Design And Implementation Of Load Monitoring System And Phase Selector

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Abstract- *As IoT plays an eminent role in the development of smart technologies, we have focused our idea on creating "Design And Implementation Of Load Monitoring System And Phase Selector". This system enables the user to monitor power consumed by the appliances in the home, change the phase, and gather information from distribution box such as voltage and current through mobile device.Finding efficient measurements for detecting excess electricity consumption has been an active research area in recent years. This system identifies the excess power usage and automatically cuts off the power supplied to the load and intimate the same to user.In the event of a power trip or an occurrence of low/high voltage, the user in the home can handle the situation through mobile device by monitoring the parameters of the power supply and changing the phase remotely whenever needed.Gathering information from distribution box such as voltage and current is very important in order to monitor and sometimes control the entire distribution network efficiently and reliably.The system is designed particularly for domestic purpose. This system can be used at homes, offices, industries, etc., where the user is allowed to monitor the power consumed by the appliances as well as tackle the issue of voltage fluctuations.*

Keywords- Voltage Sensor, Current Sensor, ArduinoUNO, IoT(Internet of Things), UART(Universal Asynchronous Receiver Transmitter)

I. INTRODUCTION

The Internet of things (IoT) is the inter-networking of physical devices, vehicles (also referred to as "connected devices" and "smart devices"), buildings, and other items embedded with electronics, software, sensors, actuators and network connectivity which enable these objects to collect and exchange data. The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.

Visualizing a world where several objects can sense, communicate and share information over a Private Internet Protocol (IP) or Public Networks. The interconnected objects collect the data at regular intervals, analyse and used to initiate required action, providing an intelligent network for analyzing, planning and decision making. This is the world of the **Internet of Things (IoT).** The IoT is generally considered as connecting objects to the Internet and using that connection for control of those objects or remote monitoring. But this definition was referred only to part of IoT evolution considering the machine to machine market today. But actual definition of IoT is creating a brilliant, invisible network which can be sensed, controlled and programmed. The products developed based on IoT include embedded technology which allows them to exchange information, with each other or the Internet and it is assessed that about 8 to 50 billion devices will be connected by 2020. Since these devices come online, they provide better life style, create safer and more engaged communities and revolutionized healthcare. The entire concept of IoT stands on sensors, gateway and wireless network which enable users to communicate and access the application/information.

IoT enables people and objects in physical world as well as data and virtual environments to interact with each other, hence realizing smart environments such as: smart transport systems, smart cities, smart healthcare, and smart energy as part of a prosperous digital society.

Lack of resources established in the present world is initiating everyone towards energy efficient technologies. Among all these resources, power is one which needs to be monitored and controlled as per the need since electricity consumption is increasing day-by day. We live in a world where almost everything runs on electricity. 67% of their sources used to produce electricity are non-renewable sources of energy. Power is the soul of world which is related to the electricity and "electricity" is the word which now rules the world. So, proper utilization of these resources is of immense important to us. Though many technological innovations are taking place in this world, existing electricity consumption billing process seems in India to be very old fashioned and

does not meet the latest technology available. In this paper we present a newly designed digital meter based on a very cheap distributed components like microcontroller architecture and current sensors.

Though electricity is very essential in day to day life, the proper utilization of it must be done. We can properly consume the electricity as well as calculate the electricity consumption by using the electric meter. The vulnerability about the supply of energy can tell the working of whole economy, especially in creating financial aspects. It is the necessity to manage consumption of electricity due to limited availability of resources. So the aim of this paper is to recognize and eliminate the misuse of electricity. Internet of things has helped many organizational systems to improve efficiency, increase the speed of processes, minimize error and prevent theft by coding and tracking the objects.

The power lines which already exist and connect every household in a particular area as it does not require any new installation or erection for establishment of communication channels. So the system doesn't require placing other cables and along with this we are using WIFI to communicate with the servers and users. By measuring current and voltage, we can analyze energy consumption, make the world smarter place and make better decisions using Internet of Things.Computing and communications has its future in the technological transformation brought by the IOT. Power consumption can be reduced to a great extent if we can monitor our daily power usage and switch off appliances which are unnecessary consuming electricity. This system focuses on developing a monitoring system using the concept of Internet of Things.

