IMPLEMENTATION OF SMART PLUG USING INTERNET OF THINGS

R.Sathishkumar[1] M.Ragul[2] K.Ranjithkummar[3] K.Saisathya[4] P.Srinivasan[5]
[1]Assistant Professor, [2345] UG Scholar, Department of ECE,
SNS College of Technology,
Coimbatore,
India

Abstract: The power crisis became the most valuable thing in this generation. Most of the countries have population rate higher, so energy usage becomes high. The power usage must be reduced from homes, colleges, industries and many. This power consumption becomes very enormously increasing day-by-day. In order to monitor and reduce the power consumption new devices are introduced to monitor and control devices, which need more or less energy consumption. Thus by controlling from any where we can reduce the power usage of devices. To prevent the enormous power usage of some devices, Smart Plugs are introduced. It requires Internet of Things to control and access from anywhere.

***Index Terms*– Smart Plugs, Raspberry PI, Current Transformers.**

I. INTRODUCTION

The foundations of devices are subjected to power crisis. This power crisis became one of the main goals for the devices to consume very less power all time. Even though the devices increased in homes day by day the power consumption increases tremendously. Thus introducing new such devices to the market, the smart plugs play an important role. This smart plug is very economical and user friendly to home and industries. The smart plug is installed at a device and we can access the device from anywhere. If the device acquires more power, we can able to control it using smart plug. In this work we propose a new technique that the webpage refreshes every one second, so that we can monitor the devices from anywhere. The power usage of devices is displayed exactly in a LCD, which is also displayed in a web page. We can access the web page at any device and control switches will be provided in the web page, so that we can see the device power consumption. We include a Raspberry PI module, where the webpage is hosted in it. We connect every phase terminal of a device to a Current Transformer coil where it can measure the power usage of devices. The final output will be a Smart Plug, where any devices may connect to it. This purely deals with the micro controller unit and energy monitoring systems. In case of abnormal behavior of devices, we can easily notify and control remotely. Merely it is not restricted to limited devices; we can also connect with many devices using more Raspberry PI and micro controllers.

II. EXISTING SYSTEM

The energy consumption is tremendously increasing day by day with huge increase of population. More energy is wasted by unwanted devices with unwanted usages. The power consumption is large even for some house hold devices. That power crisis much needed to be controlled in homes, industries and many. It becomes a big issue when devices are not switched off requires much power usage unnecessarily. Even when we are not in home and forgot some devices to switch it off, we must able to control it. Thus the smart plugs are introduced and home automation becomes easy. In existing system, the controlling devices are not possible, where the component cost becomes huge. In the display of power usage in existing system, refreshing the web page in a short period of time is not possible. We have planned to develop a new web page that displays the accurate level of power usage and the webpage is hosted from the Raspberry PI. The web page will be refreshed automatically in every one seconds, so that the power usage can be monitored. In Existing system provides each device a current sensor so that the equipment cost will be higher. Proposed system contains a Current Transformer which measures the amount of current flow through it. Refer Fig 2.

