Visvesvaraya Technological University

Belagavi, Karnataka-590 014

A PROJECT REPORT
ON

"IOT BASED POWER MONITORING SOCKET"

Project Report Submitted in Partial Fulfillment of the Requirement for the Award of the Degree Of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

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(2016-17)

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CERTIFICATE

Certified that the project work entitled **"IOT BASED POWER MONITORING SOCKET"** carried out by Ms. Manjushri Abbigeri (2KD13EC019), Ms. Laxmi Matur (2KD13EC403), Mr. Mahantesh Kadagoudar (2KD10EC023), Ms. Daneshwari Dumbali (2KD12EC016) the bonafide students of KLE College of Engineering and Technology, Chikodi in partial fulfillment for the award of **Bachelor of Engineering** in **Electronics and Communication Engineering** of the Visvesvaraya Technological University, Belagavi during the year 2016-17. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

Guide	HOD	Principal
Prof. **Shwetha Gangannawar**	Prof. J.M. Rudagi	Dr. Siddramappa Itti

External Viva

Name of the Examiners: Signature with Date:

1.
2.

DECLARATION

We, **Ms. Manjushri Abbigri** (2KD13EC019), **Ms.Laxmi Matur** (2KD13EC403), **Mr. Mahantesh Kadagoudar** (2KD10EC023), **Ms. Daneshwari Dumbali** (2KD12EC016) students of 8th semester BE in Electronics and Communication Engineering, K.L.E College Of Engineering And Technology Chikodi, hereby declare that the project work entitled **"IOT BASED POWER MONITORING SOCKET "**submitted to the Visvesvaraya Technological University during the academic year 2016-17, is a record of an original work done by us under the guidance of Prof. Shweta Gangannawar , Assistant Professor, Department of Electronics & Communication Engineering, KLE College of Engineering and Technology, Chikodi . This project work is submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Engineering in Electronics & Communication Engineering. The results embodied in this thesis have not been submitted to any other University or Institute for the award of any degree.

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Place: Chikodi

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ABSTRACT

The IOT market is expected to be the next big thing in coming years. The number of connected devices is increasing day by day and this motivates us to develop a solution for monitoring and security using IOT. In this project we measure power using Arduino. The demand for power has increased exponentially over the last century and In this project a system is developed which can be connected to internet using the internet module interfaced to arduino which can be used to monitor this device from anywhere in the world. The project involves development of system where in different appliances can be controlled from browser. The project is made smarter by implementing power monitoring sockets which can let us know the power we are consuming. In order to save the energy we are using 2 sensors like 1.temperature sensor 2.motion sensor The aim of temperature sensor is to sense the surrounding temperature and help to decide wheather the socket has to sense or no , and the motion sensor will detect IR rays and help to make the switch sensible or no, and we are again connecting one more sensor to to detect the power consumed by other device The over all project include the displaying the power consumed by particular socket And that cost will be displayed in the android app which is present in our hand ,in order to save the bit energy we are using temperature and motion sensor

Keywords: Power measurement, load, Arduino, energy measurement, IOT, Automation

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Finally we extend our thanks to the teaching and non-teaching staff of our department for their help.

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Chapter 1

INTRODUCTION

As we know that the rate at which electric energy is transferred by an electric circuit is called power. Power is an important electrical quantity and everything in our world today depends on having the power to keep them running. It is mandatory for a power engineer to know how much the amount of power a power plant generates and also the usage by the customer over a period of time. It helps in estimation of transmission losses between the generation- distribution and distribution-consumer apparatus. This estimation helps in power theft detection and in turn reduces the transmission losses. Measurement of electrical power may be done to measure electrical parameters of a system. Depending upon the requirement of accuracy, time and the nature of the circuit there is a choice for method and instrument to be used in any given case of measurement. In the existing power utility set up, consumers are presented with usage information only once a month with their bill. The length of time between updates about power usage is far too long for a consumer to observe a changed behavior's effect on power usage.

In addition utility bills can be convoluted in how they present usage information, and a consumer may not be able to decipher changes in their power usage from the last bill. An opportunity to educate customers on power usage is lost because of these realities. The goal of creating more awareness about energy consumption would be optimization and reduction in energy usage by the user. This would reduce their energy costs, as well as conserve energy. There are various methods for measuring power such as single and two wattmeter methods etc. Power is rate of doing work. For DC circuits and purely resistive AC circuits, power is product of voltage and current.

The electricity generation in India during 2005-06 was 23,819 Giga Watt-Hours (GWh). It increased to 1,022,614 GWh during 2013-14.

The annual growth rate marked was about 6.10%. The production of electricity is continuously increasing due to population. The energy consumption in domestic and commercial sector is increasing in much faster rate. According to energy statistics 2013 of India's National Statistical Organization (NSO), shows electricity accounted for domestic sector is 22% and commercial sector is about 9% during 2011-12.

An essential method for advancing more exact management of the assets and for developing new awareness about the expenses of the energy is smart metering. Smart meter is exceptionally intended for checking energy utilization and commanding each electronic equipment. IoT products can be integrated in all energy consuming equipment (air conditioning systems, electrical switches and sockets, lamps, appliances, plumbing, etc.) or in building envelope elements such as doors and windows, offering users the possibility to optimize energy efficiency, micro-climatic conditions and safety. The power of electrical device is calculated by utilizing intelligent meter and it sends the deliberate information over the web for monitoring and commanding the electronic devices. Tremendous associations over the globe are doing work on smart meters for enhancing effectiveness of the power use and into reducing power utilization in different buildings.

Electricity has become one of the fundamentals in Human lives. Today everything is powered by electricity ranging from simple wrist watch to vital medical appliances.

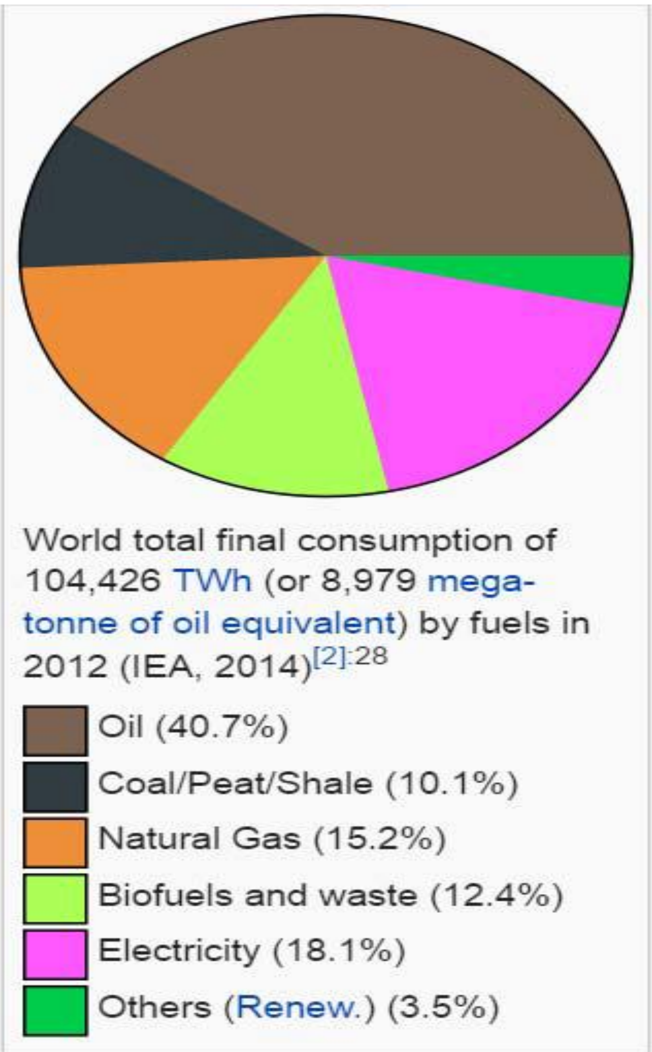


Figure 1.1: Power consumption across globe

1.1 OBJECTIVES

The primary objective of the project is to develop power electrical sockets which can monitor the amount of energy flowing through them. This would help to keep a track of the energy consumed by a particular device hence making us save energy efficiently and use energy efficient devices. The objectives are:

- To develop electric sockets which can monitor the energy that is consumed through the sockets.
- To connect the sockets to internet so that the energy consumed through the sockets can be monitored from anywhere in the world.
- To develop an android application to monitor the energy consumed by every such socket in home thus making us monitor energy using android enabled devices.

Chapter 2

LITERATURE REVIEW

Srividyadevi P[1] ”praposed a paper called Measurement of Power and Energy Using Arduino” This paper deals with the measurement of power and energy using Arduino. The demand for power has over the last century. One avenue through which today’s energy problems can be addressed is through the reduction of energy usage in households. This has increased the emphasis on the need for accurate and economic methods of power measurement. The goal of providing such data is to optimize and reduce their power consumption.

Vasudev Tadavarthy et al[2] proposed a paper on” Smart Power Monitoring System”

It live in a world where almost everything runs on electricity. 67% of the resources used to produce electricity are non-renewable sources of energy. And yet we do not comprehend the seriousness to conserve our resources as the rate at which are using them , it is estimated that all of earth’s non renewable sources of energy will get exhausted by 2100. The aim of this paper is to develop a power consumption monitor for domestic use. It uses an Arduino, current sensor acs712 , esp8266 and cloud platform as a service to store and analyze data. Our solution aims at saving power by constantly notifying the power consumed by the appliances & providing better insights to user and will help the user to cut down unmerited power and thus save a lot of resources and money.

Arati Kurde et al[3]proposed a paper called” IOT Based Smart Power Metering “

In India, plug load devices in building sectors are consuming close to 40 percent of the total electricity consumption. Though the share of plug load in building energy is increasing, very few studies exist on the plug level energy usage and consumption. In order to address the growing energy use of miscellaneous and electronic load (e.g. water heater), some measures need to be taken. Hence identifying needs, this project focuses on designing the devices that have built-in capability to measure and report the energy use or receive control input over the network. This study will help in creating energy awareness devices. Current sensor measures the current flowing through device then controller performs necessary calculations on the data and puts that data on the internet. By measuring current and voltage, it can analyze energy consumption, make the world smarter place and make better decisions using Internet of Things.

Chapter 3

METHODOLOGY

The brief methodology of the project is discussed below. The project was carried out in following steps and finally assembled to form a fully working system.

1) Material survey and selection:

This was the first and most important step of the project. The market survey was done to find the most suitable hardware for the project and the most suitable one was chosen for the project. This involved choosing a proper microcontroller, sensors and WIFI module.

2) Interfacing the Wi-Fi module to the microcontroller:

In this step the Wi-Fi module was interfaced successfully to the microcontroller. The Wi-Fi module can be used in either of the configurations. In our project we have used it in AP mode.

3) Interfacing Relays to the Arduino:

In this phase the relay board was interfaced to the controller to control the load based on commands received from the web browser. A 4 channel relay was interfaced in this project

4) Interfacing LCD display to the Arduino:

The LCD display is interfaced with the Arduino which shows the data regarding the power consumption.

5) Programming and android application development:

In this phase the developed system is programmed using Arduino C by applying logic and a web page is developed to control the appliances form the internet. Further android application is developed to test the results of the project.