II. ARCHITECTURE DIAGRAM

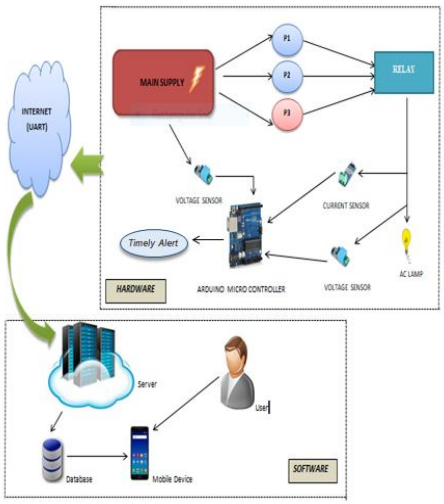

Fig 1: Overall Architecture

III. HARDWARE AND SOFTWARE DESCRIPTION

This system consists of two major parts:

1. Hardware Module
2. Software Application

Hardware module consists of the following components:

- Arduino UNO
- Voltage Sensor
- Current Sensor
- Relay
- LED Lamp

Software application is implemented as a web page built using NetBeans IDE.

Arduino UNO:

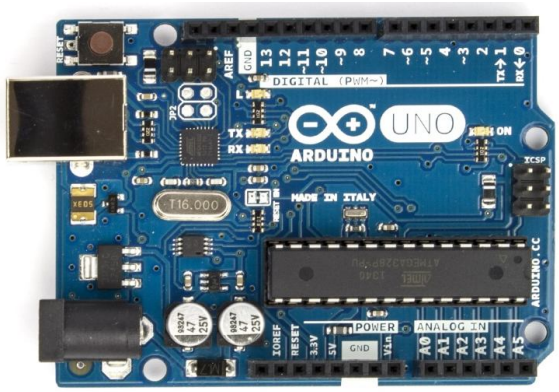

Fig 2: Arduino UNO board

The Arduino Uno is a microcontroller board based on the ATmega328. It can be connected to computer via USB cable. Batteries or AC-to-DC adapter can also be used to get started. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It has maximum of 12V power supply and minimum of 2.3V, but the recommended is 5V of supply. Arduino UNO IDE can be used to program the board for any device.

Voltage Sensor:

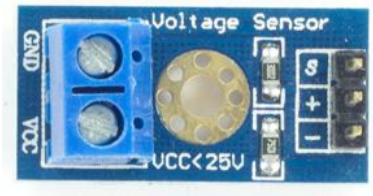

Fig 3: Voltage Sensor

The Voltage Sensor block represents an ideal voltage sensor, that is, a device that converts voltage measured between two points of an electrical circuit into a physical signal proportional to the voltage.This module is based on resistance points pressure principle, and it can make the input voltage of red terminal reduce 5 times of original voltage.The max Arduino analog input voltage is 5 V, so the input voltage of this module should be not more than 5 V x 5 = 25 V.

Current Sensor:

Fig 4: Current Sensor

A current sensor is a device that detects electric current in a wire, and generates a signal proportional to that current. The generated signal could be analog voltage or current or even a digital output. The generated signal can be then used to display the measured current in an ammeter, or can be stored for further analysis in a data acquisition system, or can be used for the purpose of control.

Relay:

Fig 5: Relay Module

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

LED Lamp:

Fig 6: LED Lamp

An LED lamp is an electric light or light bulb for use in light fixtures that produces light using light-emitting diodes (LEDs). LED lamps have a lifespan and electrical efficiency which are several times greater than incandescent lamps, and are significantly more efficient than most fluorescent lamps, with some chips able to emit more than 300 lumens per watt.

Arduino IDE:

Fig 7: ArduinoSoftware

The Arduino IDE is an Open-Source software used to provide instructions to microcontroller. It provides an environment where you can write code and upload it to your microcontroller. It is available for Windows, Linux and MAC operating system based computers.

NetBeans IDE:

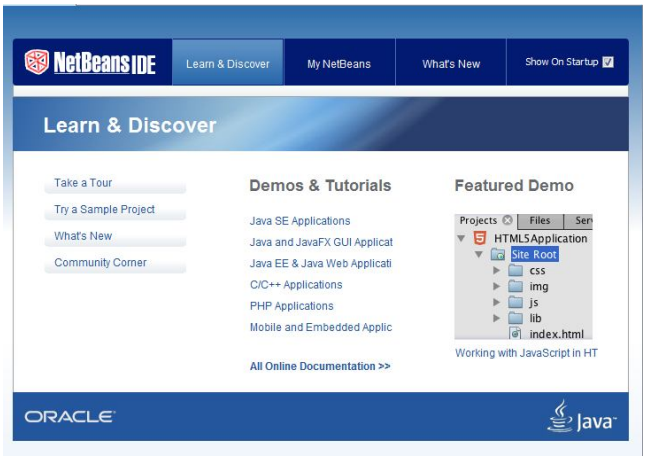

Fig 8: NetBeans IDE

NetBeans is an Integrated Development Environment(IDE) for developing primarily with Java, but also with other languages, in particular PHP, C/C++, and HTML5. It is also an application platform framework for Java desktop applications and others. The Net Beans IDE is written in Java and can run on Windows, OS X, Linux, Solaris and other platforms supporting a compatible JVM.The Net Beans Platform allows applications to be developed from a set of modular software components called modules.

