thefting. This model reduces the manual manipulation work and theft control. We must first properly understand the working of different parts that is to be combined together. The technology which we are going to use in our project and the implementation of this system will save a large amount of electricity.

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CHAPTER 1

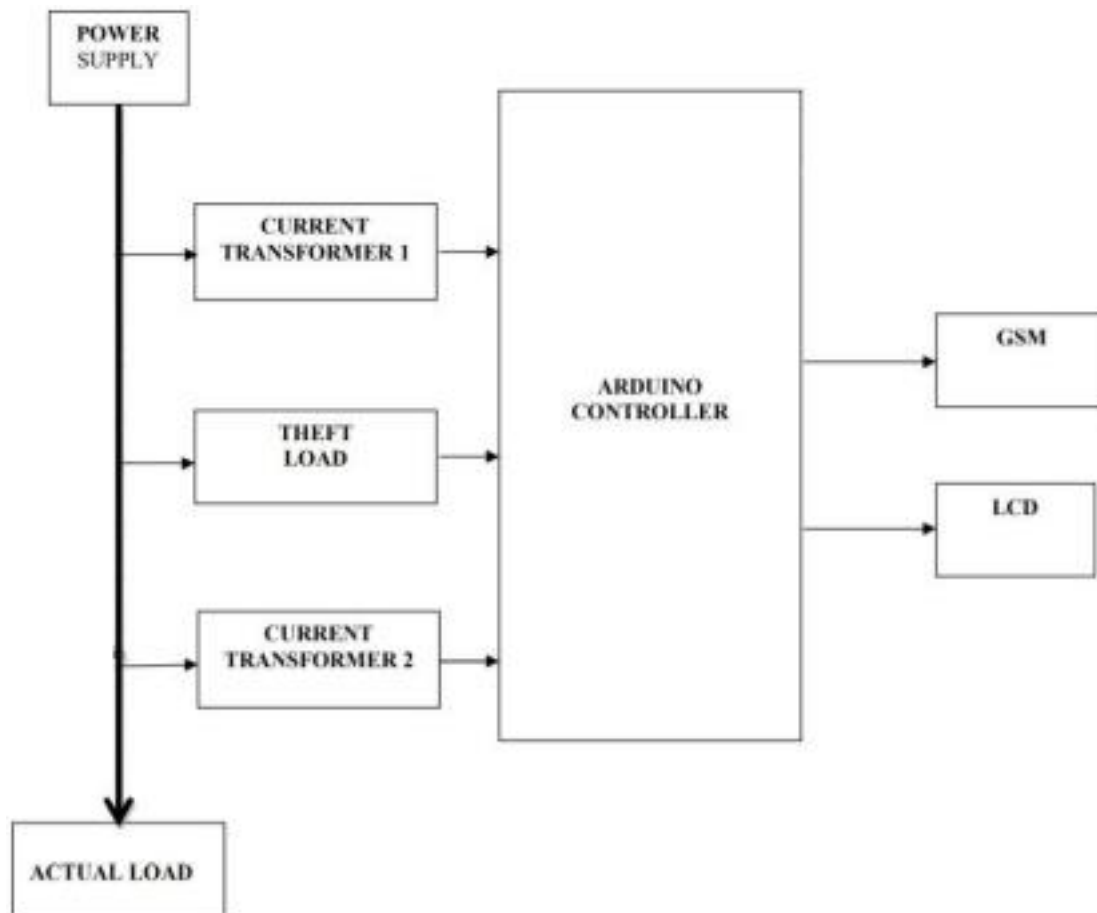
INTRODUCTION

1.1 GENERAL

The Smart Electric Bill is a complicated platform to the manner we acquire power nowadays. In earlier times the demand for electricity was substantial compared thereto presently. Since the demand for electricity has tremendously increased, a redesign of the present grid system is far needed. With the technology available in these times , the smart grid might be designed in such a fashion , that it uses digital technology to detect and react to local changes in usage. The system will feature a two-way dialog where electricity and knowledge are often exchanged between the buyer and utility. This can increase or decrease the quantity of energy a consumer needs by analyzing the feedback of the two-way dialog. In this system a practical energy meter is installed in every consumer unit and a server is maintained on the service provider side. both the meter and the server are prepared with which enables communication among the 2 ends using Server. The Arduino receives the tariff records from the energy meter and sends the received information to the server. The server in the transmission system is connected with the cloud, through this we are able to monitor and control the EB lines of every consumer through the Internet. This system also serves to shut off the EB Line to the consumers who aren't paying their monthly bills properly. The process can be easy and maintenance then even more secure this system also helps the 4consumers to monitor their daily usage current through the Internet. The transfer of electricity and knowledge between consumer and utility would increase efficiency, reliability and security. The Smart grid also enables renewable electricity technology to be integrated into the device for a greener, greater environmentally.

1.2 EXISTING SYSTEM

In existing systems errors may occur due to less concentration. It requires Huge Man power . The system monitoring work gets delayed due to external conditions. Due to this Manual operation there is a high wastage of Power. Controlling the home appliance through Bluetooth, GSM is an already existing system .Bluetooth is having the distance parameter and there is no more monitoring. By using the GSM module it just sends the units consumption to the mobile but not to store any kind of data.nowadays the sector is facing such an environment that gives demanding situations. Energy crisis is the main problem that our society faces. A relevant system control and monitor power usage is one of the solutions to this problem. One approach which is today's energy crisis that can be addressed through reduction of power usage in households. The customers are increasing rapidly and also a burden to electricity supplying divisions sharply increasing.



1.3 LITERATURE SURVEY

AUTHOR: Nilesh, Rinku Raj prakash.

TITLE: GSM BASED ELECTRICITY THEFT DETECTOR

PUBLICATION: IJEAS,2016

- The voltage and the current values are measured manually. on this paper the experimental setup for theft is achieved with the help of automation.
- The voltage and current values are measured the usage of modern-day transformer and ability transformer, it's miles provided to the bridge rectifiers and filters
- which gets rid of the unwanted indicators and with the assist of A/D converter analog values are converted to virtual values and it is feeded to the raspberry pi here the voltage and current values are fixed with the help of python coding

- whilst the extra load is hooked up the buzzer begins alarming and the theft might be detected.

AUTHOR:Q.M.Ashraf M.H.habaebi

TITLE: Autonomic schemes for threat mitigation in the internet of things.

PUBLICATION: ElsevierJournal,2015

- Current studies on strength theft detection is increasingly more centered on constructing systems because the person of the energy distribution enterprise will use the product to become aware of capability faulty customers with their contact information to minimize distribution and distribution losses.
- This product allows distribution businesses to optimize the usage of strength theft detection gear.
- so as for any of those systems to work, they want methods of detecting a faulty consumer from a specific enter statistics set.
- In this newsletter, we talk about a consultant pass section of electricity robbery detection strategies.
- The take a look at different strategies is underway to propose the brand new technique which ought to have extra precision to come across the robbery of electricity.
- The technique could therefore be useful for power authorities to further minimize non-technical losses in electricity distribution.

AUTHOR:Z.Shelby, C.Bormann

TITLE:The wireless Embedded Internet

PUBLICATION:John Wiley and sons embedded,2011

- A singular system has been devised to remove electricity robbery with the aid of automated launch of excessive voltage in the transmission line in response to the command acquired through the remote termination unit (excessive voltage supply) from Arduino within the event of robbery being detected.
- Because of the high voltage within the transmission traces, the pilferer's appliances drawing energy illegally by means of tapping get impaired.

- This operation is brief (for 5 seconds) and in the course of this time, the supply of voltage for everyday customers is kept suspended.
- But, in case of emergency i.e., while the normal delivery can not be disturbed, the skip mode is activated so that customers hold to get an uninterrupted power delivery.
- During this period, the system of theft removal is kept suspended. The real operation of this novel gadget has been demonstrated via simulating the method in Proteus 8.6 and an operating hardware prototype is evolved.
- The system for this reason advanced is effective and dependable.

