MONITORING AND CONTROLLING USAGE OF ELECTRICITY USING IOT

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Abstract—Electricity is one of our basic needs. Since 2000 electricity consumption in Indian homes has tripled. According to the data compiled by the Central Electricity Authority (CEA) from distribution companies, all Indian states show considerable increase in total residential electricity consumption in recent years. The main reason behind this is our unorganized usage of electricity. We don't have any way to know which of the devices is consuming more power. This leads to wastage of electricity. To solve this issue we introduce an IoT based power monitoring and controlling system which provides accurate details of our power consumption by monitoring the electricity consumption of each electric device in our home, office etc. and will help us to remotely control these devices.

Index Terms—Internet of Things, Current Sensors, Node MCU

I. INTRODUCTION

Energy crisis is one of the biggest problems faced by today's world. Since electricity consumption is increasing day-by day, power consumption needs to be monitored and controlled. Electricity should be used in a controlled manner. To allow everyone to benefit from the limited energy produced, wastage of electricity should be minimized. One of the main reasons your electric bill may be high is that you leave your appliances or electronic devices plugged in whether you're using them or not. Most modern appliances and gadgets draw current when turned off. To avoid such wastage we need to monitor the devices and control their usage. In the proposed model we are making the users aware of their daily electricity usage. We collect the details of power used by each electronic device in a house and monitor it through an android application. The model consists of two parts, a hardware part which include an arduino board and current sensors to collect the current used by devices and convert it into energy, and a wi-fi module, Node MCU to transfer that data to database. Relays are used to control the devices remotely. Second part is a software part which helps users to monitor the electricity usage and remotely control the devices.

II. LITERATURESURVEY

Kant Suwansit et al.,[1] proposed "PMA: Power Monitoring Application for Android" in 2014 for android and smart phone devices for monitoring energy usage of each electronic device. In this they are using CT sensors, arduino, web server and android application. Current Transformer (CT) sensors are used to detect the current through the load. CT sensors are connected to the devices and arduino board. The measured value is analog value which is converted to digital value by using micro controller arduino. The power consumption data is then send to the server .When the server receives the data, it will manipulate the data into daily, monthly and yearly statistics form. The user can view this data using an android device.

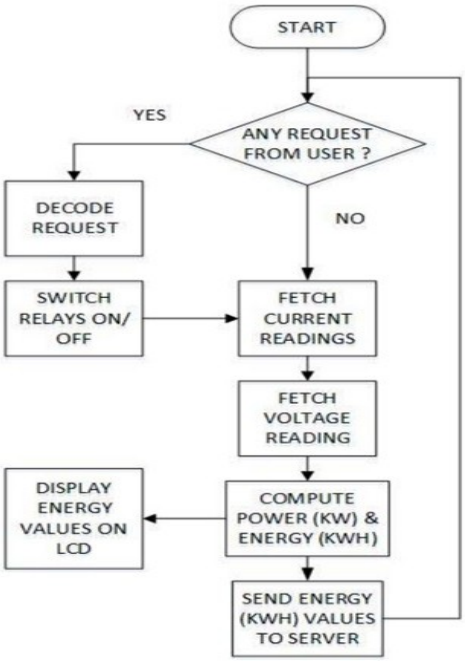
Vanessa Barnes et al.[2] presented "Design and implementation of home energy and power

management and control system" which uses embedded and micro controller for monitoring, scheduling, controlling and managing electronic equipment. In this paper they are using current and voltage sensors to collect and calculate the energy used by devices. This calculated energy is then transferred to a Raspberry Pi server using Bluetooth. The data in the Raspberry pi is transmitted using Wi-Fi communication. The instructions from the user is passed to the Raspberry Pi from where it is decoded and appropriate message(i.e device on/off)is passed to the arduino. The corresponding device will be turned on/of according to the instruction received from user.

YongMei Jiang et al., [3] in the paper "Design of a Home Energy Management System Based on Cloud Service" proposed energy management in house. The electricity consumption data is stored using cloud computing .The unit named SCADA collects the data from home micro grid, control the equipments in the grid and uploads the data to the server via internet. The data processed by SCADA is transferred to the server using an intelligent gateway. Raspberry Pi is used as the intelligent gateway. They used We Chat server for storing data. A smart socket with Wi-Fi communication is developed by them to read the voltage, current, active power etc. used by devices and give it to the SCADA unit.

III. PROPOSEDSYSTEM

The proposed system has a current sensor named ACS712 which detect the amount of current flow and this sensor gives an analog signal as output. This analog output is passed to Arduino which converts the analog signal to digital value. digital value is then processed to find the energy in units. This data is transferred to cloud storage through a Wi-Fi module called nodeMCU(ESP8266). Both Arduino an node MCU can be coded using open source software Arduino IDE. The data obtained is stored in the database in cloud so that we can access data from anywhere at any time. A mobile application is the front end of our system. This application shows the usage of electricity in real time. We get a clear picture of our usage of electricity in our day to day life. This application also provides interface to control the appliances remotely by way of relay switches. A button is provided for relay connected devices so that when we click on the button it will sent signal to the relay via node MCU. If the signal is false the device is turned off. If the signal is true the device is turned on.