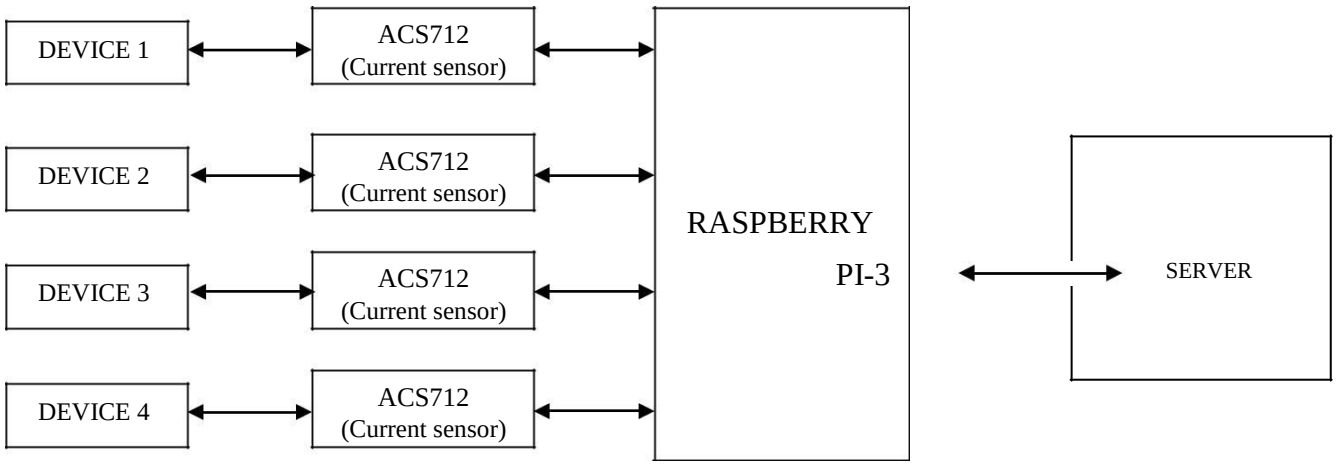

Fig 2 Existing Block Diagram

III. IMPLEMENTATION

This system can be used in both home and industrial purposes. In our system we can monitor the device and handle the devices very easily. We have prepared a new Internet Protocol address which can be used anywhere. For the security purposes we introduced new login identification and a password. By knowing the user ID and password can only enter the web page and monitor the devices which are connected to the smart plug and control. There will be two tabs, the first tab shows the power usage and second tab shows the device and the switch to turn on and turn off the device. So we can control and monitor the devices from anywhere. Refer Fig 3.1.

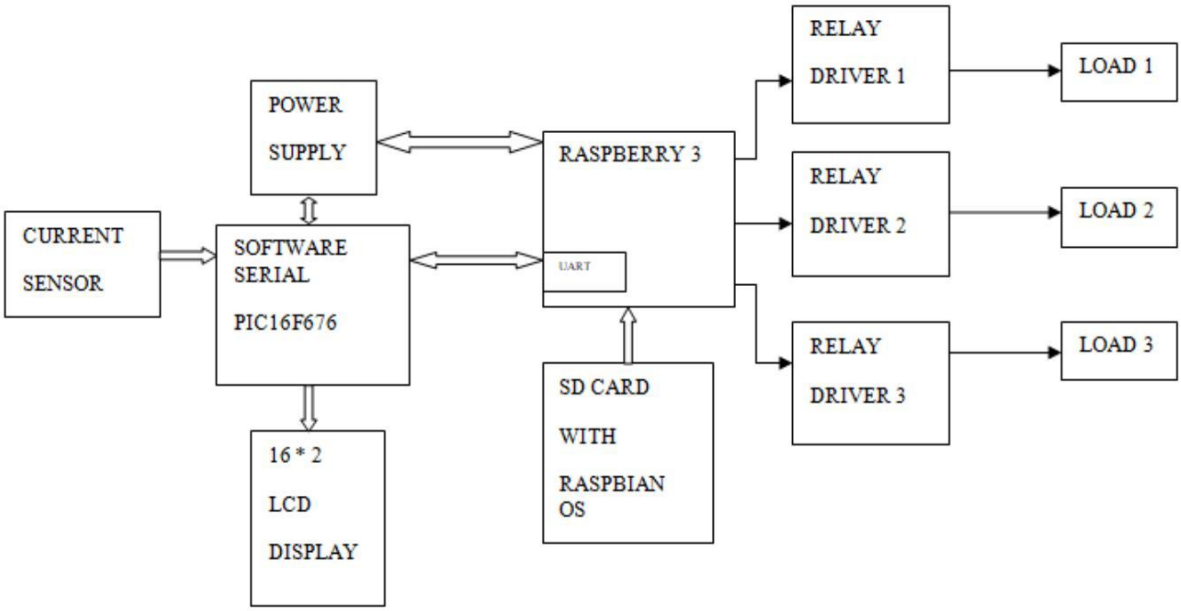

Fig 3.1 Proposed Block Diagram

The picture of the webpage tab 1 shows the device status whether the device is in ON state or OFF state. Refer Fig-3.2.