AUTHOR:Nayan Thakre,Shreya Vaidya,Prachi Damedha

TITLE:Power theft detection distribution system

PUBLICATION:“IEEE J.select. Area Commun., vol. 31,no.7,pp.1319- 1330, jul.2013

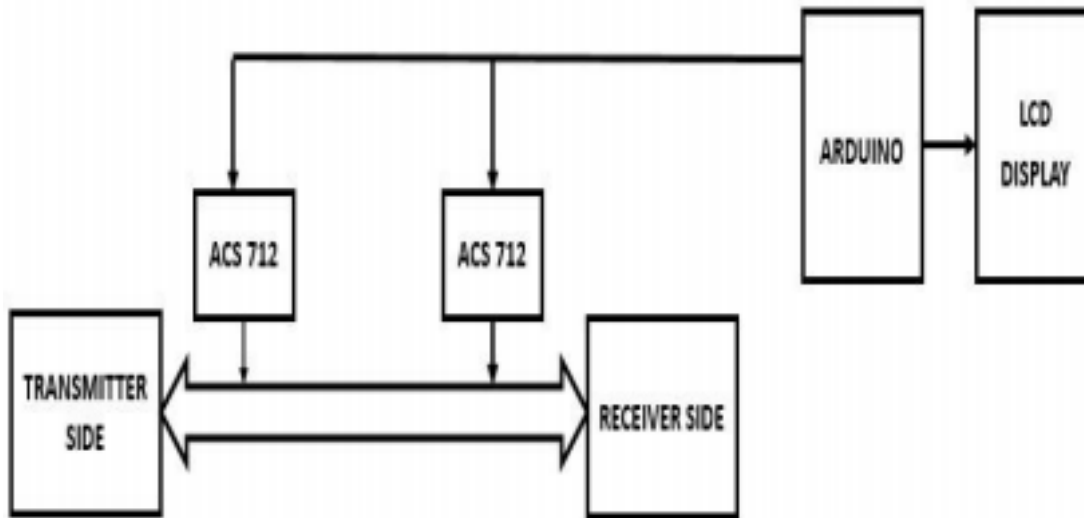
- On this task, we display how it's far feasible to supply automatic facts to go to the workplace about power robbery.
- For this magnetic sensor is used to feel a magnet which is placed on the meter. The piezo element is used to sense the vibration of a meter.
- With the electric enterprise undergoing trade, multiplied interest is being targeted on energy supply reliability and strength excellent strength carriers and customers alike are worried about reliable energy.
- whether the focus is on interruptions and disturbances or prolonged outage monitoring can offer facts about energy glide and call for and help to discover the reason of electricity machine disturbances.
- The work of this paper is to monitor the power consumed with the aid of a model enterprise of this kind of household customers from a centrally located factor. monitoring the electricity manner calculating the energy ate up exactly through the user at a given time.
- The power consumed by using the person is measured and communicated to the controlling substation on every occasion wanted by using the character on the substation.

- Theremarks from the user helps in identifying usages among authorized and unauthorized users which allows in controlling the power robbery, one of the prime challenges in modern-day eventualities.
- verbal exchange among user/family and substation can be of stressed out and wireless

1.4 PROPOSED SYSTEM

The smart grid entails the application of superior communications and control technologies and practices to enhance reliability, performance, and protection which are key elements inside the on-going modernization of the energy delivery infrastructure. Advanced metering infrastructure (AMI), which take in smart meters, communication networks, information management systems, is enhancing operational efficiency of utilities that provide electricity customers with the information to make more effective 14management of their energy use. smart grid programs permit utilities that automatically find and isolate faults which reduce outages, dynamically optimize voltage and reactive power levels for making more efficient power use, and monitor asset health for guide maintenance. To placing the current sensor in the transmitter side and receiver side if any one theft the power in- between the lines receiver side is get analyse power consumption automatically gives the indication through the LCD screen To automatically control the electrical appliance through internet because it does not having any kind of distance parameter and the continuously monitoring the data and stored in cloud The smart EB involves the application of advanced communications and control technologies and practices to improve reliability, efficiency, and security which are key ingredients in the on-going modernization of the electricity delivery infrastructure. Advanced metering infrastructure (AMI), which take in smart meters, communication networks, information management systems, is enhancing the operational efficiency of utilities and providing electricity to the customers with information to make more effective management of their energy use. smart grid applications allow utilities to mechanically locate and isolate faults which lessen

outages, dynamically optimize voltage and reactive power levels for making more efficient power use, and also to monitor asset health to guide maintenance. By using a button to manually restart the function.



1.5 ADVANTAGES OF PROPOSED TECHNIQUE

- Control the appliance at anywhere in the world.
- Continuously monitoring.

CHAPTER 2

PROJECT DESCRIPTION

2.1 GENERAL

Electrical power theft is a major problem in power system networks all over the world, which is illegal and should be strictly prohibited. Power theft can be defined as the usage of electrical power without any contract with the supplier. In order to eliminate power theft, the location of power theft is to be known so that appropriate

action will be taken on the legal offenders. Circuit consists of an arduino,GSM,ESP8266 and Current transformer. Meters cannot be used for high currents so current sensing is done by current transformers.Three current transformers are used two is at load side measure of current of load and one is connected at supplier end. Using IOT power theft detectors or kits has been implemented.

2.2 MODULE NAME

- Arduino UNO
- ACS712 Current Sensor
- Nodemcu ESP8266
- Bulbs
- Switches

2.3 MODULE DESCRIPTION

2.3.1 IOT(INTERNET OF THINGS)

The internet of things (IOT) is the inter-networking of physical devices, vehicles (also known as "connected devices" and "smart devices"), buildings, and different items embedded with electronics, software, sensors,actuators, and community connectivity which enable these gadgets to acquire and alternate information. In 2013 the worldwide requirements Initiative on internet of factors (IOT-GSI) defined the IOT as "a global infrastructure for the information society, enabling advanced services by interconnecting (bodily and virtual) matters based on existing and evolving interoperable information and communication networks" and for those purposes a "thing" is "an object of the physical world (physical things) or the information world (virtual things), which capable of being diagnosed and included into communication networks". The IOT permits objects to be sensed or controlled remotely across current community infrastructure, creating opportunities for more direct integration of the physical global into computer based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.

2.3.2 ARDUINO UNO

Arduino is an open-supply platform used for constructing electronics tasks. Arduino includes each a physical programmable circuit board (often called a microcontroller) and a piece of software program, or IDE (integrated improvement environment) that runs to your laptop, used to put in writing and add computer code to the physical board. The Arduino platform has grown to be quite famous with people simply beginning out with electronics, and for true cause. in contrast to most previous programmable circuit boards, the Arduino does no longer want a separate piece of hardware (known as a programmer) which will load new code onto the board – you can honestly use a USB cable. additionally, the Arduino IDE makes use of a simplified version of C++, making it less complicated to discover ways to use software program . Subsequently, Arduino offers a well known shape component that breaks out the capabilities of the micro-controller into a greater handy package.

What Does it Do?

The Arduino hardware and software turned into designed for artists, designers, hobbyists, hackers, rookies, and everyone interested in creating interactive objects or environments. Arduino can engage with buttons, LEDs, vehicles, audio system, GPS units, cameras, the internet, or even your smart-telephone or your tv! this pliability combined with the reality that the Arduino software program is free, the hardware boards are pretty reasonably-priced, and both the software and hardware are easy to examine has brought about a large network of customers who've contributed code and released instructions for a big sort of Arduino-based totally initiatives.

For everything from robots and a heating pad hand warming blanket to sincere fortune-telling machines, and even a Dungeons and Dragons dice-throwing gauntlet, the Arduino may be used as the brains in the back of nearly any electronics venture.

What's on the board?