. Fig.1.Flow chart of Proposed System

The hardware consists of a current sensor, Arduino UNO, relay and node MCU. The sensors measure the current consumed by the load. These sensors collect the device status and report it to the Arduino periodically. The microcontroller may be a high end single SoC on the sting that collects the knowledge from the sensors. The output from current sensor is an analog signal which is converted to digital value so that we get actual current value flowing through the wire. Arduino Uno is programmed to get the energy usage. The calculated value is forwarded to the cloud using a Wi-Fi module. Since the micro-controller cannot provide enough power to the load, an external power source is supplied to provide a power driving circuit for the appliances.

A. ARDUINO

The Arduino UNO is an open-source microcontroller board developed by Arduino. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards (shields) and other circuits.

Fig.2.Arduino

Fig.3.ACS712 Current sensor

B. ACS712 CURRENT SENSORS

ACS712 can accurately detect AC or DC current. The maximum AC or DC that can be detected can reach 30A, and the present current signal can be read via analog input/output port of Arduino. Here we use the Current Sensor ACS71230A to measure current used by the load which is connected to phase wire. Series connection is made with the load and input power supplies to detect current. Current Sensor gives the analog signal, but we want digital signal for transmitting. So analog signal is send to Arduino for converting it to digital.

C. NODEMCU WIFI MODULE

The ESP-01 ESP8266 Serial WIFI Wireless Transceiver Module is a self-contained SOC with integrated TCP/IP protocol stack which will give any micro controller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. This module features a powerful enough onboard processing and storage capability that permits it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime.

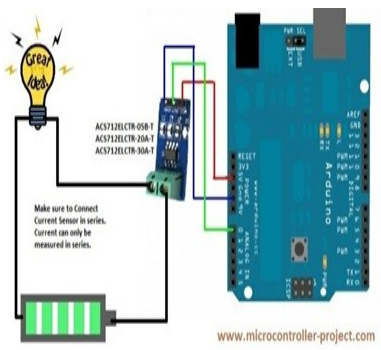


Fig.4.ACS712 interfacing with arduino

Fig.5.ESP8266 programming mode

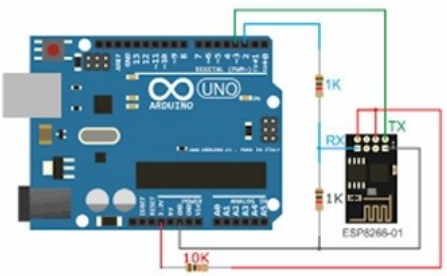


Fig.6.ESP8266 running mode

D. RELAY MODULE

A relay is an electrically operated switch that can be turned on or off, letting the current go through or not, and can be controlled with low voltages, like the 5V provided by the Arduino pins. The Arduino relay module can be used in two states which are Normally open state (NO) and Normally closed state (NC). In the normally open state, the initial output of the relay will be low when it will be powered. In this state, the common and the normally open pins are used. In the normally closed state, the initial output of the relay will be high when it will be powered. In this state, the common and the normally close pins are used.

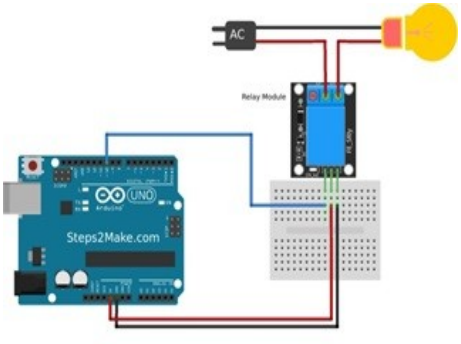


Fig.7.Relay interfacing with arduino

Fig.8.Application UI

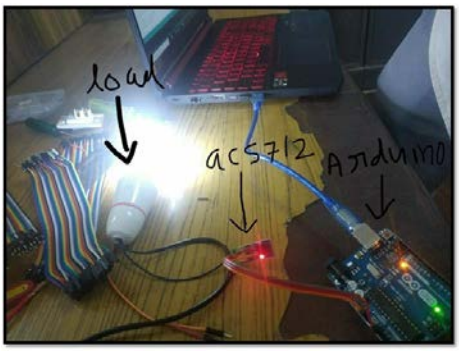


Fig.9.Interfacing load, current sensor and arduino

IV. WORKING

We used an android application for monitoring and controlling the device. The architecture consists of two modules monitor module and control module. In monitoring module we categorize devices based on their location in the building. We can see the amount of electricity consumed by each device in units. In the controlling part, a switch is provided corresponding to each appliance which send signal to nodeMCU to turn on/off the appliance corresponding to the relay id of that appliance.

V. CONCLUSION

In this paper, we describe the design and development of a home power and energy management system with mobile interface for mana ging and controlling power in the home. This energy and power management system provides management solution for users to effectively monitor, control, and regulate the amount of power and energy usage in the home more easily and efficiently via mobile application software. Through the proposed system, users can know their energy consumption pattern, reduce their energy costs, lower the overall impact on demand, and enhanced energy management services. The system can offer a reliable solution for energy management system for users in a home. It is also recognized that having the ability to remotely monitor and control user energy and power consumption introduces issues of security and privacy.

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