6) Testing:

In this the entire project is assembled and tested

Chapter 4

Block Diagram

The Figure 4.1 Shows the Block diagram of smart power monitoring system

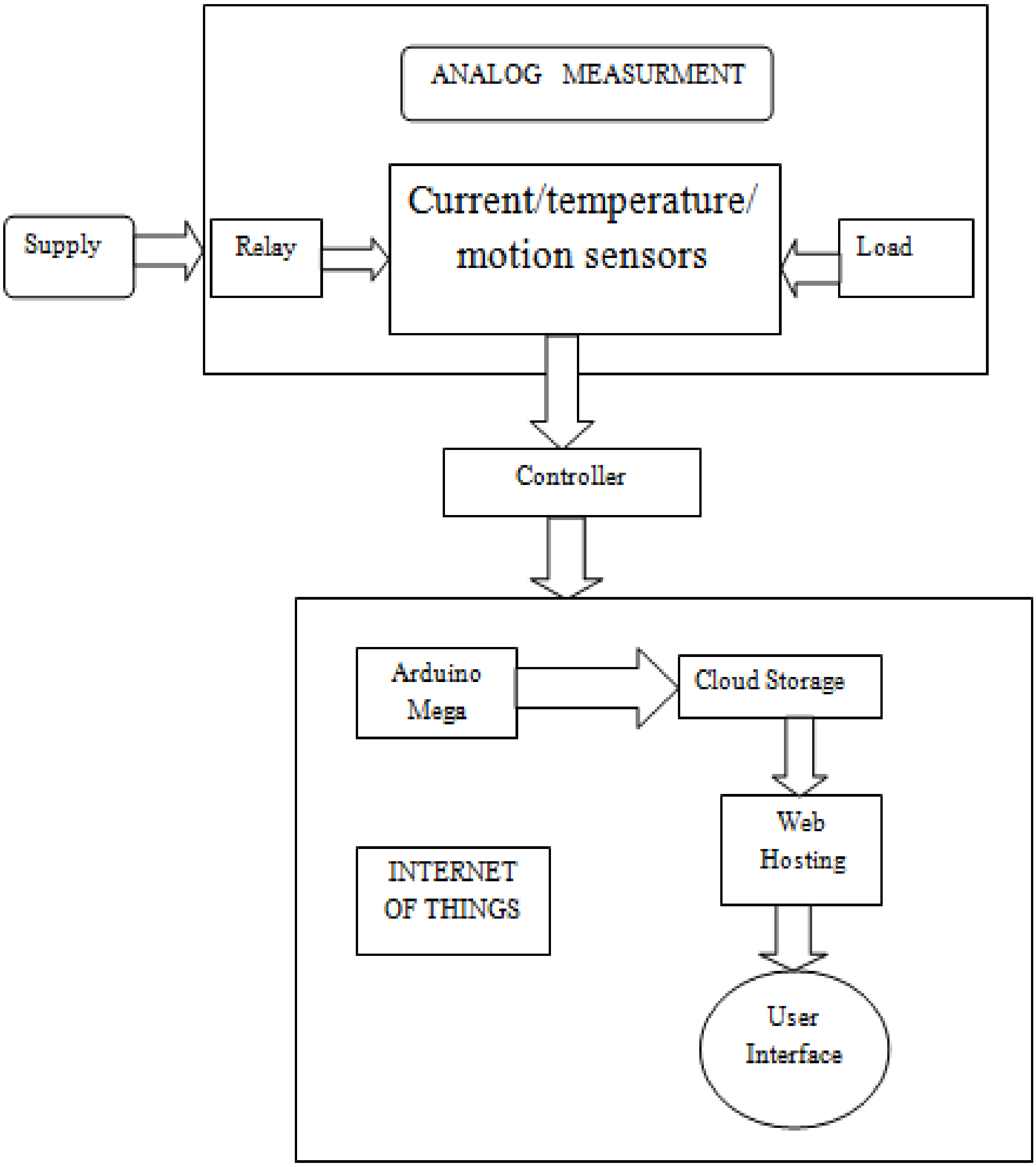


Figure 4.1: Block diagram of smart power monitoring system

4.1 Power and Power Measurement

Power is rate of expending energy. Watt is the unit for power (joule per second (J/s)). The difference in potentials between two points is equal to the energy per unit charge and this is required to move electric charge between the points, as we know, electric current measures the charge per unit time (in coulombs/second). The electric power *p* is given by the product of the current I and the voltage V (in joules/second = watts).

$$P = \text{work done per unit time} = \frac{qV}{T} = IV \qquad (1)$$

Where: *q* is electric charge in coulombs, *t* is time in seconds, *I* is electric current in amperes, *V* is electric potential or voltage in volts

Energy: The amount of energy used (or supplied) depends on the power and the time for which it is used. Energy is defined by scientists as the ability to do work. This energy is found in different forms, such as light, heat, sound, and motion. There are many forms of energy, but they can all be put into two categories: potential and kinetic.

$$E = P*T \qquad (2)$$

Where: E= energy in watt hrs, P= power in watts, T= time taken in sec

DC Circuits: DC circuits mainly consists of only of resistive (Ohmic, or linear) loads, Joule's law can be combined with Ohm's law ($V = I \cdot R$) to produce alternative expressions for the

$$\text{Dissipated power} = \frac{2V}{R} \qquad (3)$$

Where *R* is the electrical resistance.

AC Circuits: Energy storage elements such as inductance and capacitance results in periodic reversals of the direction of energy flow which are alternating in nature.

4.2 HARDWARE USED

4.2.1 Arduino mega2560

The project uses Arduino microcontroller board the Arduino ecosystem consists of software and hardware. The microcontroller board used in the project is Arduino mega2560. A microcontroller is a self-contained system with peripherals, memory and a processor that can be used as an embedded system for processing signals. Most programmable microcontrollers that are used today are embedded in other consumer products or machinery including phones, peripherals, automobiles and household appliances for computer systems. Due to that, another name for a microcontroller is "embedded controller." Some embedded systems are more sophisticated, while others have minimal requirements for memory and programming length and a low software complexity. Input and output devices include solenoids, LCD displays, relays, switches and sensors for data like humidity, temperature or light level, amongst others.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems.

Some microcontrollers may use four-bit words and operate at clock rate frequencies as low as 4 kHz, for low power consumption (single-digit mill watts or microwatts). They will generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption.

The microcontroller used in this project is Arduino Mega consisting of at mega 2560. At mega 2560 features The high-performance, low-power Atmel 8-bit AVR RISC-based microcontroller combines 256KB ISP flash memory, 8KB SRAM, 4KB EEPROM, 86 general purpose I/O lines, 32 general purpose working registers, real time counter, six flexible timer/counters with compare modes, PWM, 4 USARTs, byte oriented 2-wire serial interface, 16-channel 10-bit A/D converter, and a JTAG interface for on-chip debugging. The device achieves a throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves a throughput approaching 1 MIPS per MHz, balancing power consumption and processing speed.

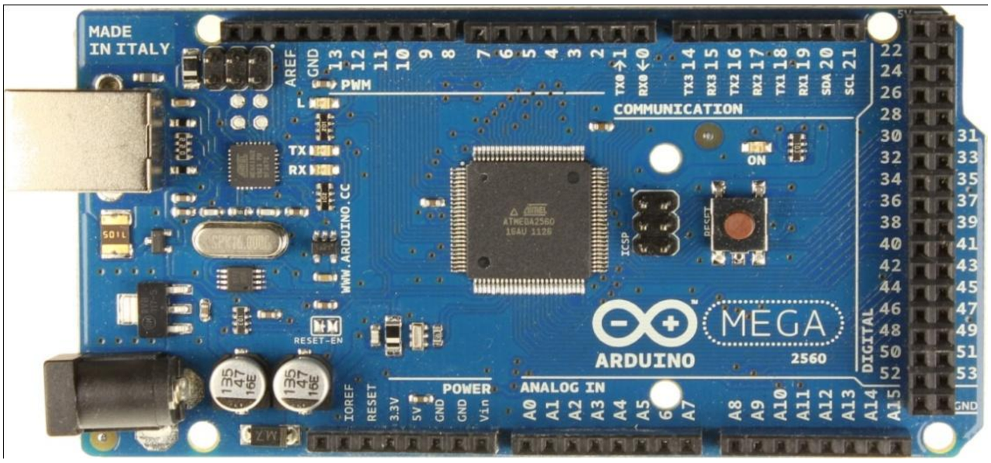


Figure 4.2: Arduino mega2560

4.2.2 Features

• High Performance, Low Power AVR® 8-Bit Microcontroller

• Advanced RISC Architecture

– 135 Powerful Instructions – Most Single Clock Cycle Execution

– 32 x 8 General Purpose Working Registers

– Fully Static Operation

– Up to 16 MIPS Throughput at 16 MHz

– 64K/128K/256K Bytes of In-System Self-Programmable Flash

– 4K Bytes EEPROM

– 8K Bytes Internal SRAM

• In-System Programming by On-chip Boot Program

• True Read-While-Write Operation

– Programming Lock for Software Security Endurance: Up to 64K Bytes Optional External Memory Space

• JTAG (IEEE std. 1149.1 compliant) Interface

– Boundary-scan Capabilities According to the JTAG Standard

– Extensive On-chip Debug Support

– Programming of Flash, EEPROM, Fuses, and Lock Bits through the JTAG Interface

• Peripheral Features

– Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode

– Four 16-bit Timer/Counter with Separate Prescaler, Compare- and Capture Mode

– Real Time Counter with Separate Oscillator

– Four 8-bit PWM Channels

–Six/Twelve PWM Channels with Programmable Resolution from 2 to 16 Bits (ATmega1281/2561, ATmega640/1280/2560)

– Output Compare Modulator

– 8/16-channel, 10-bit ADC (ATmega1281/2561, ATmega640/1280/2560)

–Two/Four Programmable Serial USART (ATmega1281/2561,ATmega640/1280/2560)

– Master/Slave SPI Serial Interface

– Byte Oriented 2-wire Serial Interface

– Programmable Watchdog Timer with Separate On-chip Oscillator

– On-chip Analog Comparator

– Interrupt and Wake-up on Pin Change

• Special Microcontroller Features

– Power-on Reset and Programmable Brown-out Detection

– Internal Calibrated Oscillator

– Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby and Extended Standby

• I/O and Packages

– 54/86 Programmable I/O Lines (ATmega1281/2561, ATmega640/1280/2560)

– 64-pad QFN/MLF, 64-lead TQFP (ATmega1281/2561)

– 100-lead TQFP, 100-ball CBGA (ATmega640/1280/2560)

– RoHS/Fully Green

• Temperature Range:

–-40°C to 85°C Industrial

• Ultra-Low Power Consumption

– Active Mode: 1 MHz, 1.8V: 500 µA

– Power-down Mode: 0.1 µA at 1.8V

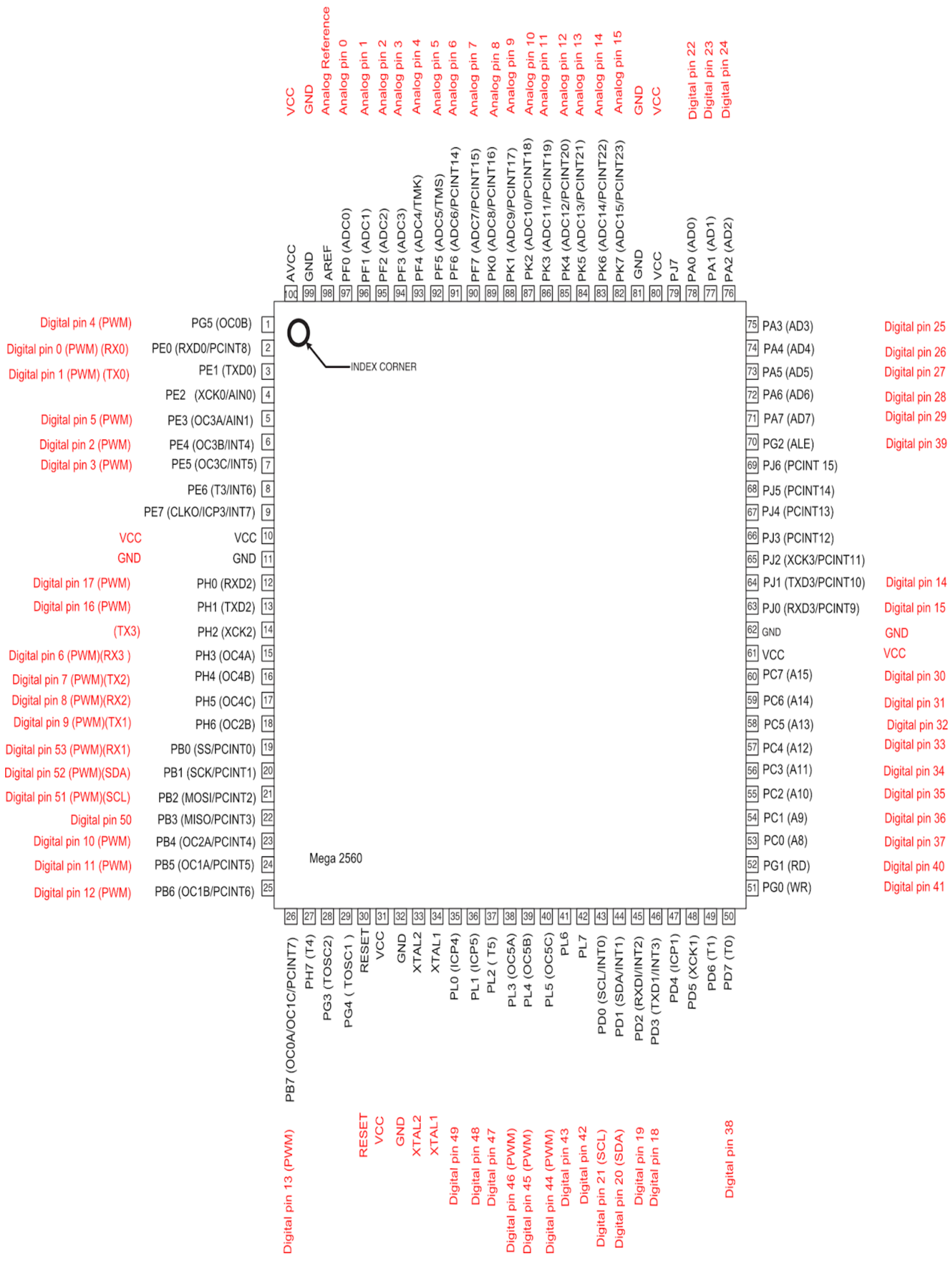


Figure 4.3: Atmega 2560 pin

4.2.3 Channel relay board

In order for the load to be controlled using internet this project uses 4 channel relay board. Relays are electromechanical switches. They have very high current rating and both AC and DC motors can be controlled through them because motor will be completely isolated from the remaining circuit. Two common available SPDT relays are shown in the picture below.

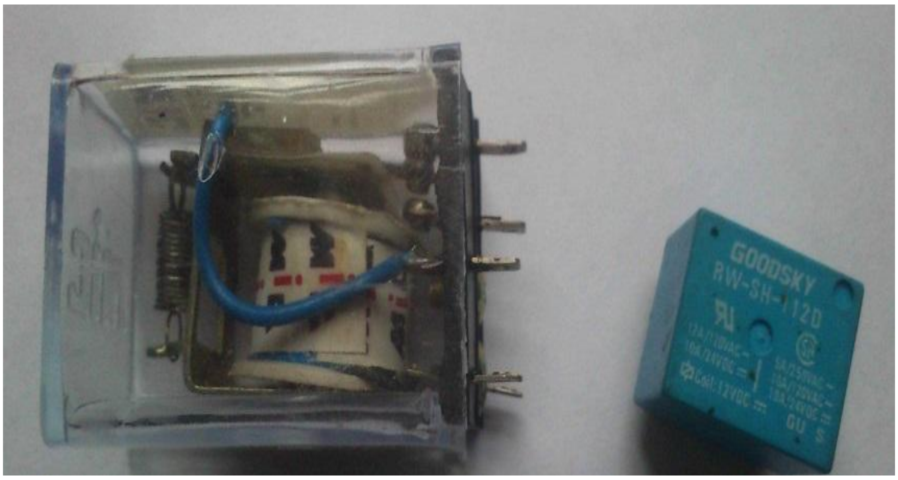


Figure 4.4: Channel relay board

4.2.4 Working of a relay:
Relays consist of a electromagnet, armature, spring and electrical contacts. The spring holds the armature at one electrical contact and as soon as a voltage is applied across the electromagnet, it coils the armature, changes its contact and moves to another electrical contact. The figure below describes its working.

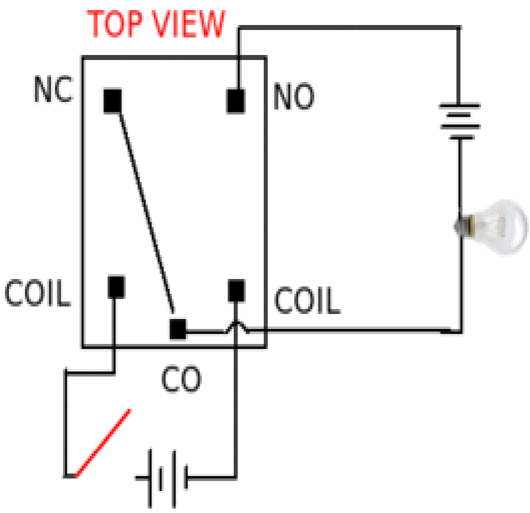


Figure 4.5: Working of relay

4.2.5 Terms associated with relays:

- **Normally Open (NO):** contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive.

- **Normally Closed (NC):** contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive.
- **Change over (CO):** It's the common contact.
- **COIL:** It's the electromagnet coil inside relay.

4.2.6 Relay ratings:

- **Coil rating:** It's the Voltage at which the coil gets fully activated. Some also have coil resistance mentioned on them. Relay coil voltage rated 6V and 12V are the most commonly available.
- **Contact rating:** It depends on whether AC or DC current is passing through the contacts. The blue colored relay shown in the start of this page has a rating of 12A at 120V AC, 5A at 250V AC and 10A at 24V DC.

4.2.7 Relay triggering circuit:

Depending upon a relay's coil rating, some may require current greater than 100mA. If an IC cannot provide this much current, a transistor is used as a switch to trigger the relay as shown below. Don't avoid the protection diode (D1 shown in circuit) as it will protect transistor from back emf induced in relay coil.

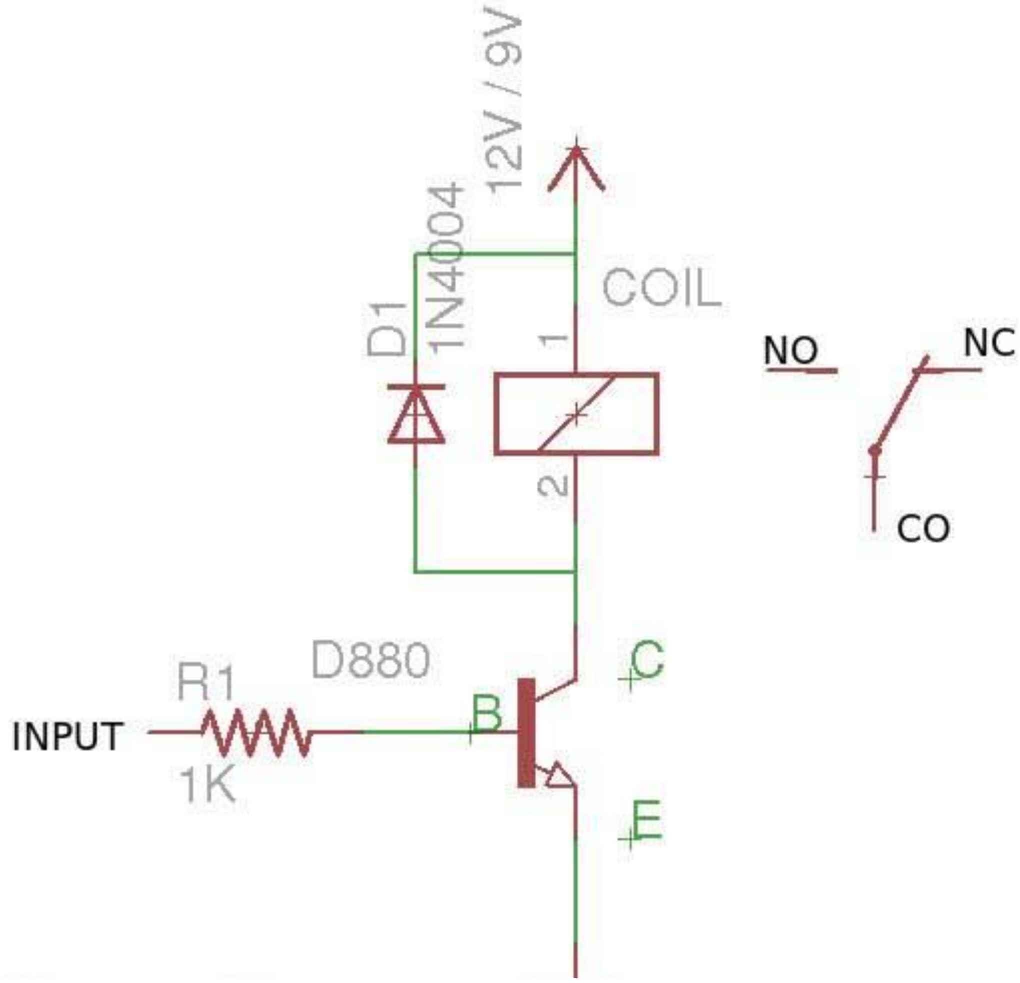


Figure 4.6: Relay triggering circuit

Switching speed of a relay is slow, around 10ms. Relays are used to drive an AC load from a small DC circuit, or to drive a high current consuming motors. Have you noticed a sound of tic -tic while car wiper is on, This is the sound of relay inside the car that drives the wiper motor.

4.3 ESP8266 Wi-Fi Module

This is the heart of the project. Since the project is based on WIFI control of appliances, the module forms the important component of the project.