There are numerous kinds of Arduino forums (explained on the following page) that may be used for one of a kind purposes. A few forums look a piece different from the one below, but maximum Arduinos have the majority of these additives in commonplace

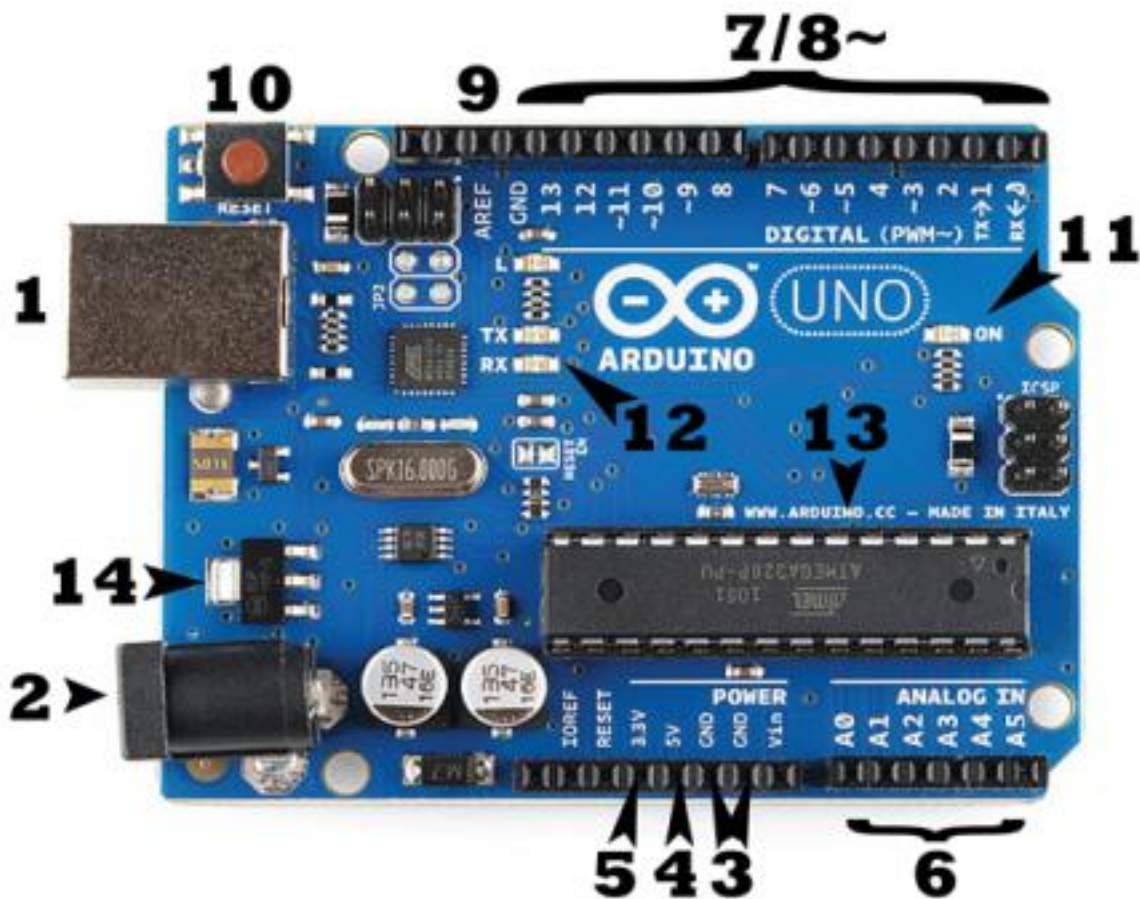


Fig. 2.3.2 Arduino UNO

The Arduino programming is a simplified version of C/C++. in case you understand C, programming the Arduino can be familiar. if you do not now recognize C, no need to worry as just a few commands are hard to carry out beneficial functions.

An important characteristic of the Arduino is that you may create a control software at the host computer, download it to the Arduino and it will run automatically. get rid of the USB cable connection to the computer, and this system will nevertheless run from the pinnacle on every occasion you push the reset button.do away with the battery and put the Arduino board in a closet for 6 months. While you reconnect the battery, the final program you stored will run. which means you connect the board to the host computer to expand and debug your application, but once this is completed, you do not need the laptop to run the program. What You want for a working device

Arduino Duemilanove board

USB programming cable (A to B)

9V battery or external electricity deliver (for stand-alone operation)

Solderless breadboard for external circuits, and 22 g stable cord for connections

Host pc jogging the Arduino improvement environment. variations exist for windows, Mac and Linux installing the software.

2.3.3 CURRENT SENSOR

The Allegro ACS712 offers comparatively cheap and particular solutions for AC or DC modern-day sensing in commercial, commercial, and communications structures. The device bundle lets in for clean implementation by using the purchaser. typical programs encompass motor control, load detection and control, switched mode electricity components, and over modern-day fault safety. The tool isn't meant for automobile packages. For the car grade model, seeacs712.



Fig. 2.3.3 current sensor

The device includes a particular, low-offset, linear corridor sensor circuit with a copper conduction direction positioned near the floor of the die. carried out present day flowing through this copper conduction route generates a magnetic discipline which is sensed by the included corridor IC and transformed right into a proportional voltage. device accuracy is optimized through the close proximity of the magnetic sign to the corridor transducer. A particular, proportional voltage is provided with the aid of the low-offset, chopper stabilized Bi CMOS corridor IC, that is programmed for accuracy after packaging.

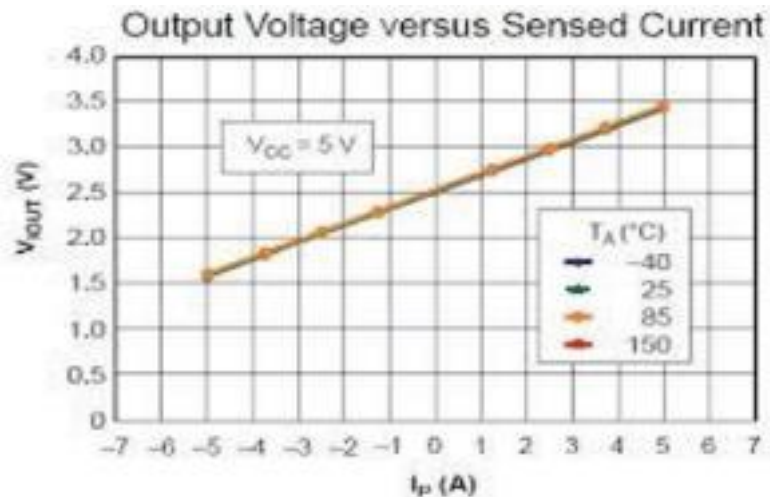


Fig 2.3 Output Voltage Vs Sensed Current

2.3.4 Nodemcu ESP8266

NodeMCU is an open-source Lua primarily based firmware and development board specially targeted for IoT primarily based programs. It includes firmware that runs at the ESP8266 wireless SoC from Espressif systems, and hardware that is primarily based at the ESP-12 module. The Nodemcu ESP8266 development board comes with the ESP-12E module containing ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor helps RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to save records and packages. Its high processing strength with in-constructed wi-fi / Bluetooth and Deep Sleep operating capabilities make it perfect for IoT projects. NodeMCU can be powered by the use of Micro USB jack and VIN pin (outside deliver Pin). It supports UART, SPI, and I2C interface.