IV. BLOCK DIAGRAM

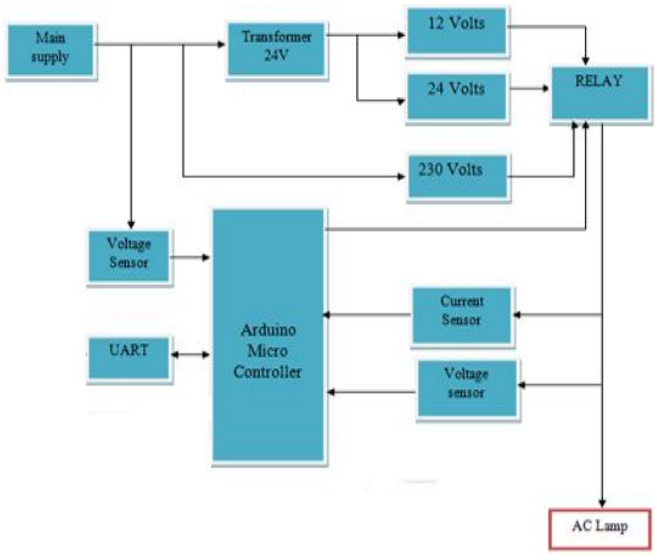

Fig 9: Block Diagram

V. METHODOLOGY USED

In this system, the arduino board is used to interface various sensors which is used for reading parameters like voltage and current. The users are registered with the server side so that only registered users will be able to access the system. The arduino which is interfaced with the sensors acts as a remote device which senses the data stores them into the server database. The system is designed in such a way to monitor distribution box that notifies the user during excess power consumption through UART and automatically cut off the power supply given to the load. The user is notified with the measure of units consumed by the appliances in the home periodically.

The hardware and the software interface are connected to each other to monitor the power consumption of the user and further, this will be monitored by server and will be uploaded to cloud from where the user can log on to the webpage in computer and App installed in the mobile. The web page will display the measure of voltage, current and units consumed.

The system is developed for easy handling of phase change during the occurrence of low voltage remotely. With the report of the gathered parameters, we can switch off the appliances in the home if the voltage rises too high or we can change the phase if either the voltage in a particular phase drops down or power in a particular phase goes off. A multi-parameter continuous condition monitoring approach gives valuable data to detect abnormal situations like heavy voltage passing inside home and enables the user to shut down the entire power supply from remote location. This data is stored in the Database server and accordingly, the data is sent to the registered user. So that the user can manage the appliances based on the units consumed.

The proposed method uses the Arduino UNO board as the main controller. It is programmed using Arduino IDE, which is a platform specifically designed for coding the projects run by Arduino UNO. This software can be downloaded for no cost from the official website of Arduino. After download is complete, connect your board to laptop via USB cable. Select **Tools** -> **Board** menu according to the microcontroller being used. The ATmega328 on the Arduino Uno comes pre-burned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. ICSP (In-Circuit Serial Programming) header can also be used to bypass the bootloader and program the microcontroller.

Voltage sensor is connected with the Arduino UNO microcontroller to measure the voltage supply. Arduino analog inputs can be used to measure DC voltage between 0 and 5V (on 5V Arduinos such as the Arduino Uno when using the standard 5V analog reference voltage).The range over which the Arduino can measure voltage can be increased by using

two resistors to create a voltage divider. The voltage divider decreases the voltage being measured to within the range of the Arduino analog inputs.This allows voltages greater than 5V to be measured.AC voltage measurement can be carried out by converting AC voltage into proportional DC Voltage using rectifier and filter circuits. For low AC voltage (mili volts) measurement precision rectifier is used as diode knee voltage is 0.7 Volt.

Current sensor is connected with the Arduino UNO microcontroller to measure the current received. The Vcc pin of current sensor module is connected with 5V pin of Arduino and Ground pin is connected with Ground pin of Arduino and output pin of current sensor module is connected with Analog channel 0 of Arduino which built in analog to digital converter of Arduino. Load is connected in series with IP+ and IP- pin and dc battery.