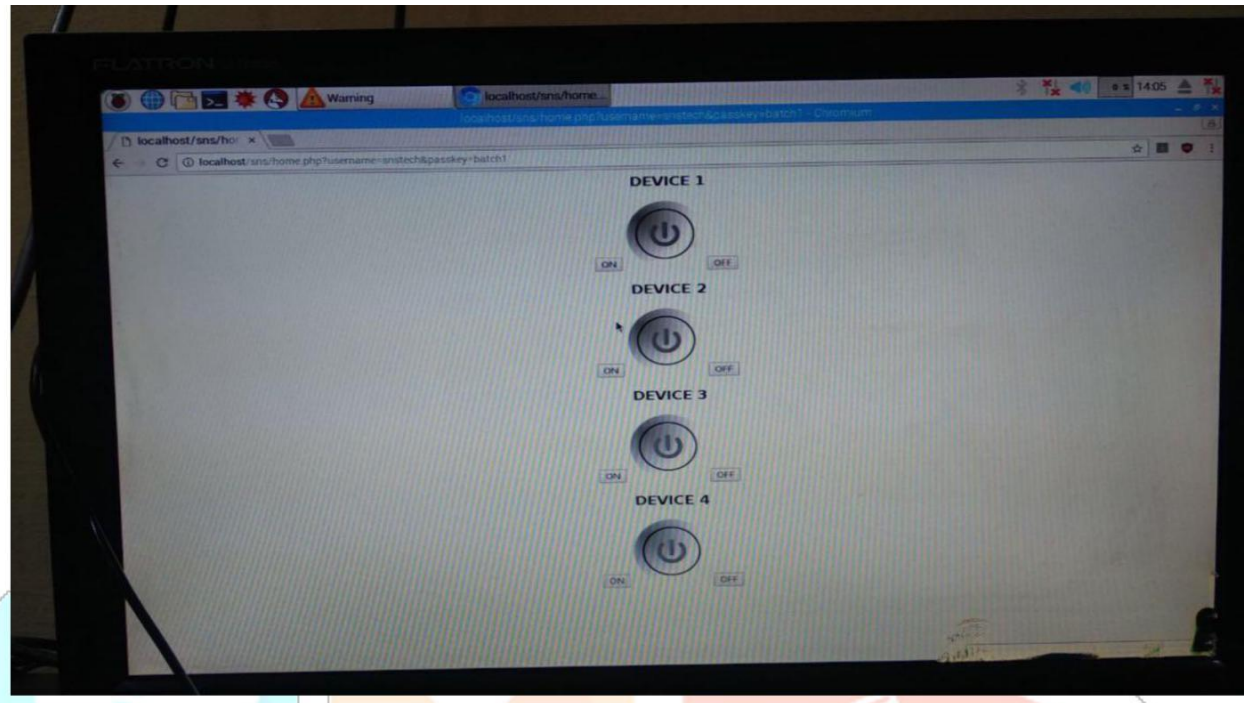

Fig-3.2 Device Switch status

In the tab two, shows the amount of current usage in the devices. Refer Fig-3.3.