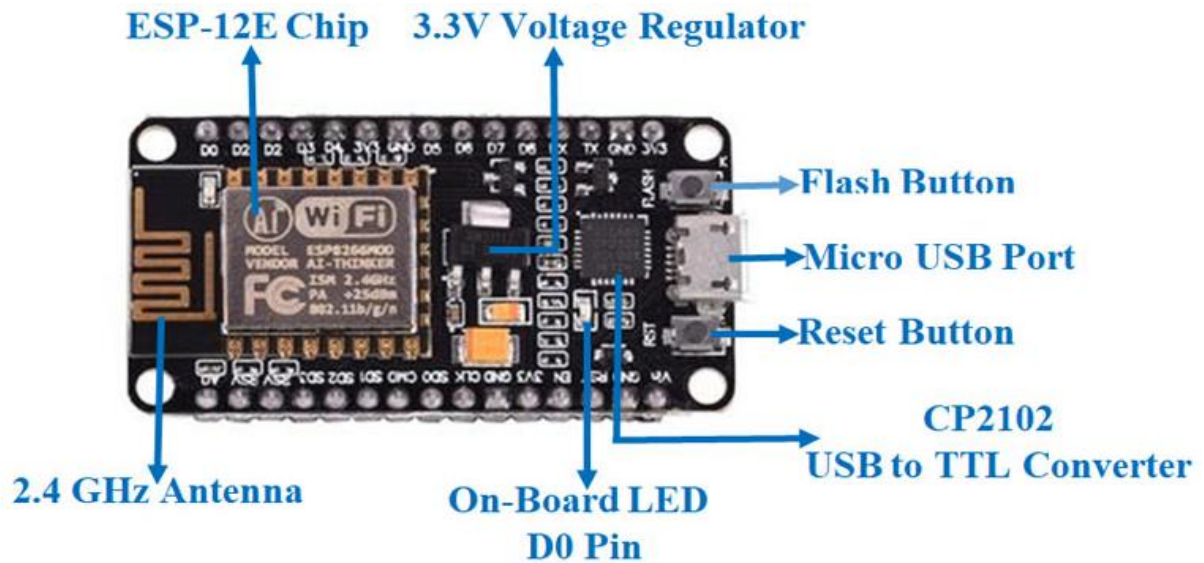
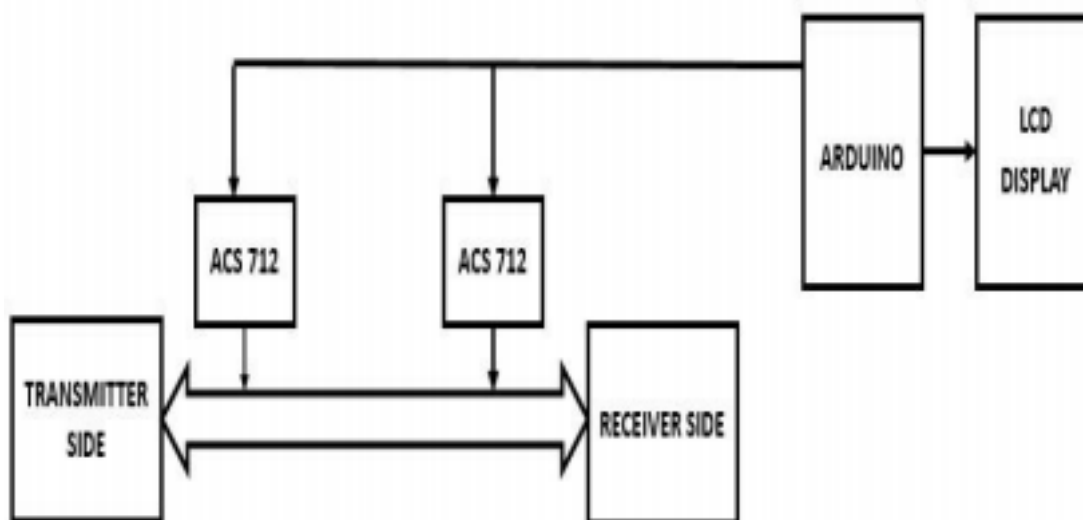


Fig 2.3 Nodemcu ESP8266

2.4 MODES OF OPERATION

Smart grid applications enable utilities to automatically locate and isolate faults to reduce outages, dynamically optimize voltage and reactive power levels for more efficient power use, and monitor as set health to guide maintenance. To design a smart grid using various sensors this can be controlled and monitored by the Raspberry Pi via the Internet of Things (IOT) .To provide a low cost platform for interconnecting electrical/electronic devices and various sensors in a home via the internet network.



CHAPTER-3

SIMULATION THEORY

3.1 GENERAL

Arduino Integrated Development Environment (IDE)

The Arduino IDE supports the languages C and C++ using unique regulations of code structuring. The Arduino IDE supplies a software program library from the Wiring challenge, which presents many commonplace input and output strategies. user-written code best calls for simple capabilities, for beginning the cartoon and the main program loop, which might be compiled and related with a program stub predominant into an executable cyclic government software with the GNU toolchain, also protected with the IDE distribution. The Arduino IDE employs this machine arduino to convert the executable code into a text report in hexadecimal encoding that is loaded into the Arduino board by means of the usage of a loader software program in the board's firmware. With the aid of default, arduino is used as the uploading tool to flash the consumer code onto reputable Arduino boards.

3.2 BUILDING OF MODEL

IOT devices can be used to screen and control the mechanical, electric and digital systems applied in various kinds of houses (e.g., public and private, commercial enterprise, establishments, or residential) in home automation and constructing automation structures. in this context, 3 main regions are being protected in literature: the mixture of the net with building electricity management systems to be able to create strength performance and IOT driven “ smart buildings' ”. The viable way of real-time tracking for decreasing energy consumption and monitoring occupant behaviours. the aggregate of clever gadgets in the built surroundings and the way they are probably used in destiny packages.

3.3 ABOUT ARDUINO IDE

The Arduino project gives the Arduino incorporated development surroundings (IDE), that's throughout-platform utility written inside the programming language Java. It originated as a hierarchy of operation menus. It consists of a code editor with capabilities which includes text reducing and pasting, looking and changing textual content, automated indenting, brace matching, and syntax highlighting, and provides easy one-click on mechanisms to collect and add programs to an Arduino board. It also carries a message location, a text console, a toolbar with buttons for not unusual functions. An application written with the IDE for Arduino is called a ketch. Sketches are stored on the development pc as textual content documents with the record extension into. Arduino software program (IDE) pre-1.0 saved sketches with the extension. The Arduino IDE helps the languages C and C++the use of unique regulations of code structuring. user-written code most effectively requires simple functions, for starting the cartoon and the principle software loop, which might be compiled and linked with a program stub predominant () into an executable cyclic executive software with the GNU tool chain, also covered with the IDE distribution. The Arduino IDE employs this system to convert the executable code right into a text record in hexadecimal encoding that is loaded into the Arduino board with the aid of a loader application within the board's firmware.

3.4 PROGRAM OF ARDUINO

```
void setup() {
  Serial.begin(9600);
  pinMode(17,OUTPUT);
  pinMode(18,OUTPUT);

  digitalWrite(17,LOW);
  digitalWrite(18,LOW);

  delay(2000);
}

// the loop routine runs over and over again forever:
void loop() {
  // read the input on analog pin 0:
  int sensorValue1 = analogRead(A0);
  int sensorValue2= analogRead(A1);
  int sensorValue3 = analogRead(A2);
  // print out the value you read:
  Serial.print(sensorValue1);
  Serial.print(" ");
  Serial.print(sensorValue2);
  Serial.print(" ");
  Serial.print(sensorValue3);
  Serial.println(" ");
  // Serial.println(sensorValue4);
  // Serial.print(" ");
  delay(1);

  if (sensorValue3 == 0 && sensorValue1 > sensorValue2 + 20)
  {
    Serial.println("Power theft detected in line 1");
    digitalWrite(17,HIGH);
    delay(500);
    delay(50);
  }
  else if (sensorValue2 == 0 && sensorValue1 > sensorValue3 + 20)
  {
    Serial.println("Power theft detected in line 2");
    digitalWrite(18,HIGH);
    delay(500);
  }
  else
  {
    digitalWrite(17,LOW);
    digitalWrite(18,LOW);
  }
}
```

3.5 PROGRAM 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 Theft Line .
- Sensors will measure the Power from Line 1, Line 2, Theft Line .
- Current flowing through the sensors will calculate the power w.r.t L1, L2.
- Calculated Load will be sent to the Cloud.
- Power consumption is increased beyond the values and Threshold values conditions will execute.
- Condition 1:Sensor value 3 is equal to 3 and Sensor value 1 is greater than Sensor value 1 in addition to 20.
- Then theft power detected in line 1
- Condition 1:Sensor value 2 is equal to 3 and Sensor value 1 is greater than Sensor value 3 in addition to 20
- Then power theft was detected in line 2. Then notification displayed on mail.
- Stop the Execution