The ESP8266 Arduino compatible module is a low-cost Wi-Fi chip with **full TCP/IP capability**, and the amazing thing is that this little board has **a MCU (Micro Controller Unit) integrated** which gives the possibility **to control I/O digital pins** via simple and almost pseudo-code like programming language. This device is produced by Shanghai-based Chinese manufacturer, Es press if Systems.

This chip was first time seen in August 2014, in ESP-01 version module, made by AI-Thinker, a third-party manufacturer. This little module allows the MCU to connect to WiFi network and create simple TCP/IP connections. His His very low price (1.7$ – 3.5$) and the incredible small size attracted many geeks and hackers to explore it and use it in a large variety of projects. Being a true success, Espressif produces now many versions having different dimensions and technical specifications. One of the successors is ESP32. You can find over the internet hundreds of projects and various implementations like home automation, data logging solutions, robotics, controlling things over the internet, even drones or copters.

4.3.1 ESP8266-01Technical specifications

- 32-bit RISC CPU: Ten silica Xtensa LX106 running at 80 MHz **
- 64 KiB of instruction RAM, 96 KiB of data RAM
- External QSPI flash – 512 KiB to 4 MiB* (up to 16 MiB is supported)
- IEEE 802.11 b/g/n Wi-Fi
- Integrated TR switch, balun, LNA, power amplifier and matching network
- WEP or WPA/WPA2 authentication, or open networks
- 16 GPIO pins **
- SPI, I²C,
- I²S interfaces with DMA (sharing pins with GPIO)
- UART on dedicated pins, plus a transmit-only UART can be enabled on GPIO2
- 1 10-bit ADC

** CPU and flash clock speeds can be raised via over clocking on some devices and the 16 I/O are not available in all versions.

ESP8266 Arduino Module comes with PCB trace antenna which seems to have a very good coverage (I saw a demonstration with more than 1km range!!!). Other version can have on-board ceramic antenna or an external connector which allows you to attach external Wi-Fi antennas modules. ESP-01 has only 6 active pins, although the MCU can support up to 16 I/O. Board dimensions are 14.3 x 24.8 mm.

Figure 4.7: ESP8266 Wi-Fi Module

Over the internet i found that ESP8266 Arduino module, version 01, is sold in two or more versions, which at first glance seem quite the same. After buying both of them i saw that there is a difference in size of the flash memory. You may encounter issues while flashing if you don't make the proper settings according to board specifications.

Although the board default has 2 available GPIOs, you can do some workarounds and use other MCU available pins if you have the proper soldering tools. I managed to use GPIO 16 in order to wake up the device after DEEP SLEEP mode (explained later in SLEEP MODES).

4.3.2 Module pin description (pin out)

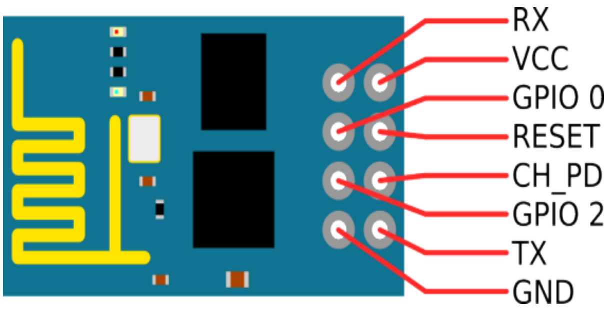


Figure 4.8: ESP8266 -01 pin diagram

Pins are arranged in two rows, having 4 on each row. Some models have pin description on the PCB, which make it simple. On the top row you can find following pins from the left to the right:

1. GND (Ground from power supply)
2. GPIO2 (Digital I/O programmable)
3. GPIO0 (Digital I/O programmable, also used for BOOT modes)
4. RX – UART Receiving channel

On the bottom (second row) you can find:

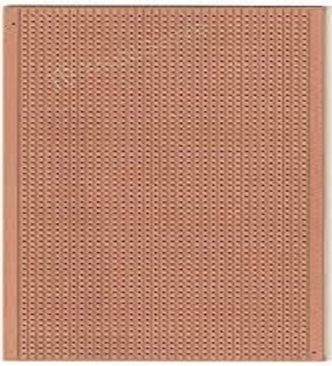
1. TX – UART Transmitting channel
2. CH_PD (enable/power down, must be pulled to 3.3v directly or via resistor)
3. REST – reset, must be pulled to 3.3v)
4. VCC -3.3v power supply

Power supply and current consumption

All esp8266 Arduino compatible modules must be powered with DC current from any kind of source that can deliver stable 3.3V and at least 250mA. Also logic signal is rated at 3.3v and the RX channel should be protected by a 3.3v divisor step-down. You should be careful when using this module with Arduino or other boards which supplies 5v, because this module usually do not come with overpower protection and can be easily destroyed.

4.3.3 Prototyping board

The prototyping board is used to assemble all the components on the project. The figure below shows a perforated board used in the project.



4.4 ACS 712 current sensor

The ACS712 [3] provides economical and precise solutions for AC or DC current sensing in industrial, commercial, and communications systems. The device consists of a precise, low-offset, linear Hall circuit with a copper conduction path located near the surface of the die. Applied current flowing through this copper conduction path generates a magnetic field which the Hall IC converts into a proportional voltage. Device accuracy is optimized through the close proximity of the magnetic signal to the Hall transducer. A precise, proportional voltage is provided by the low-offset, chopper-stabilized BiCMOS Hall IC, which is programmed for accuracy after packaging. The output of the device has a positive slope (>VIOUT (Q)) when an increasing current flows through the primary copper conduction path (from pins 1 and 2, to pins 3 and 4), which is the path used for current sampling. The internal resistance of this conductive path is 1.2 mΩ typical, providing low power loss.

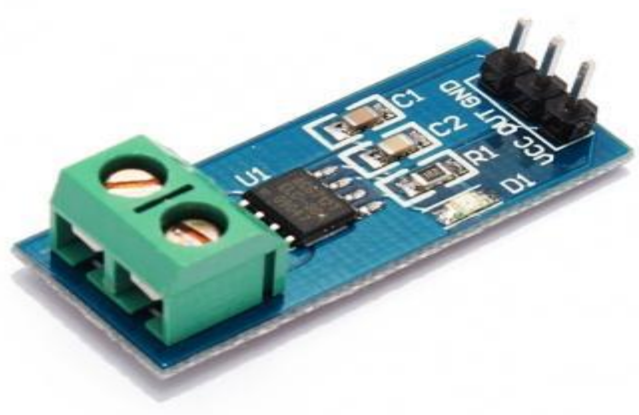


Figure 4.9: ACS 712 current sensor

It has 3 pins on its right side as shown in above figure [3].VCC pin which requires 5V, GND pin which is connected to circuit ground and OUT pin which gives output voltage proportional to sensed current. On the left side, we have two screws which are meant for the AC wires to connected.

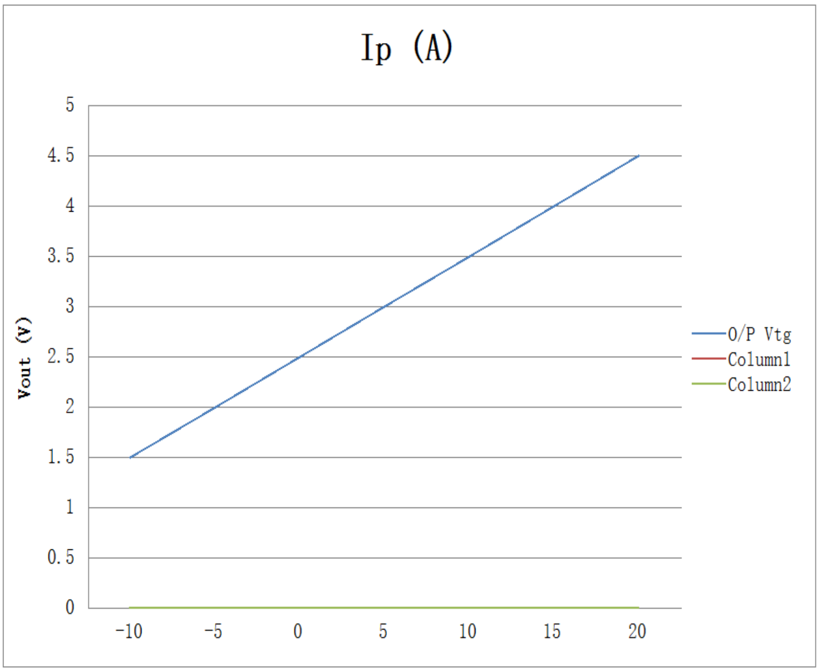


Figure 4.10: Output characteristics of ACS 712 current sensor

Graph of Output voltage vs Sensed current. Thus when there is no current flowing i.e the appliance is off , current sensor will give out 2.5V . Thus we have to calibrate our Power monitoring system keeping this equation in mind.

4.4.1 Temperature sensor

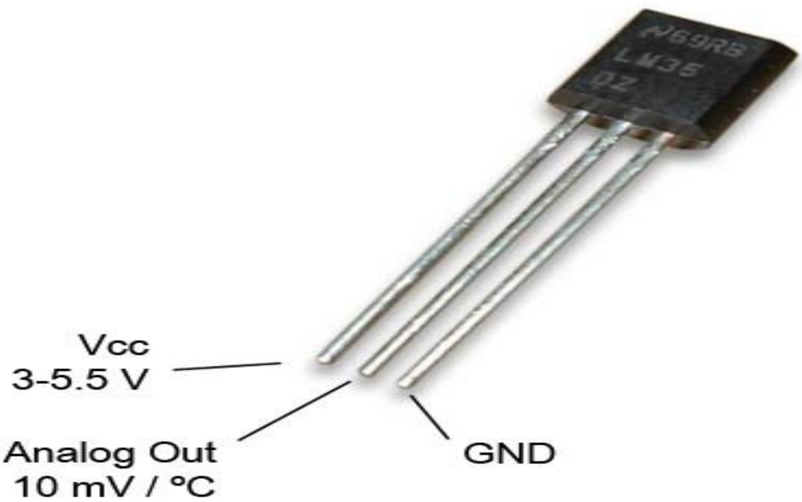


Figure 4.11: Temperature sensor

Description

The LM135 series are precision, easily-calibrated, integrated circuit temperature sensors. Operating as a 2-terminal zener, the LM135 has a breakdown voltage directly proportional to absolute temperature at 10 mV/°K. With less than 1-Ω dynamic impedance, the device operates over a current range of 400 μA to 5 mA with virtually no change in performance. When calibrated at 25°C, the LM135 has typically less than 1°C error over a 100°C temperature range. Unlike other sensors, the LM135 has a linear output.Applications for the LM135 include almost any type of temperature sensing over a −55°C to 150°C temperature range. The low impedance and linear output make interfacing to readout or control circuitry are especially easy.

The LM135 operates over a −55°C to 150°C temperature range while the LM235 operates over a −40°C to 125°C temperature range. The LM335 operates from −40°C to 100°C. The LMx35 devices are available packaged in hermetic TO transistor packages while the LM335 is also available in plastic TO-92 packages.