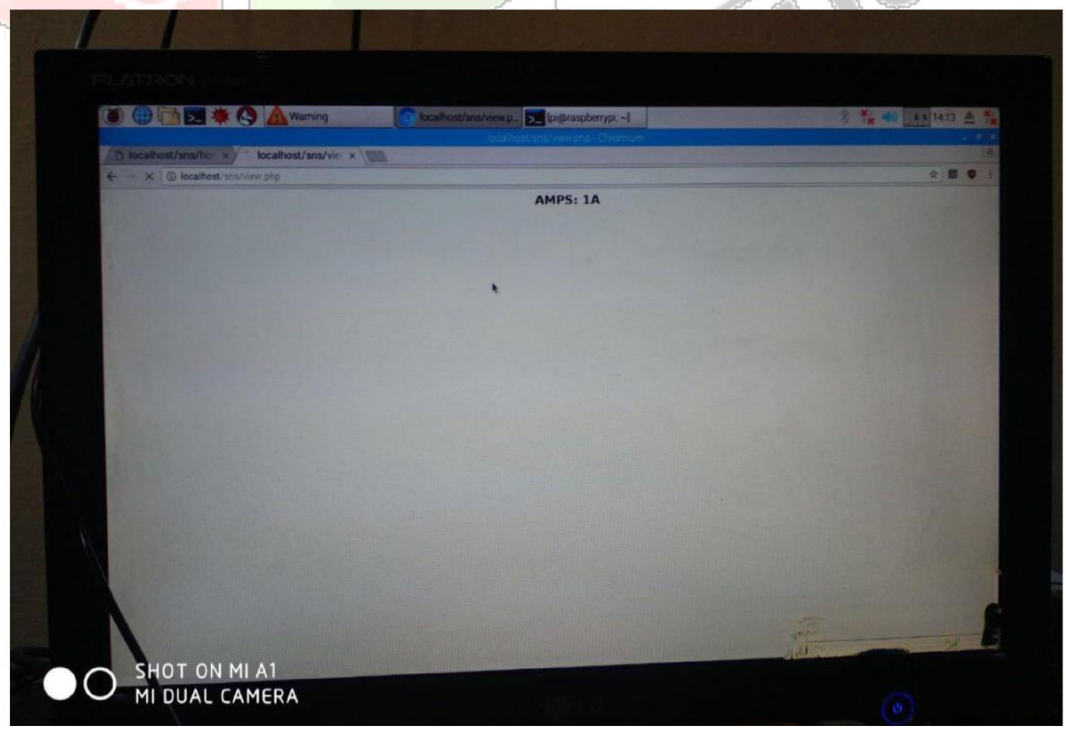

Fig-3.3 Current Usage

The smart plugs, when the three loads as serial lights, heat sink and a bulb. All the three are connected with switch 1, 2, 3. When the switch is on state, all the three devices get the power supply and the usage will be displayed in LCD display also. Final result will be, refer Fig-3.4.