CHAPTER-4

SIMULATION RESULTS

4.1 SIMULATIONS

NO LOAD

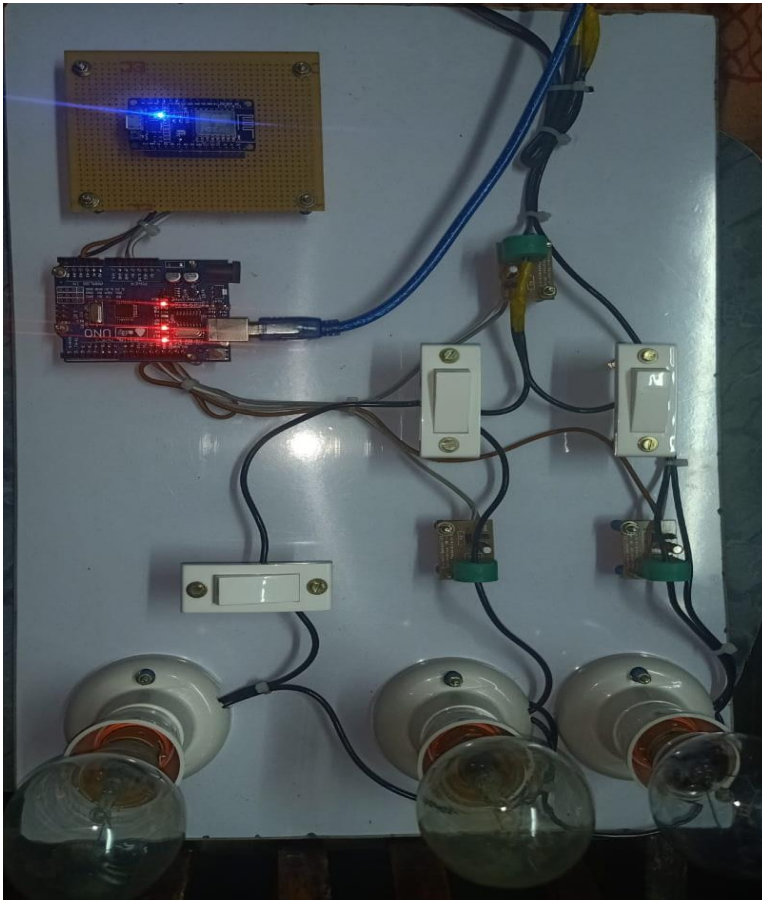


Fig.4.1.1 With No load

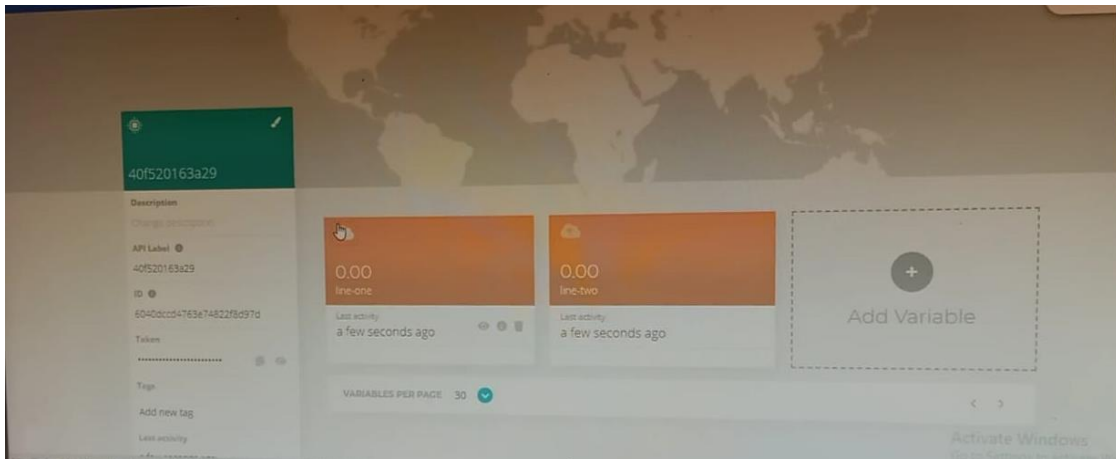


Fig.4.1.2 ubidot screen

No load, no theft occurred. It shows the 0

THEFT OCCURRED IN LOAD 1

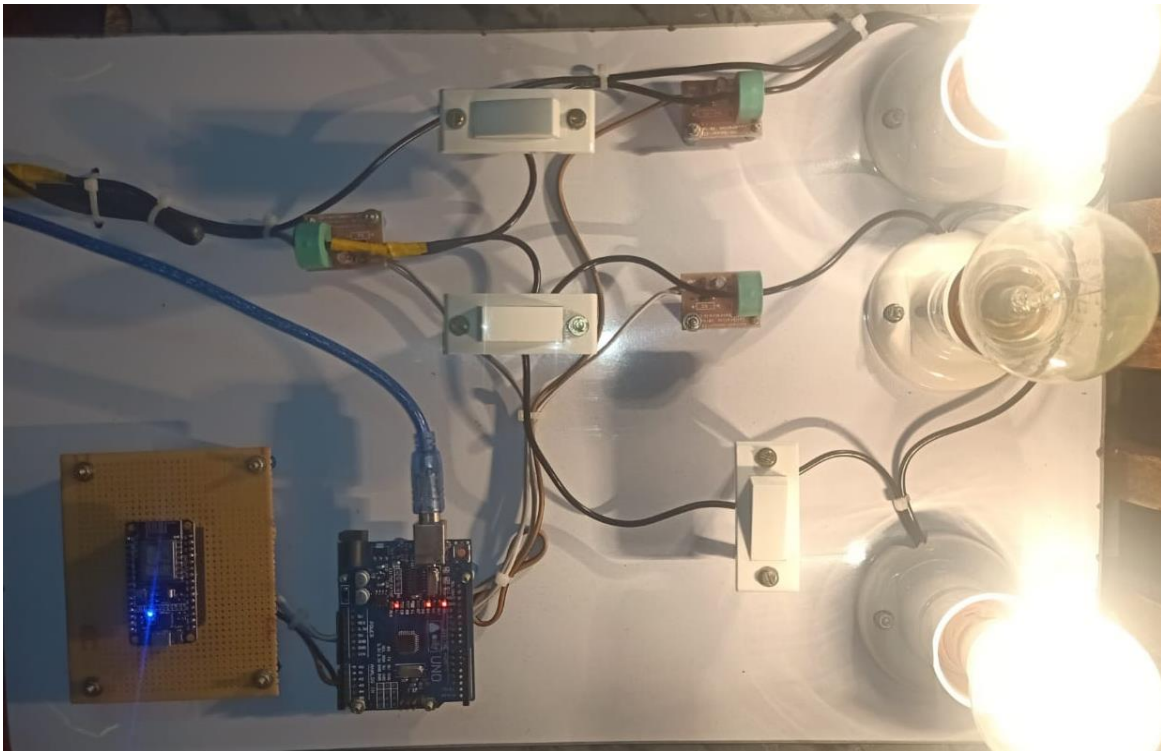


Fig.4.1.3 with Load

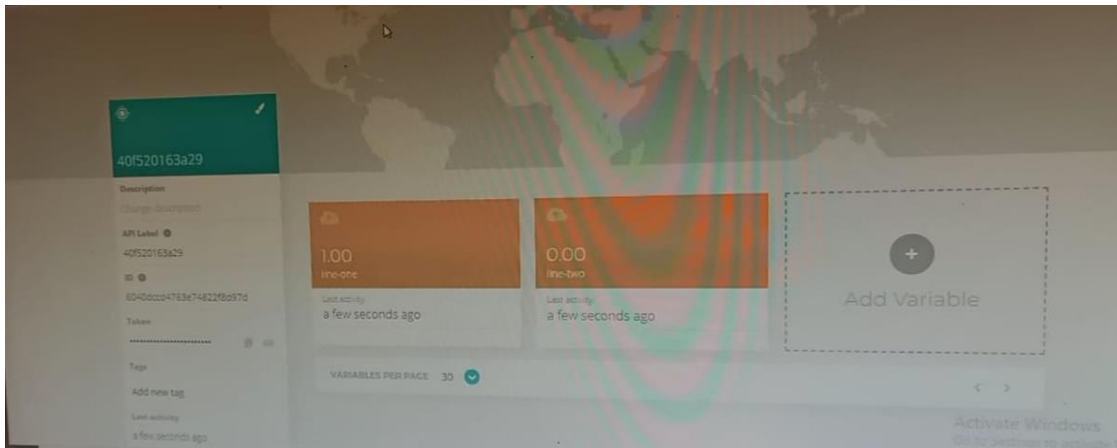


Fig.4.1.4 Ubidots screen

- Theft occurred in load 1. It shows the 1. Then graphs increase from 0 to 1.



Fig.4.1.5 Graph

- This graph explains the power theft occurred time.
- This graph is between on X-axis time and date Vs On Y-axis Theft occurred details.
- 0 if theft has not occurred. 1 is theft occurred.