Features

- Directly Calibrated to the Kelvin Temperature Scale
- 1°C Initial Accuracy Available
- Operates from 400 μA to 5 mA
- Less than 1-Ω Dynamic Impedance
- Easily Calibrated
- Wide Operating Temperature Range
- 200°C Overage
- Low Cost

Applications

- Power Supplies
- Battery Management
- HVAC
- Appliances

4.4.2 Motion Sensors

PIR sensors allow you to sense motion. They are used to detect whether a human has moved in or out of the sensor’s range. They are commonly found in appliances and gadgets used at home or for businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors.

Following are the advantages of PIR Sensors –

- Small in size
- Wide lens range
- Easy to interface
- Inexpensive
- Low-power
- Easy to use
- Do not wear out

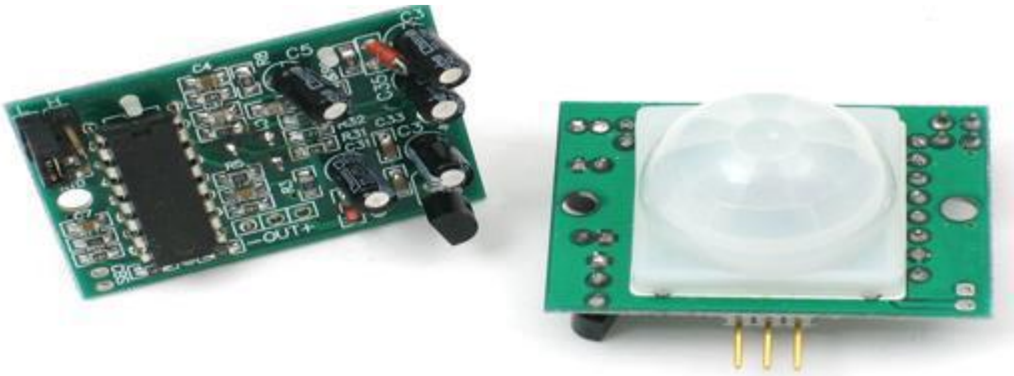


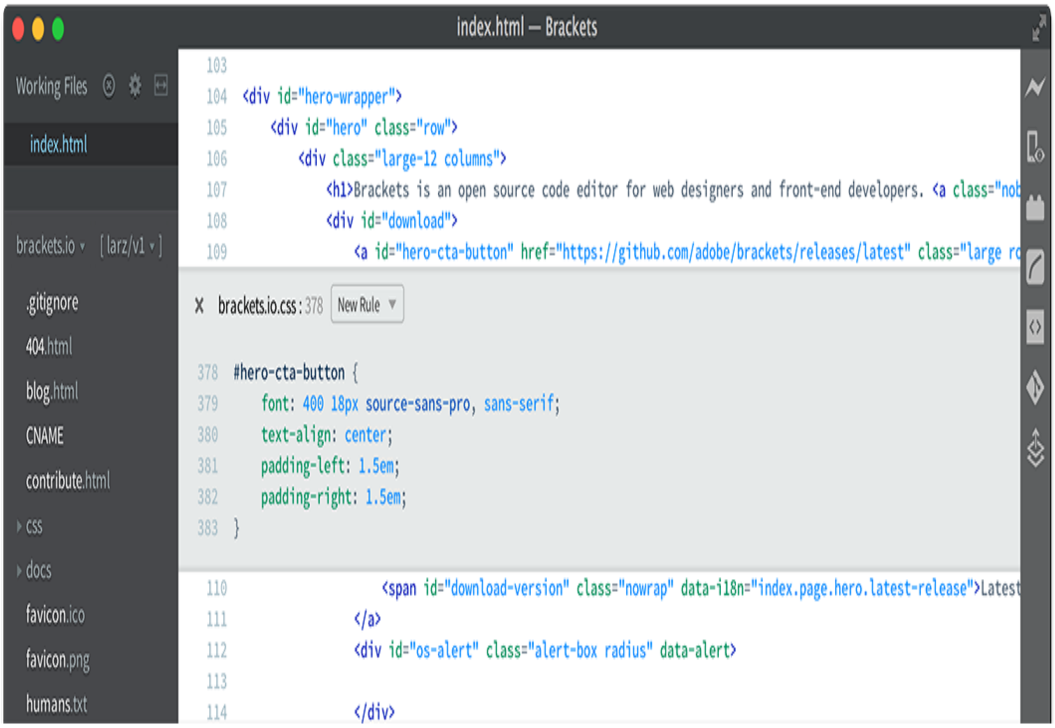
Figure 4.12: Motion Sensor

PIRs are made of pyroelectric sensors, a round metal can with a rectangular crystal in the center, which can detect levels of infrared radiation. Everything emits low-level radiation, and the hotter something is, the more radiation is emitted. The sensor in a motion detector is split in two halves. This is to detect motion (change) and not average IR levels. The two halves are connected so that they cancel out each other. If one-half sees more or less IR radiation than the other, the output will swing high or low.

4.5 SOFTWARE USED

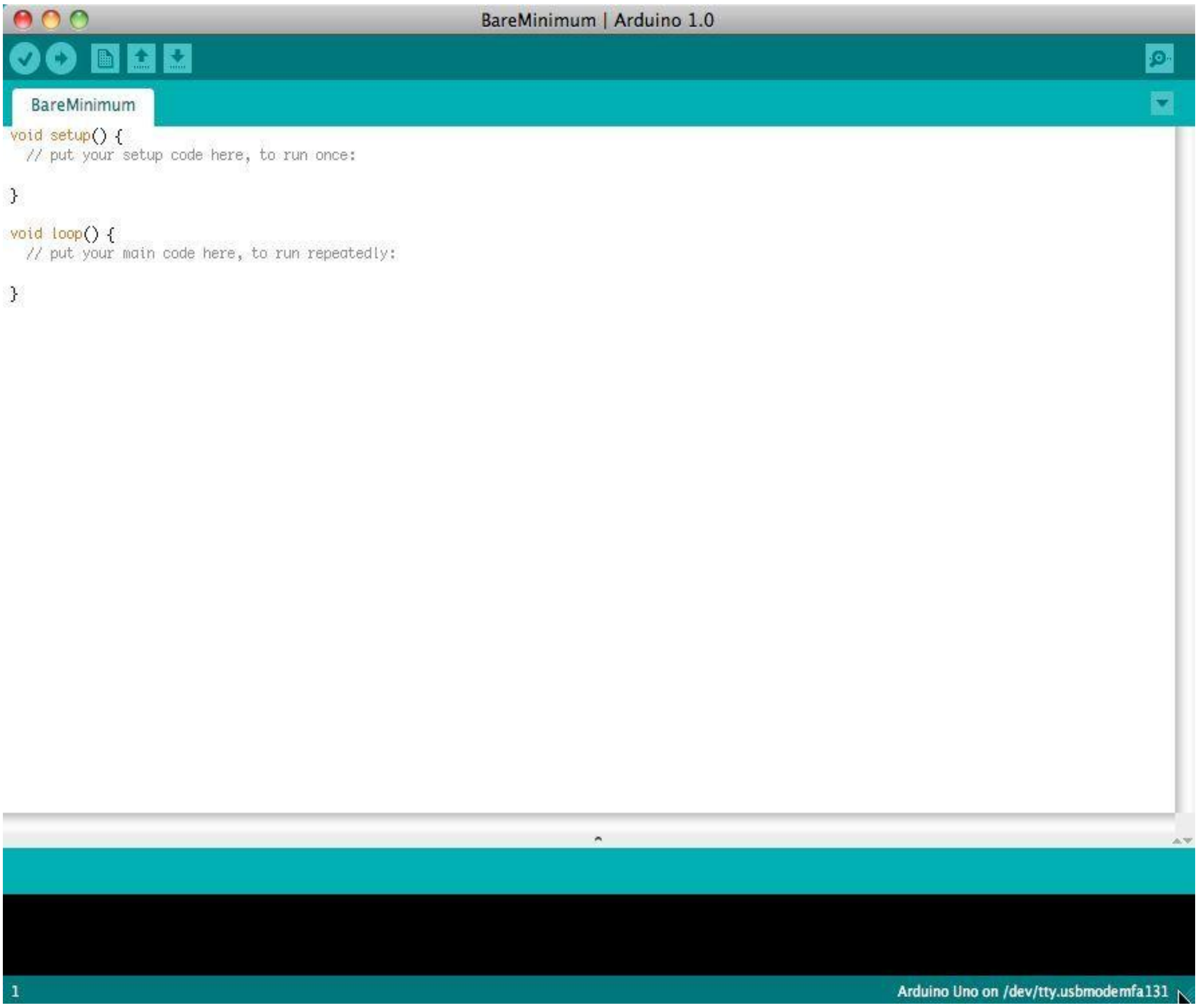
4.5.1 Brackets IDE

The project involves webpage appliance control so it was necessary to design the webpage The webpage was designed in the software called brackets and the Developed html files were accesses from the local server. Brackets is a lightweight, yet powerful, modern text editor.



4.5.2 Arduino IDE

The project uses arduino IDE as software to program microcontroller. The program is written in arduino IDE and compiled and fed into the microcontroller. The following steps are involved into programming a microcontroller using arduino



Before you can start doing anything with the Arduino, you need to download and install the Arduino IDE (integrated development environment). From this point on we will be referring to the Arduino IDE as the Arduino Programmer.

The Arduino Programmer is based on the Processing IDE and uses a variation of the C and C++ programming languages

Plug your Arduino to your computer using the programmer as shown before.

4.5.3 Select the board

Before compiling the programmer and feeding it onto the Arduino board you need to select the appropriate board into which you are feeding the program.

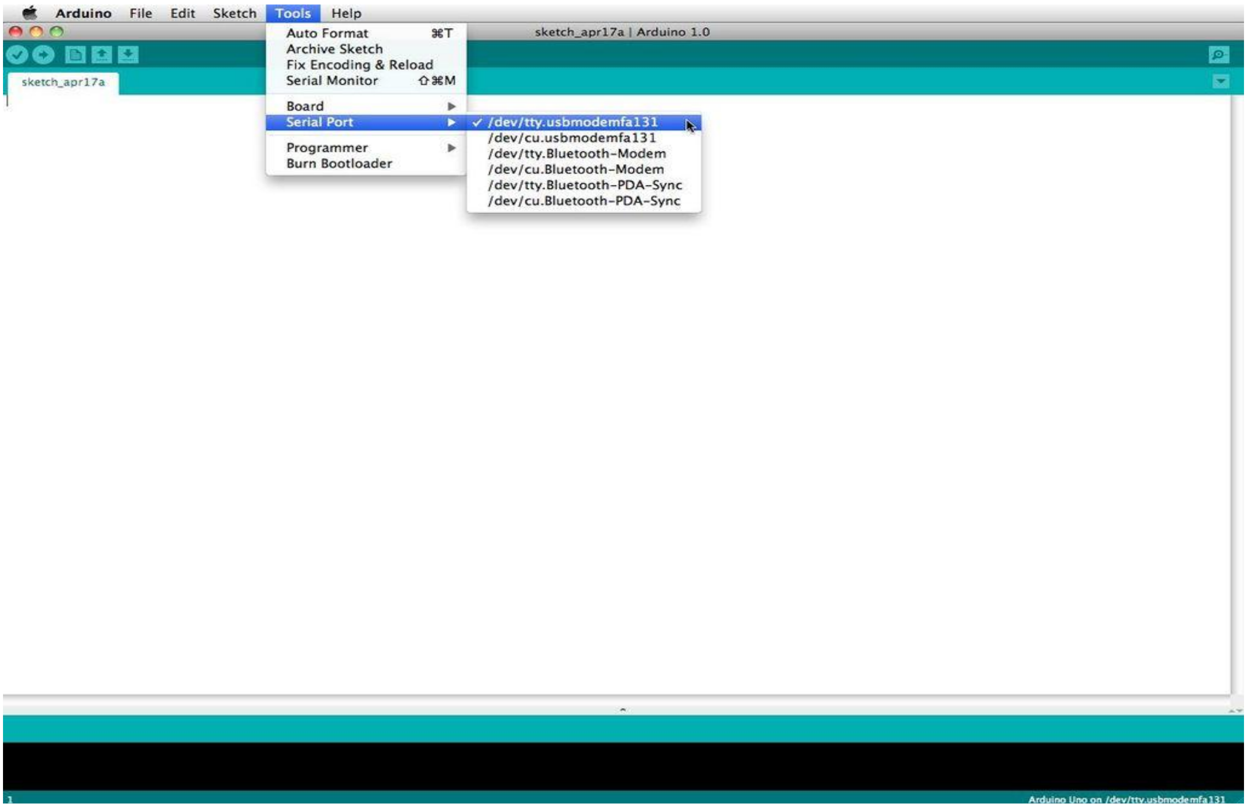
To set the board, go to the following:

Tools --> Boards

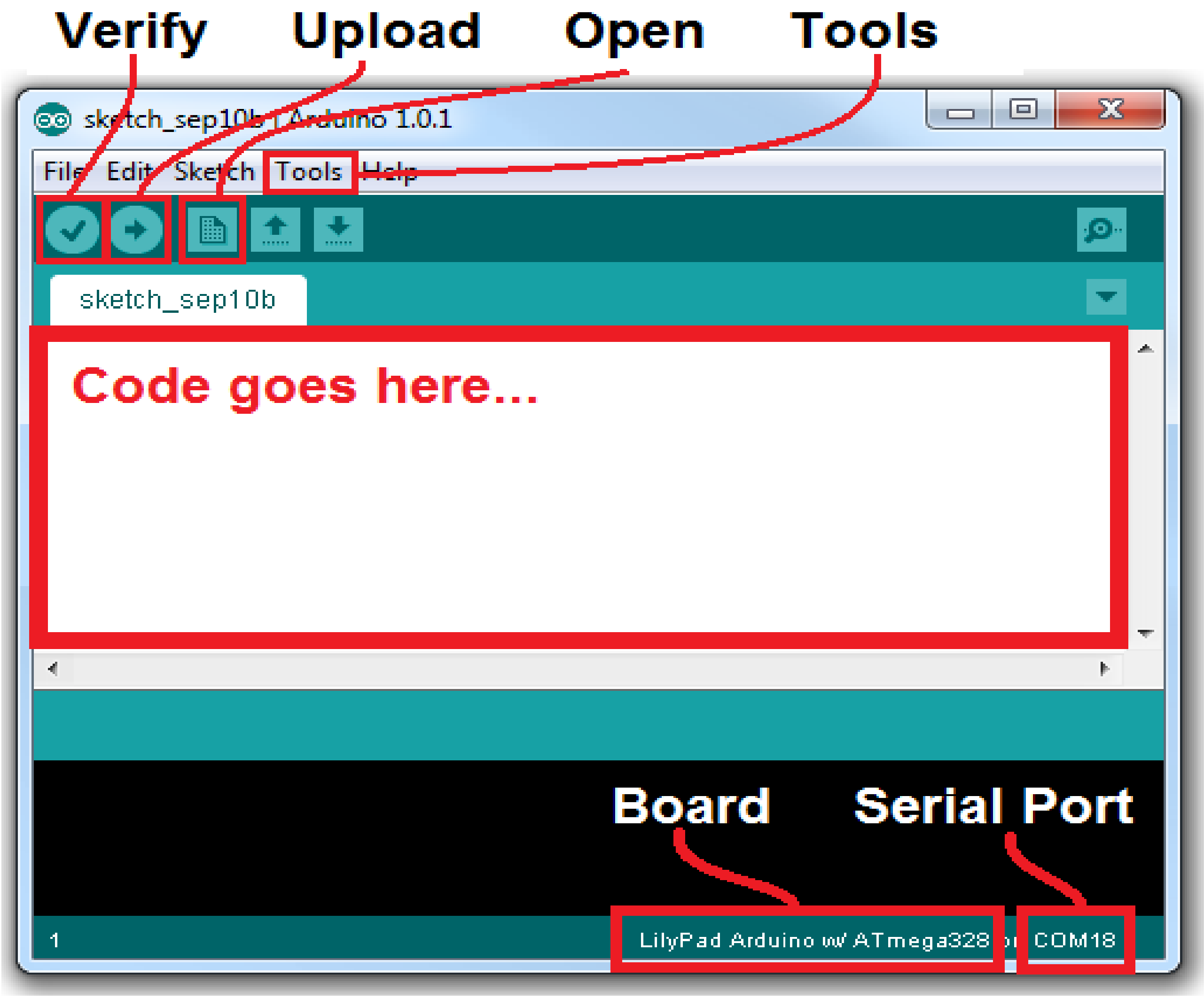
Since we are using Arduino mega in our project we selected Arduino mega

To set the serial port, go to the following:

Tools --> Serial Port

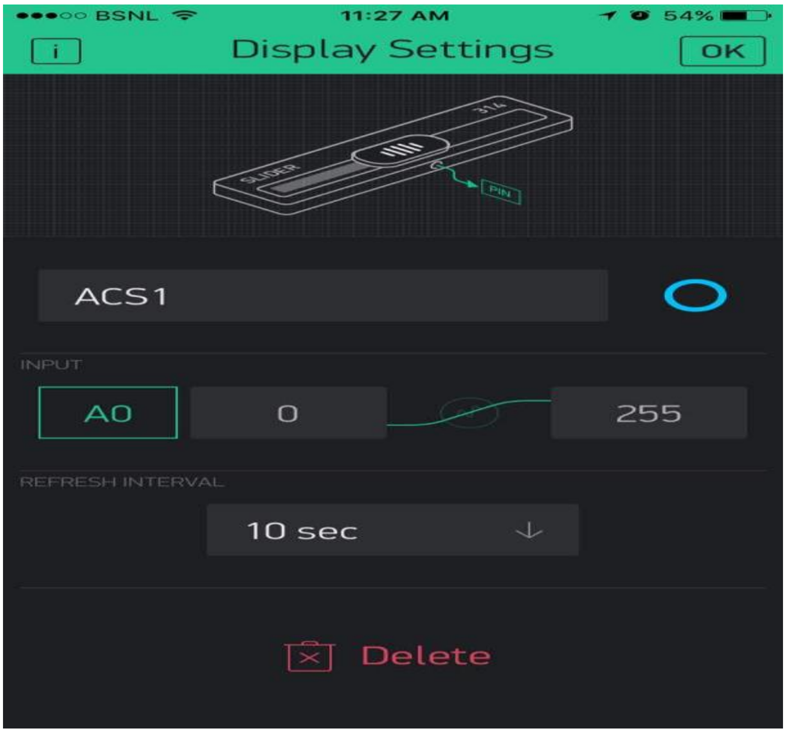


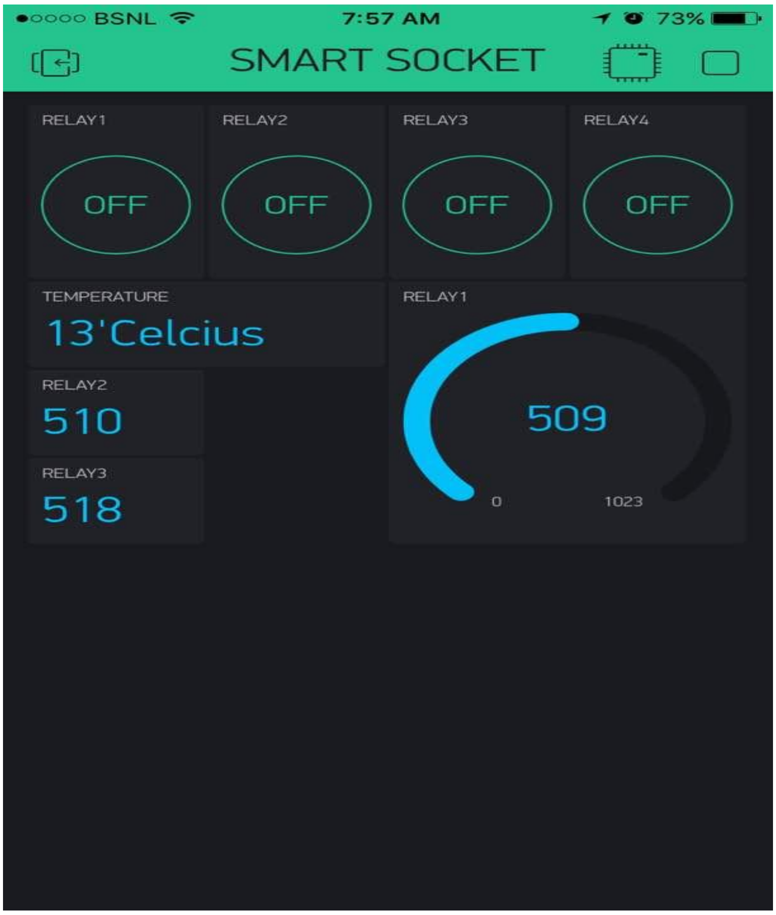
1. Compile and upload the sketch to Arduino board