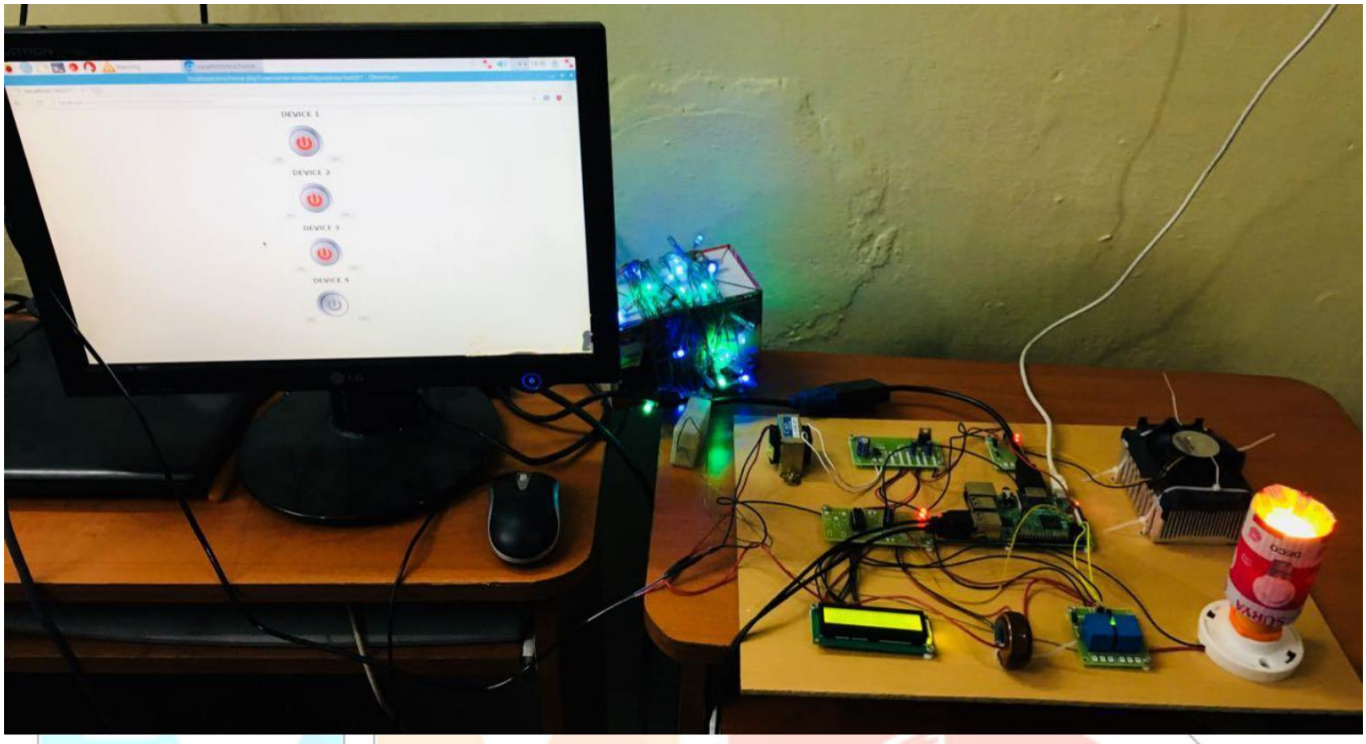

Fig-3.4 Result

IV. HARDWARE

4.1 Raspberry PI

Raspberry PI is a credit card sized minicomputer. Raspberry PI is a series of small single board computers. There are several generations in Raspberry PI. Raspberry PI3 model B has an on-board Wi-Fi/Bluetooth support. We use Raspberry PI3 model B in our smart plug device.

The Raspberry PI has several advantages and speed of the processor than many other micro controllers. This Raspberry PI3 model B has some advantages. Raspberry PI runs Debian based GNU/Linux operating system. Raspberry PI3 Model-B has a Broadcom BCM2837 Processor which we can also use for 64-bit processors. Raspberry PI3 model B have a Central Processing Unit (CPU) core is Quad core ARM Cortex-A53. The speed of the processor is 1.2 GHz, which is purely 50% faster than its previous model Raspberry PI2. The Random Access Memory is 1GB. For network connection reliability, there is an Ethernet port where RJ-45 cable can be inserted.

One of a specialty in Raspberry PI3 model B is, it has a Wireless LAN (Wi-Fi) which has an Internet Protocol address 802.11 which is majorly used for Local Area Network. Also it has a Bluetooth connectivity version 4.1. Raspberry PI3 models B have a ceramic antenna which is used by Wi-Fi and Bluetooth 4.1. It also has four USB ports mounted and a 15-pin MIPI port for camera usages. Refer Fig-4.1.