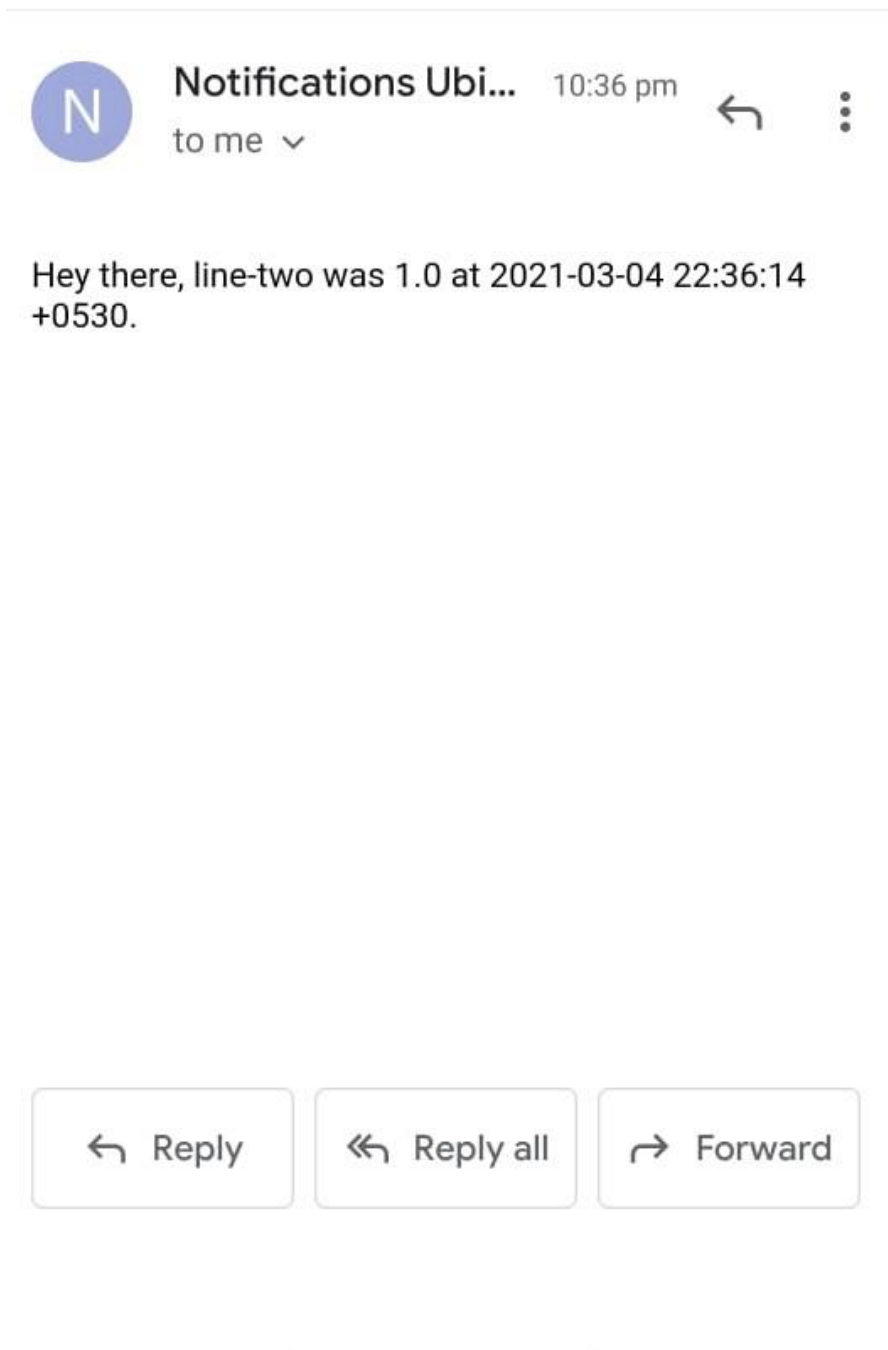


Fig.4.1.6 Mail message photo

- Will receive a mail to the transmission side authorities

CHAPTER 5

HARDWARE DESCRIPTION

5.1 INTRODUCTION

The hardware of the proposed system is implemented using Internet Of Things (IOT). The software system like C++ is used for the system design for coding the program.

5.2 SOFTWARE REQUIREMENTS

5.2.1 INTERNET OF THINGS

The internet of factors (IOT) is the inter-networking of physical devices, vehicles (additionally referred to as "related gadgets" and "clever devices"), buildings, and one of a kind gadgets embedded with electronics, software, sensors ,actuators, and network connectivity which allow these gadgets to acquire and alternate records. In 2013 the global necessities Initiative on internet of factors (IOT-GSI) defined the IOT as "a international infrastructure for the statistics society, allowing advanced offerings by way of interconnecting (physical and digital) topics primarily based on existing and evolving interoperable facts and communicate networks" and for the ones purposes a "component" is "an object of the bodily global (physical things) or the records global (digital matters), which capable of being recognized and included into communicate networks". The IOT lets in gadgets to be sensed or controlled remotely throughout modern-day network infrastructure, growing possibilities for extra direct integration of the bodily international into computer primarily based systems, and resulting in improved efficiency, accuracy and monetary gain in addition to reduced human intervention. whilst IOT is augmented with sensors and actuators, the era becomes an example of the more preferred beauty of cyber-bodily structures, which

additionally encompasses technologies which include clever grids, clever houses, smart transportation and smart cities. each issue is uniquely identifiable through its embedded computing device but is able to interoperate within the modern-day internet infrastructure. experts estimate that the IOT will encompass about 30 billion gadgets by using 2020. usually, IOT is anticipated to offer advanced connectivity of devices, structures, and offerings that goes beyond gadget-to-system (M2M) communications and covers a spread of protocols, domain names, and packages. The interconnection of those embedded gadgets (which includes clever gadgets), is anticipated to herald automation in almost all fields, whilst moreover allowing superior packages like a smart grid, and increasing to regions which include smart towns. "matters", within the IOT feel, can speak to a great sort of devices which incorporates coronary heart monitoring implants, biochip transponders on farm animals, electric powered clams in coastal waters, motors with built-in sensors, DNA analysis devices for environmental/meals/pathogen tracking, or discipline operation gadgets that help hearth opponents in search and rescue operations. criminal pupils recommend concerning "matters" as an "inextricable combination of hardware, software program, statistics and provider". these devices collect useful facts with the help of numerous present era and then autonomously glide the records among other devices. present day marketplace examples consist of domestic automation (moreover known as clever domestic devices) along with control and automation of lighting, heating (like clever thermostat), air flow, air conditioning (HVAC) structures, and domestic gadget such as washer/dryers, robotic vacuums, air purifiers, ovens, or refrigerators/freezers that use wi-fi for far off tracking. in addition to the enlargement of internet-linked automation right into a plethora of latest software areas, IOT is likewise anticipated to generate big amounts of records from numerous places, with the consequent necessity for brief aggregation of the information, and an boom inside the need to index, hold, and way such facts more correctly. IOT is one of the platforms of modern day clever city, and smart energy management gadget.

5.2.2 APPLICATIONS

According to Gartner, Inc. (an era research and advisory enterprise), there could be nearly 20.8 billion devices on the internet of things by 2020. ABI studies estimates that more than 30 billion devices might be wirelessly linked to the internet of factors by the year 2020. As in step with a 2014 survey and study carried out through Pew research internet mission, a big majority of the generation experts and engaged net customers who replied—83 percent—agreed with the belief that the net/Cloud of things, embedded and wearable computing (and the corresponding dynamic systems could have massive and useful consequences by 2025. As such, it is clear that the IOT will encompass a totally large variety of devices being connected to the internet. In an energetic circulation to accommodate new and emerging technological innovation, the United Kingdom authorities, in their 2015 finances, allotted £40,000,000 towards research into the internet of things. the former British Chancellor of the Exchequer George Osborne, posited that the internet of things is the next stage of the data revolution and referenced the inter-connectivity of everything from city shipping to scientific devices to household appliances. The potential to network embedded gadgets with limited CPU, memory and power sources method that IOT unearths applications in almost every area. [48] Such structures might be in the price of collecting statistics in settings starting from natural ecosystems to buildings and factories, thereby locating applications in fields of environmental sensing and urban making plans. Then again, IOT systems may also be liable for appearing actions, now not just sensing things. smart buying structures, for example, could screen specific customers' purchasing habits in a store by means of monitoring their specific cellular telephones. Those users may want to then be supplied with unique gifts on their favorite merchandise, or even region of items that they need, which their refrigerator has automatically conveyed to the phone. additional examples of sensing and actuating are contemplated in packages that deal with heat, water, energy and power management, as well as cruise-helping transportation structures. Other programs that the net of factors can offer is enabling extended home protection features and domestic automation. The concept of an "internet of living things" has been proposed to explain networks of organic sensors

that would use cloud-based total analyses to permit customers to examine DNA or other molecules. but, the utility of the IOT is not best confined to those areas. other specialized use instances of the IOT may exist. An overview of some of the most outstanding software areas is furnished right here.