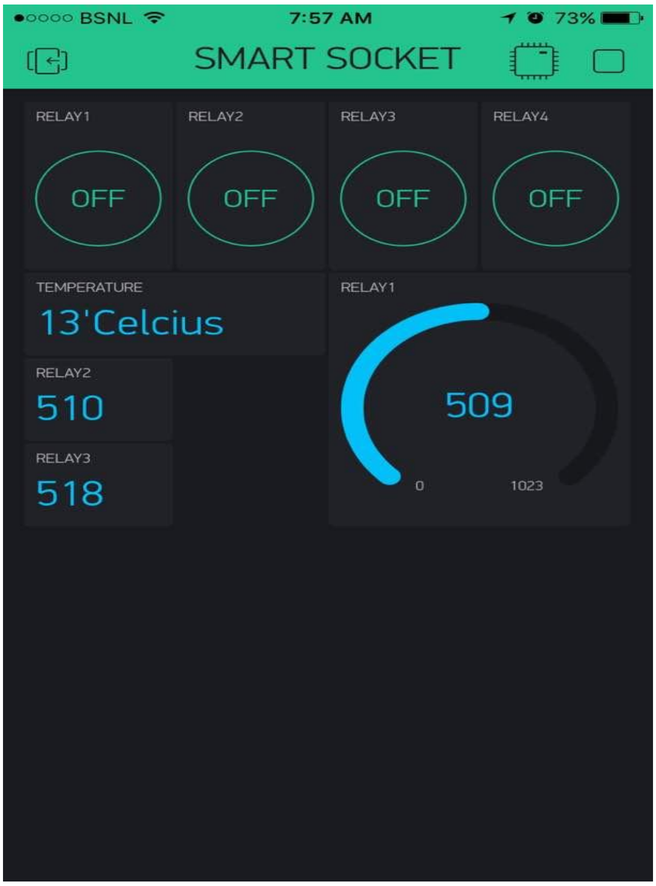


2. Steps for reading current consumed by the socket in the blink

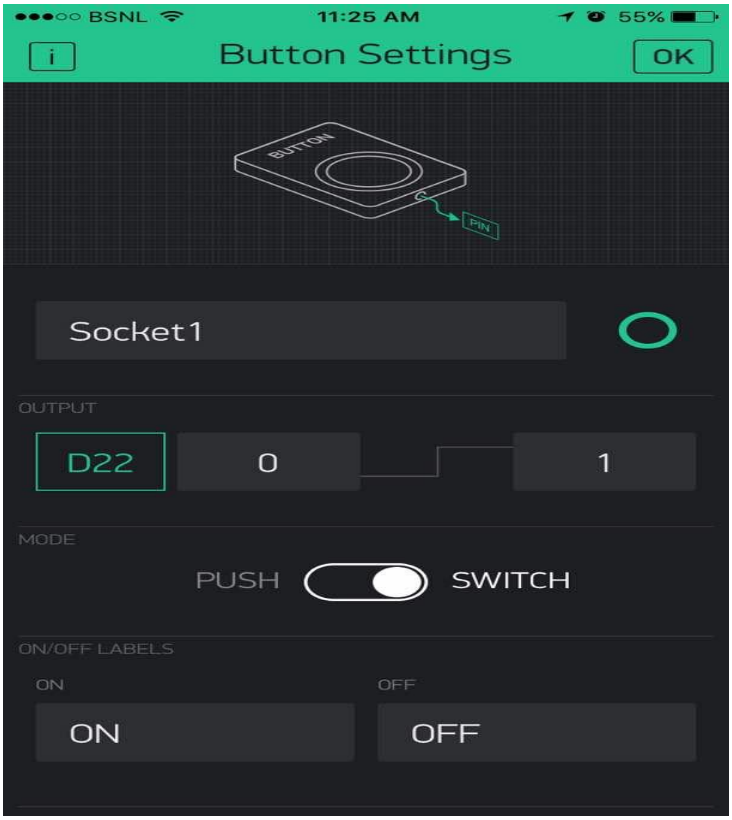
Step 1: Display Setting

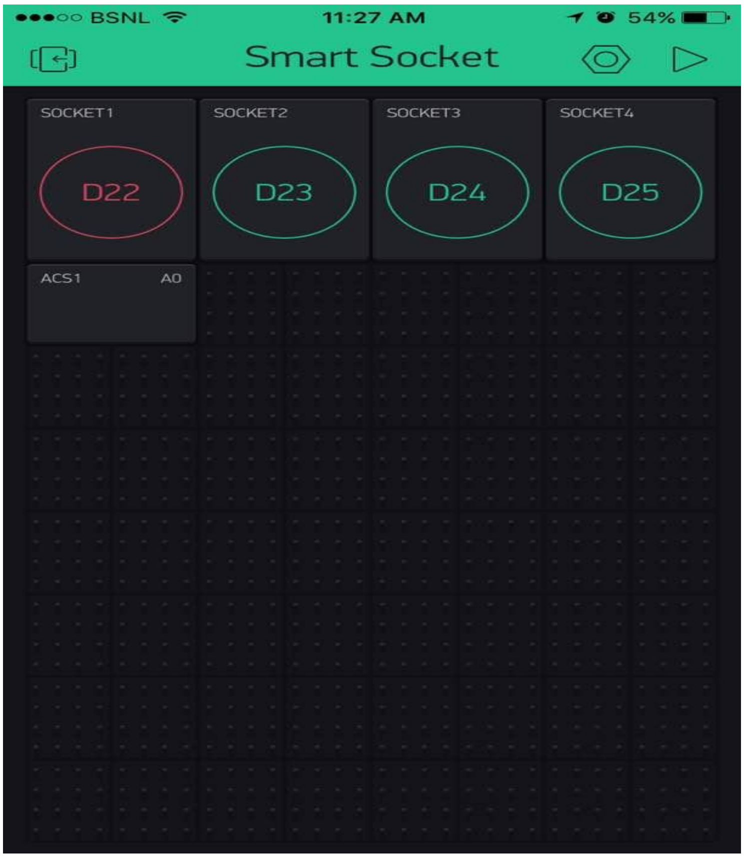




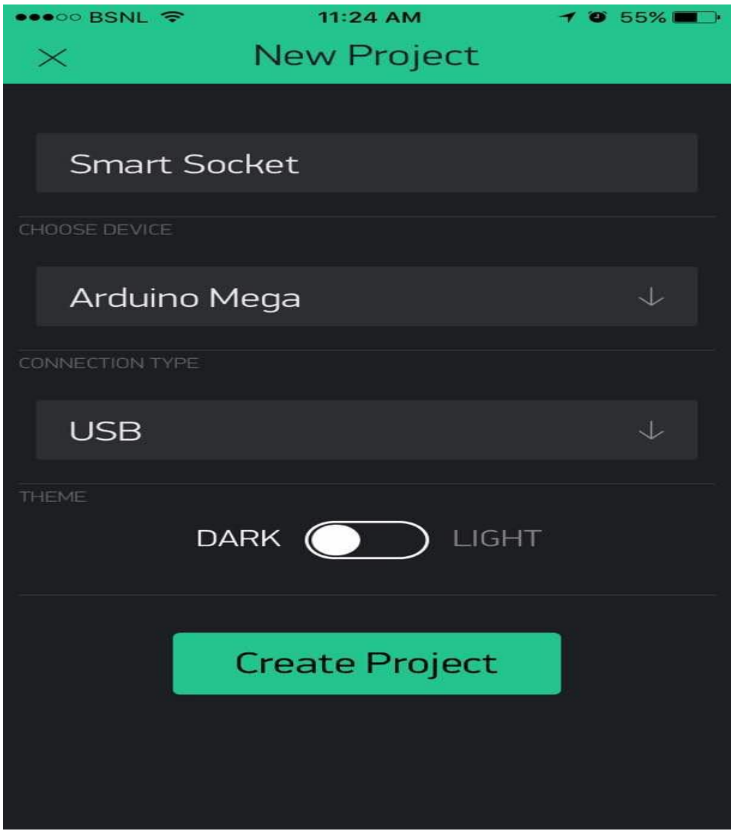


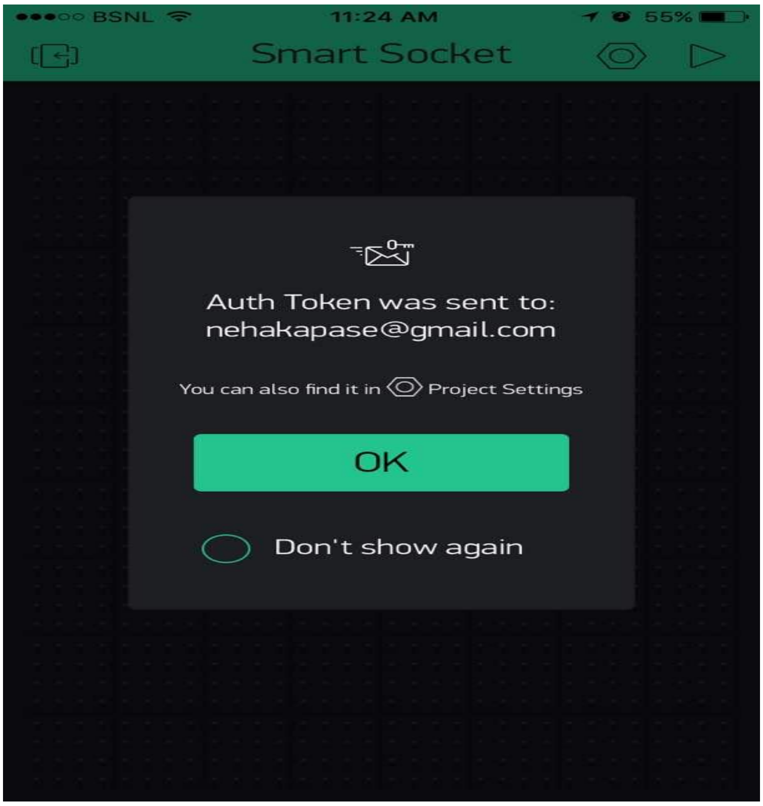
Step 2: Button Setting

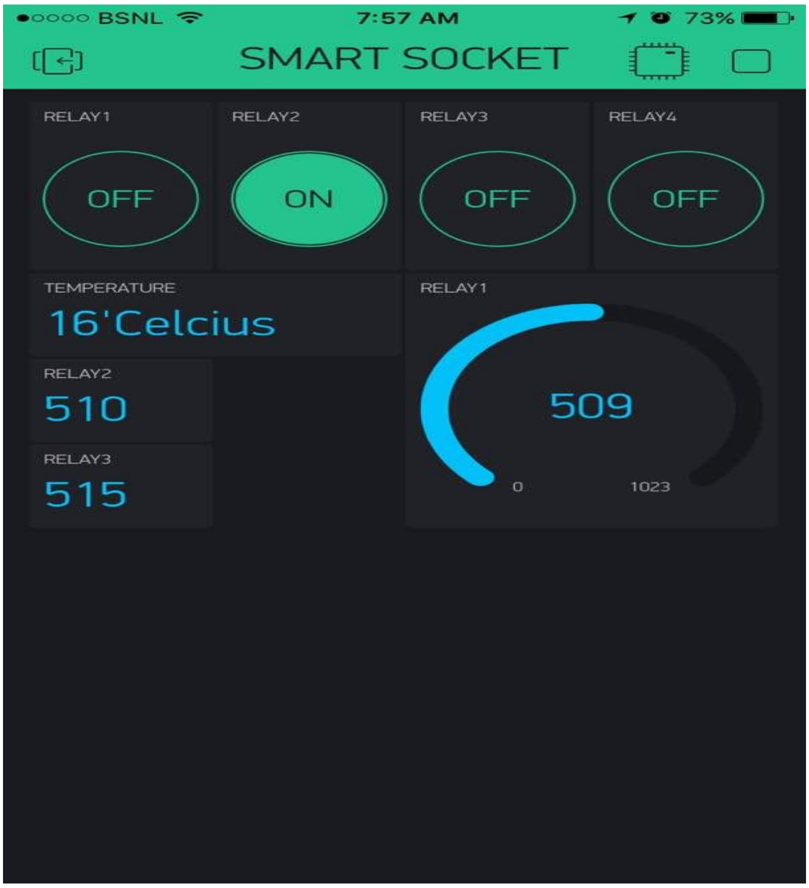


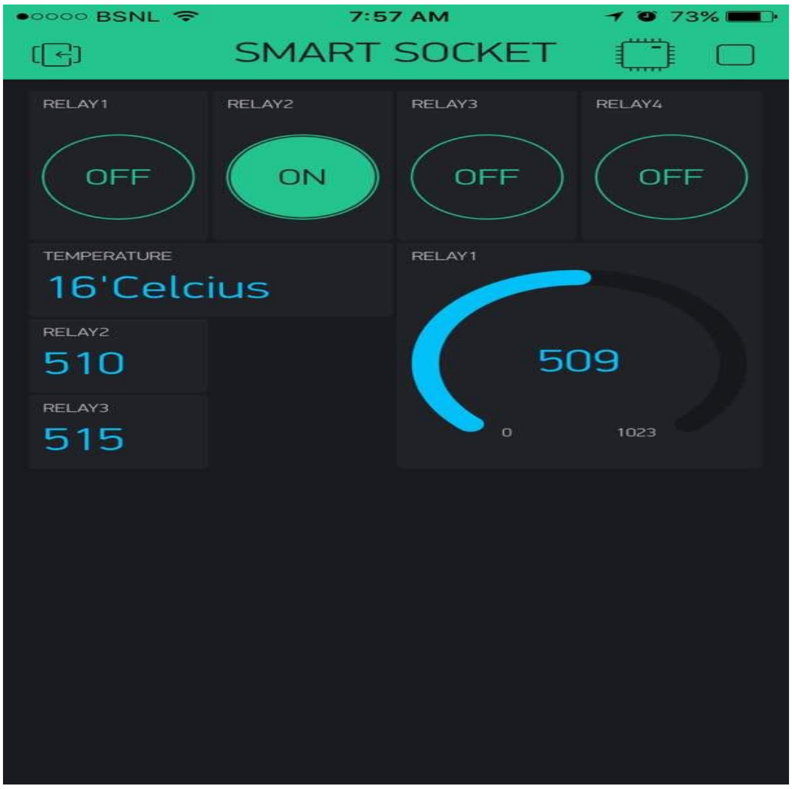


Step 3: Create new project




●●●○○ BSNL
11:24 AM
55%
Smart Socket
Auth Token was sent to:
nehakapase@gmail.com
You can also find it in Project Settings
OK
Don't show again


●○○○○ BSNL
7:57 AM
73%
SMART SOCKET
RELAY1
RELAY2
RELAY3
RELAY4
OFF
ON
OFF
OFF
TEMPERATURE
16'Celcius
RELAY1
RELAY2
510
509
RELAY3
515
0
1023



2. Program for calculate the current

```
#include <SoftwareSerial.h>
SoftwareSerial DebugSerial(2, 3); // RX, TX

#include <BlynkSimpleStream.h>

char auth[] = "daf64e438b784a58bd871c680156bd18";

#include<LiquidCrystal.h>
LiquidCrystal lcd(8,9,10,11,12,13);


#define BLYNK_PRINT Serial
/* Set this to a bigger number, to enable sending longer
messages */
//#define BLYNK_MAX_SENDBYTES 128
#define PIN_UPTIME V5


float ACS_1 = A0;
const int ACS_2= A1;
const int ACS_3 =A2;
const int ACS_4 = A3;
const int relay1 = 6;
const int relay2 = 24;
const int relay3 = 26;
const int relay4 = 28;


int Acs_val1 =0;
```

```
int Acs_val2 =0;
int Acs_val3 = 0;
int Acs_val4 = 0;

void setup() {

      pinMode(ACS_1,INPUT);
      pinMode(ACS_2,INPUT);
      pinMode(ACS_3,INPUT);
      pinMode(ACS_4,INPUT);
      pinMode(relay1,OUTPUT);
      pinMode(relay2,OUTPUT);
      pinMode(relay3,OUTPUT);
      pinMode(relay4,OUTPUT);
      lcd.begin (16,2);
      lcd.clear();
      lcd.setCursor(0,0);
      lcd.print("WELCOME TO IOT");
      lcd.setCursor(0,1);
      lcd.print("SMART SOCKET");
      delay (2000);
     // lcd.print("Connecting..");

  DebugSerial.begin(9600);

  Serial.begin(9600);
  Blynk.begin(Serial, auth);

  // put your setup code here, to run once:

}

void loop() {
  // put your main code here, to run repeatedly:
 Blynk.run();

}
```

Chapter 5

ADVANTAGES AND DISADVANTAGES

5.1 Advantages

– Can be used to monitor the power consumed by the devices individually

– Can be used to save power as we will exactly know which device consumes how much power

– Since the system is connected to internet we can monitor the power from anywhere

5.2 Disadvantages

- Requires some initial investment

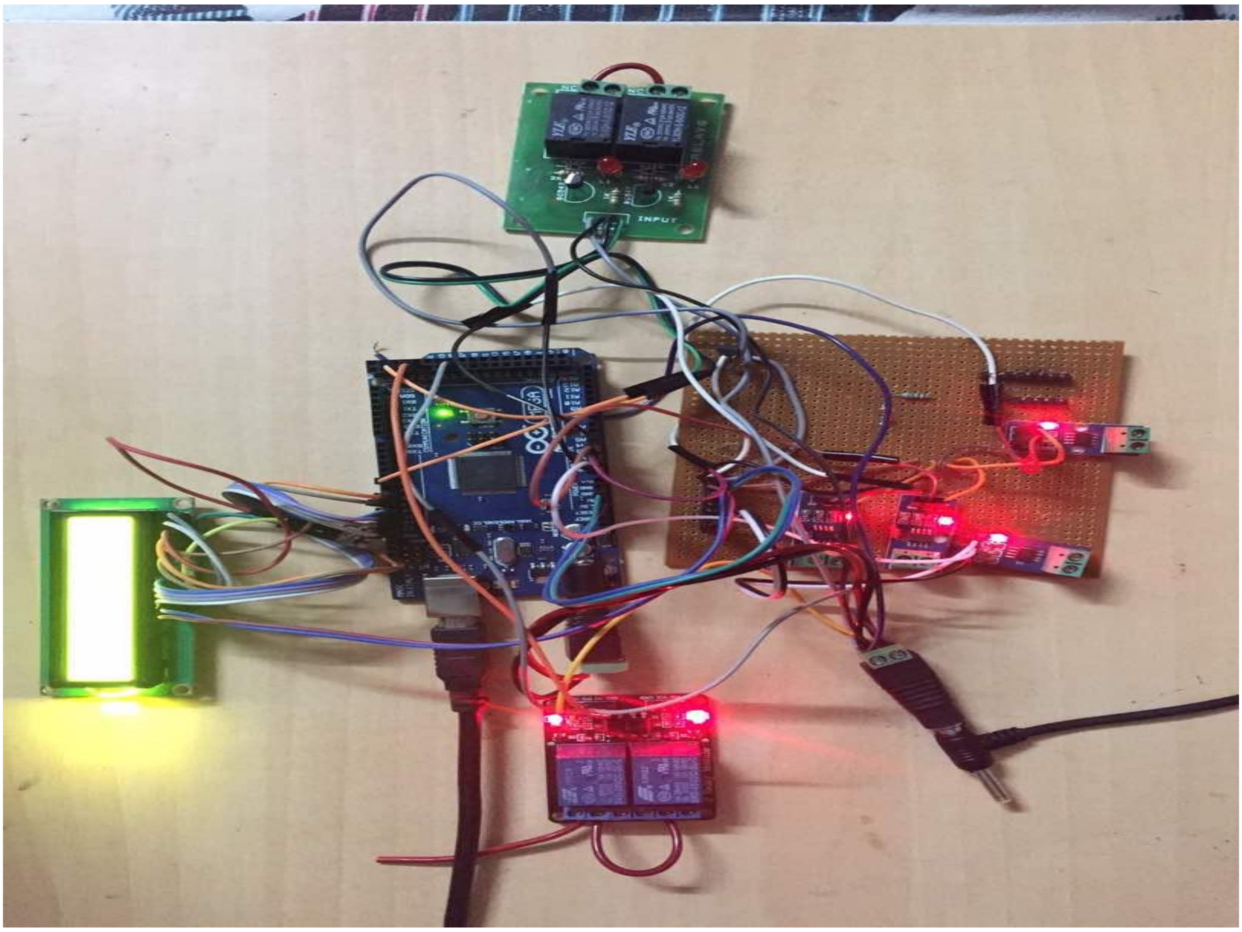
5.3 Applications

- Can be used as smart sockets in house hold to monitor the electricity consumption and keep a track of power consumed
- Can be used anywhere, where the electricity consumption of every electric socket needs to monitored

Chapter 6

RESULT

Parameter	For first load (25w bulb)	For second load (60w bulb)	For third load (150w bulb)	For fourth load (1000w bulb)
Voltage	230v	230v	230v	230v