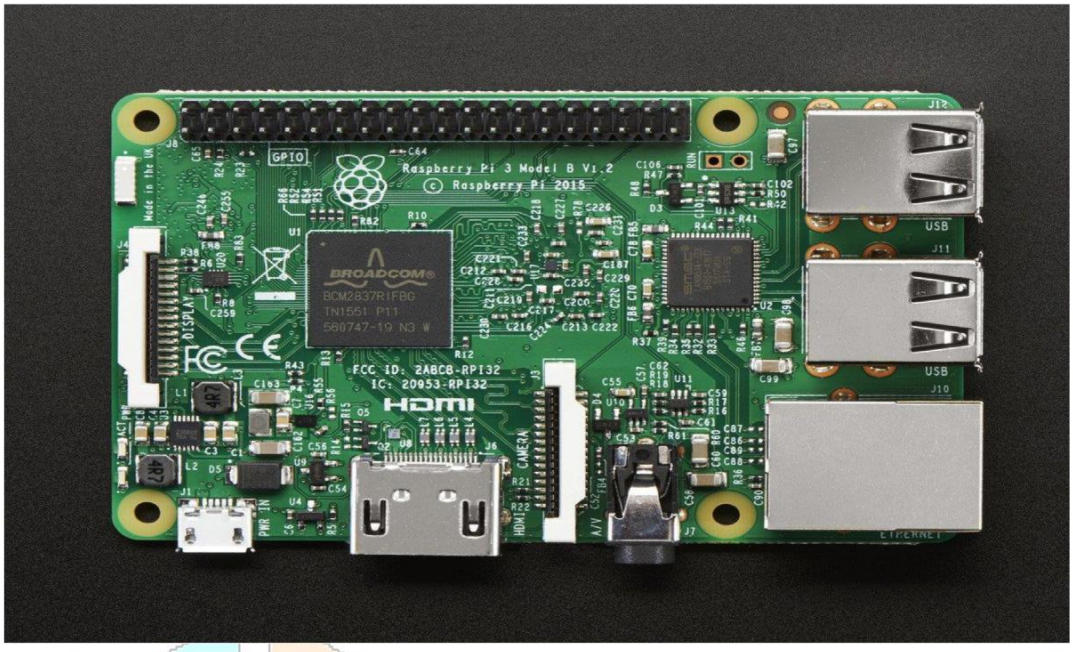

Fig-4.1 Raspberry PI

4.2 Current Transformer

A current transformer (CT) is a type of transformer that is mainly used to measure the alternating current (AC). This current transformer produces a current in its secondary which is merely proportional to that of current in its primary. In our smart plug implementation, we use 0 to 40 Ampere current transformer coil. For every device, phase and neutral connections must be given. The phase terminal is connected to switch through CT coil, and negative terminal is connected directly to devices. By this the current transformer senses the total power used. Refer Fig-4.2.

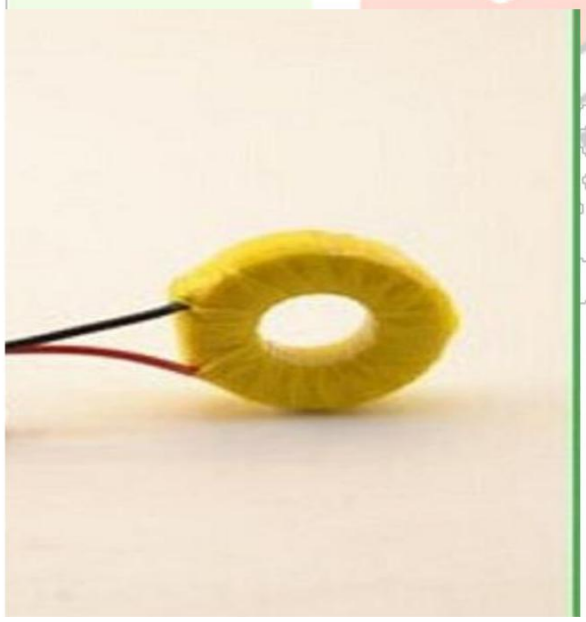

Fig-4.2 Current Transformer

4.3 Micro controller

As the Raspberry PI3 model does not have any analog to digital data converters, here we use a 14-pin micro controller which performs as an analog to digital converter. The micro controller used here is PIC16F676.

This PIC16F676 is mainly used because it is easy to program, CMOS Flash-based 8-bit microcontroller. It has 8 channels for the 10-bit analog to digital converter. This PIC16F676 has programmable pull-up resistors, individually selectable analog channels, ICD2 programming support or debugging support with optional header adapter. By these reprogrammable features, this controller is programmed to provide the data for a LCD display.

The micro controller gets the input data from CT coil and converts the data as digital signal and it gives to the LCD display unit. Refer Fig-4.3.

Fig-4.3 Micro Controller

4.4 Relay

Relays are nothing but electrically operated switches. There are many types of relays. Basically a relay is a five terminal device which is an electronic switch. Refer Fig-4.4.