5.3.3 SIMULATION

IOT modelling and simulation (and emulation) is commonly done at the design stage before deployment of the community. community simulators like OPNET, net Sim and NS2 can be used to simulate IOT networks. Virtual Twins can also be carried out to supply updates on the reputation and health of an asset, primarily based upon sensor readings integrated with a computational model of the asset.

5.2 UBIDOTS

Use the Ubidots platform to send facts to the cloud from any net-enabled device. you could then configure actions and indicators based totally to your real-time records and free up the value of your records through visual gear. Ubidots offers a rest API that lets in you to examine and write records to the sources available: statistics assets, variables, values, activities and insights. The API supports each HTTP and HTTPS and an API secret's required.

5.2.1 DATA STORAGE AND ANALYTICS

A venture for producers of IOT packages is to systemize and interpret the huge amount of records that is accumulated with the aid of the sensors. there may be an answer proposed for the analytics of the facts called wireless Sensor Networks. those networks percentage statistics amongst sensor nodes which can be shipped to a dispensed gadget for the analytics of the sensory facts. Another venture is the garage of this bulk data. relying on the software there may be excessive facts acquisition requirements which in turn result in high garage necessities. presently the internet is already chargeable for five% of the whole strength generated

and this consumption will increase considerably while we begin using packages with multiple embedded sensors.

5.3 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 find out the Arduino IDE on our computer and prepare the board to receive the program via USB cable fig. 4.1.

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 5.3.1: 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.

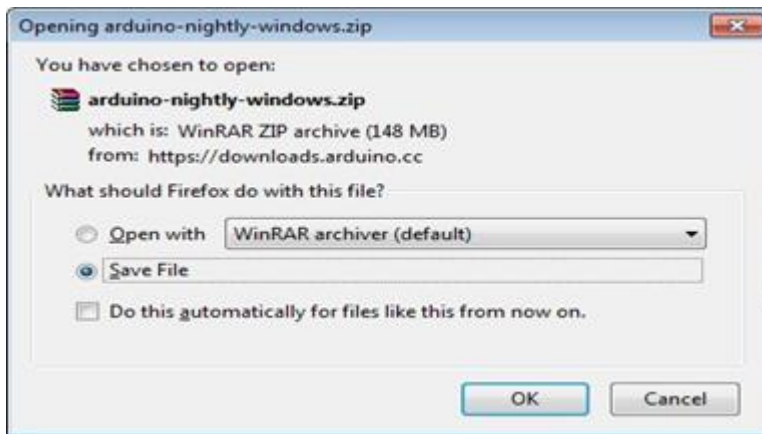


Fig 5.3.2: Download Arduino IDE Software

Step 3: Power up your 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 using an Arduino Diecimila, you have to be positive that the board is configured to draw energy from the USB connection.. The electricity delivery is chosen with a jumper, a touch piece of plastic that fits on top 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 and use the USB cable. The green energy LED needs to glow.

Step 4: Launch Arduino IDE

After your Arduino IDE fig. 5.3.3 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.

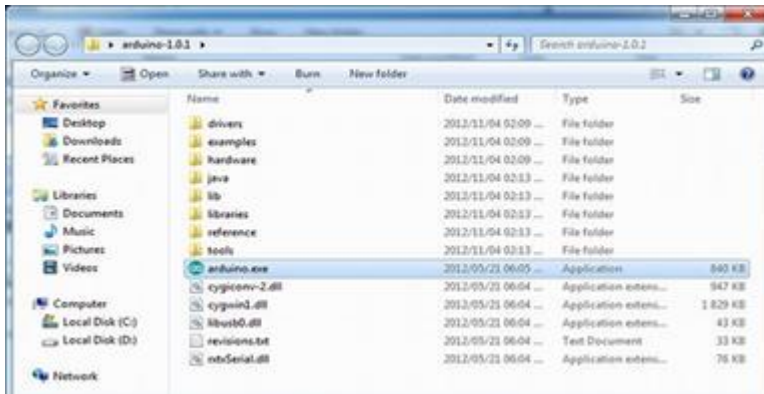


Fig5.3.3 Launch Arduino IDE

Step 5: Open your 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. 5.3.4

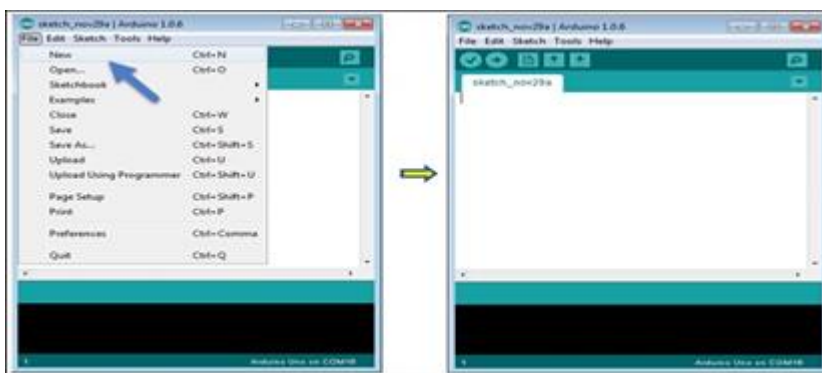


Fig 5.3.4 Create new project

To open an existing project example, select File -> Example -> Basics -> Blink as shown in fig 5.3.5.

Step 7: Select your serial port

Select the serial device of the Arduino board. Attend equipment -> interface menu. This is normally possible to be COM3 or higher . To seek out, you'll disconnect your Arduino board and re-open the menu as shown in the figure below fig. 5.3.7, the access that disappears has to be of the Arduino board. Reconnect the board and choose that interface.

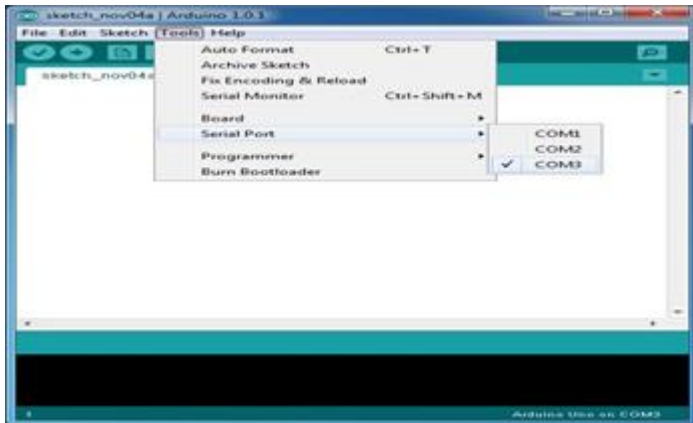


Fig 5.3.7: Select serial port

Step 8: Add the program to your 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 as shown in fig. 5.3.8.



Fig 5.3.8: 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.

5.4 Node-MCU (ESP8266)

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 5.4.1 Node MCU (ESP8266)

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 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 is a unit typically accustomed to 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.

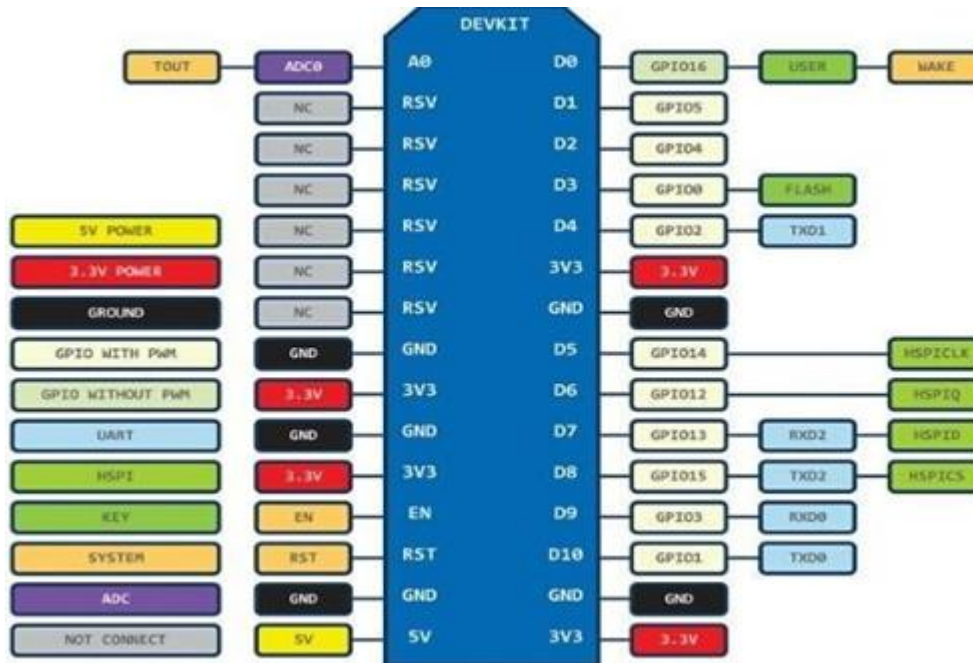


Fig 5.4.2: Pin diagram of Node MCU

The ESP8266 has visible a first rate adoption as a value-powerful decision for IoT and WiFi-capable gadgets. The ESP8266 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 to be attached 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 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 TX, 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 begin to experiment with the ESP-12E.