Current(A)	0.10	0.26	0.65	4.34
Power (Practical)	23w	59.8w	149.5w	998.2w



Chapter 7

CONCLUSION

Form the project t we can conclude that the IOT home automation system can be of use as it helps us to switch off the appliances form anywhere in the world. Since the system is connected to the internet it can be of use to switch on the load form the web browser. This project is expected to monitor the energy consumed by each device separately, and let the user know if some device is consuming energy. Currently the electric meters installed in home show is the total consumption of the home and there is no such existing technology to monitor the energy consumed at every socket of the home. This project aims to implement such technology by developing smart sockets which can keep a track of energy consumed through that particular socket and display it on an android application over the internet. This would help the users use high consumption devices more effectively thus saving energy.

7.1 Future Scope

This implementation can be further extended by creating a network of all other electrical appliances. One such example would be using a connected thermostat, water heater & smart watch. Based on the body temperature of the bearer, the temperature of the other two appliances can be altered accordingly. The ability of Internet of Things is limited to our imagination & there is a immense scope in this field.

REFERENCES

1. Cataliotti A. and Cosentino V., *A* PC-based wattmeter for high accuracy power measurements, Instrumentation and Measurement Technology Conference (I2MTC), *IEEE* 1453–1458 **(2010)**

2. Sandesh J., Singh T.S. and Phulambrikar S.P., improve power factor and reduce the harmonic distortion of the system, Research Journal of Engineering Sciences, **(5),** 31-36 **(2012)**

3. D. Al. Katsaprakakis, D.G. Christakis, A. Zervos and S. Voutsinas, A Power Quality Measure, IEEE Transactions on Power Delivery, **23(2), (2008)**

4. Influence of Instrument Transformers on Quality of Electrical Power and Energy, Measurement Industrial Electronics, ISIE IEEE International symposium **(2007)**

5. Shuyan Zhang, Pingping Xiao, Juan Zhu, Chao Wang and Xiaoguang Li: “Design and implement on Smart Home System” 978-1-4799-3279-5 /14/$31.00 ©2014 IEEE

6. Kim Baraka, Marc Ghobril, Sami Malek, Rouwaida Kanj, Ayman Kayssi, “Low cost Arduino/Android-based Energy-Efficient Home Automation System with Smart Task Scheduling”,2013 Fifth International Conference on Computational Intelligence, Communication Systems and Networks.

7. D. Balsamo and Luca Benini, “Non-intrusive Zigbee Power Meter for load monitoring in Smart Buildings”, Sensors Applications Symposium (SAS), IEEE 2015.

8. Michael C. Lorek, Fabien Chraim and Kristofer S. J. Pister, “Plug-Through Energy Monitor for Plug Load Electrical Devices,” SENSORS, 2015 IEEE, pp. 1-4, 2015.