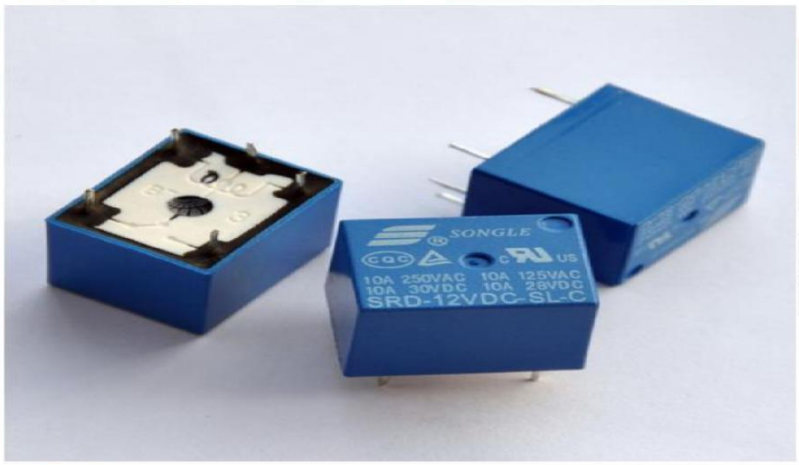

Fig-4.4 Relay

V. SOFTWARE

The smart plugs have little software used for coding in Raspberry PI and also in PIC16F676.

5.1 Python - PHP Software

The Python is a programming language also used for software programming in Raspberry PI. Python is basically a general-purpose, high-level programming language. It is very easy to read the program. The Raspberry PI3 Model-B has twenty-four pins GPIO (General Purpose Input/output). We can give input at any GPIO pins and tend output at any pin. We use PHP software to code the GPIO pins in the Raspberry PI. In our project PHP software is used for web development. PHP has a command line interface and can be used in most of the embedded projects.

In our project, PHP software is integrated with python. Using Ajax concept, the web page is refreshed automatically in every one seconds. The port one, two, three, four and seventeen are the used ports in Raspberry PI. Those ports are programmed to on and off by user, manually. When user gives input as on, the port status gets high and the relay allows passing the current through it. When user off the switch, the port gets state as low, the relay switches to no current.

5.2 Software Serial

The software serial is used to alter the ports used in PIC16F676. The main use of this is to convert the analog value into digital values and sends the data to Raspberry PI. The PIC16F676 has no data conversion ports, so we implement the software serial onto it. This results the controller to read and deliver the data in digital form to Raspberry PI.

VI CONCLUSION

We have developed a functional prototype of smart plug. The final product seems to a smart plug which can be connected to numerous devices with the help of Raspberry PI. The server end shows the amount of electricity usage is being used by devices in the tab 1. The tab 2 displays the devices connected and the on and off switch in the display. The Internet Protocol can be accessed through anywhere by any number of devices. Ajax concept is introduced to view the current usage instantly, because it refreshes the webpage automatically in every 3 seconds.

VII FUTURE WORKS

The future work includes calculation of current usage of every devices and indicates the user if any excessive amount of current used by any devices under smart plug. We can also implement the electricity bill on measuring the amount of current used in the house hold devices or industries. Automatic electricity bill payment using the credit or debit cards can be done by CPU. But it is a risky process that it can be attacked by hacking. Security must be improved for these kinds of works.

REFERENCES

[1] Automated IOT based system for Home Automation and Prediction of electricity usage and Comparative Analysis of various Electricity Providers, Anitha Chaudhari, Brinzel Rodrigues, Shraddha More,2016.
[2] An Implementation of Access-Control Protocol for IoT Home Scenario
Xiaoyang Wu, Ron Steinfeld, Joseph Liu, Carsten Rudolph, May 2017.
[3] A case study of security vulnerabilities in smart plug system. Zhen Ling,Junzhou Luo, Yiling Xu, Chao Gao, Kui Wu and Xinwen Fu,2017.
[4] Inderpreet Kaur, Rayat and Bahra "Microcontroller Based Home Automation System with Security", *(IJACSA) International, Vol. 1, No.6, December 2010.*
[5] Yuting Pan, Yuchen Chen, Zhiqiang Yuan and Bo Liu, "The Real-Time Research of Optimal Power Flow Calculation in Reduce Active Power Loss Aspects of Power Grid", *International Journal of Advanced Computer Science and Applications, Vol.6, No. 2, 2015.*
[6] A.Karthikeyan, S.Vigneshwaran, A.Santhosh kumar, S.Srikanth "Energy saving system using embedded system for street light controller" in International Journal of Advance Research in Science and Engineering (IJARSE), Volume:6, Issue:1, January 2017,pp 193-199 , ISSN:2319-8354.