5.4.1 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

5.3.2 Pin design

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

Table 5.4.2 Pins of Node MCU

5.4.3 Applications

- Smart power plugs
- Home automation
- Mesh network
- Industrial wireless management
- Baby monitors
- IP Cameras

5.5 CURRENT SENSOR

5.5.1 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 is going to be administered to interface the sensor with a PIC microcontroller to live a dc current.



Fig 5.5.1: ACS712 Current sensor

5.5.2 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
- 80 kc information measure

- Total output error one.5% at metallic element = 25°C
- Little footprint, low-profile SOIC8 package

5.5.3 WORKING PRINCIPLE

The Allegro ACS712 current sensing element is based on the principle of Hall-effect, which 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 is recognised, the observed hall voltage square measure commonly accustomed estimates the opportunity.

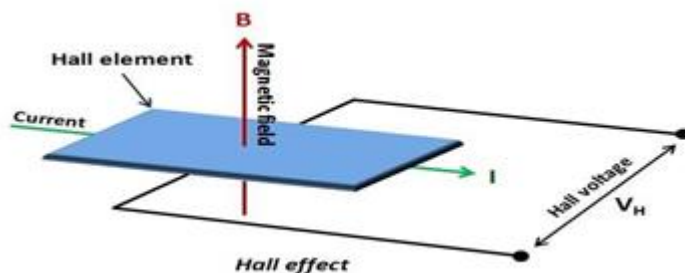


Fig 5.5.2 Current Sensor element rule

The ACS712 device is provided throughout a tiny low, surface mount SOIC8 package. It consists of a particular, low-offset, linear hall sensing detail circuit with a copper physical phenomenon path located near the floor 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 associate degree filter circuit stabilizes associate degree enhances the elicited Hall voltage to an applicable level so as to 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.

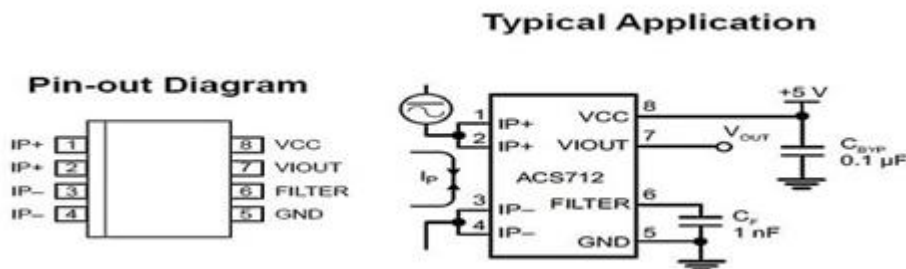


Fig 5.5.3: Pin diagram and a typical application circuit of ACS712

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. 5.5.3 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 an associate degree

external condenser (CF) between the Filter pin and ground. It ought to be noted that the use of an 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.

5.5.4 SENSITIVITY AND 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 are 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, VCC. This feature is particularly helpful once exploiting 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 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 the same as a result of the availability voltage of ACS712, then the magnitude relation metric output of ACS712 can catch any error among the A/D conversion due to the fluctuation among the reference voltage.

Let's justify this with an 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 voltage powers Associate in Nursing ACS712 detector chip. The analog output of the ACS712 is aiming to be digitized through the ADC chip. Once there is zero current through the current detector, the output is $V_{cc}/2 = \text{a pair of.5V}$. 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 $V_{cc} = \text{four.5V}$, then, due to the magnitude relation metric nature, the new output of the ACS712 detector ar aiming to be $\text{four.5}/2 = 2.25\text{V}$, which might still be digitized to 512 by the ADC as its reference voltage is in addition down to four.5V.

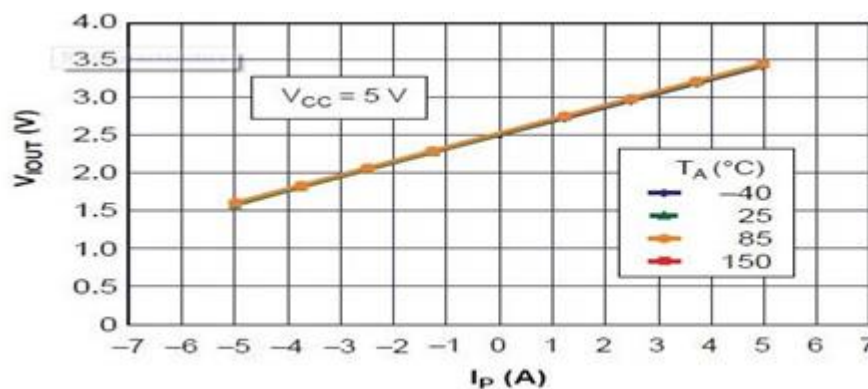


Fig:5.5.4 Output voltage vs detected current

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 incorporate 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 terminals can even degree current for hundreds operating at high voltages like 230V AC mains while output sensed voltage is removed from measuring components.

5.5.5 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 to 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.

5.5.6 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

Table 5.5.5: Sensor specifications

5.6 CONNECTING WIRES

Connecting wires fig.2.13 permits associates 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:5.6.1 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 the attraction, permitting it to draw electricity and perform its task.

5.7 NODEMCU BASE BOARD

Node MCU is a companion in nursing open supply IoT platforms. 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.5.7.1 Node MCU Base Board

5.7.1 CONVERSATION OF POWER INTO COST

- Energy = power * time /1000 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.

5.7.2 CALIBRATION OF ACS – 712 SENSOR

- 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
- $\text{Actual value} = (\text{value} - 2.5)V$
- $\text{Current in amp} = \text{actual value} * 10$
- $V_{\text{out}} = R_2 / (R_1 + R_2) * V_{\text{bat}}$
- $V_{\text{bat}} = 6.5$ when fully charged $R_1 = 10\text{k}$ and $R_2 = 10\text{k}$
- $V_{\text{out}} = 10 / (10 + 10) * 6.5 = 3.25\text{v}$ which is lower than 5v.

CHAPTER 6

CONCLUSION & FUTURE WORK

6.1 CONCLUSION

In the era of smart city development, this assignment is concentrated on the connectivity and networking component of the IOT .on this device, an power consumption calculation primarily based on the counting of calibration pulses are designed and implemented using the ATMEGA328P Microcontroller unit in the embedded gadget domain. in the proposed work, IOT and

MMC based totally meter studying system is designed to continuously reveal the meter reading and provider provider can Disconnect the energy source on every occasion the customer does now not pay the month-to-month bill and additionally it eliminates the human Involvement, delivers powerful meter analyzing, prevent the billing mistake. The assignment has completed following goals: Ease of getting access to information for purchasers from energy meters via IOT. robbery detection at customers leads to actual time. a liquid crystal display displays power consumption gadgets and temperature. Disconnection of provider from far flung server.

6.2 FUTURE WORK

This basic system we can upgrade to a great level by introducing the GPS module in the system. If we introduced the GPS in the system, then it would become easy to identify the perfect energy theft area. Thing Speak Cloud also provides the Map in their charts to display the locations of systems. So to improve the performance of the system more efficiently we have to connect the GPS module to the Particle photon board and the location we have to send on the cloud location chart.

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