Arduino cannot controlhigh voltageand ampere, but a relay can do this job, which is the sole design of it. So, we are using relay as switch to control high power devices.The Arduino can be programmed to turn on the relay when a certain event occurs, for example when the user clicks phase 2 button on the web page the current starts flowing through phase 2.

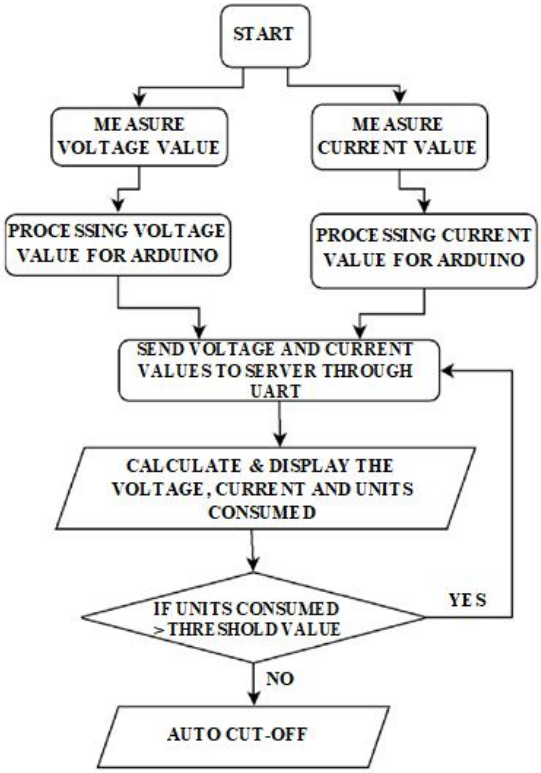

Fig 10: Overall Flowchart Diagram

VI. IMPLEMENTATION

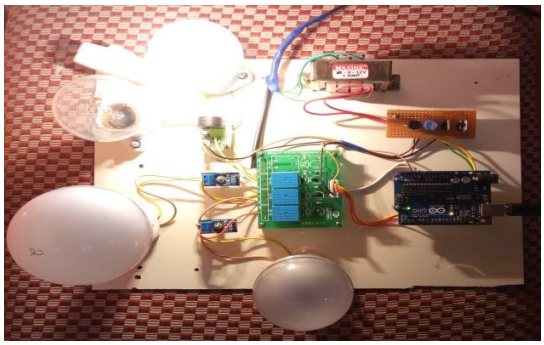

Fig 11: Hardware Kit

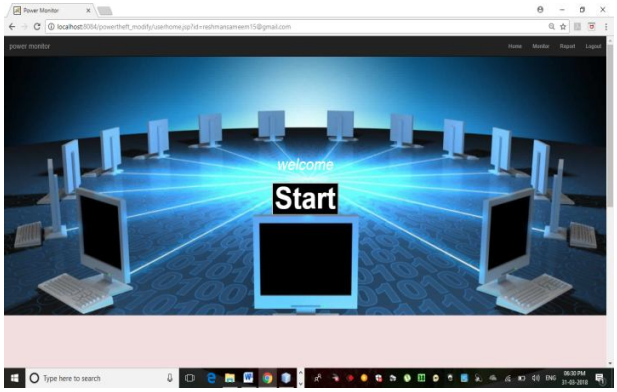

Fig 12: Home Page

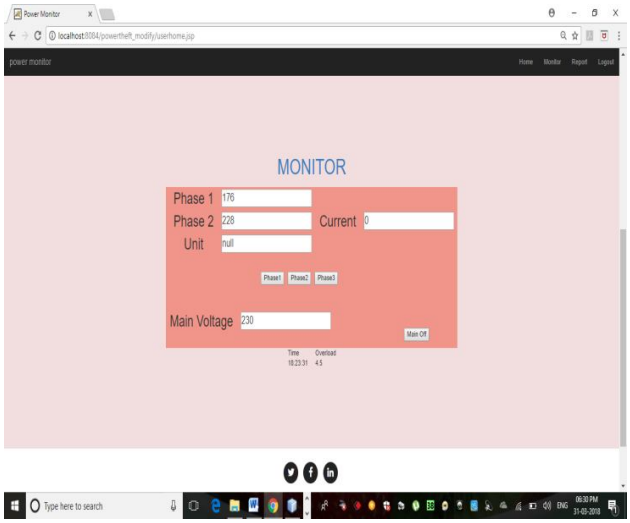

Fig 13: Monitor Module

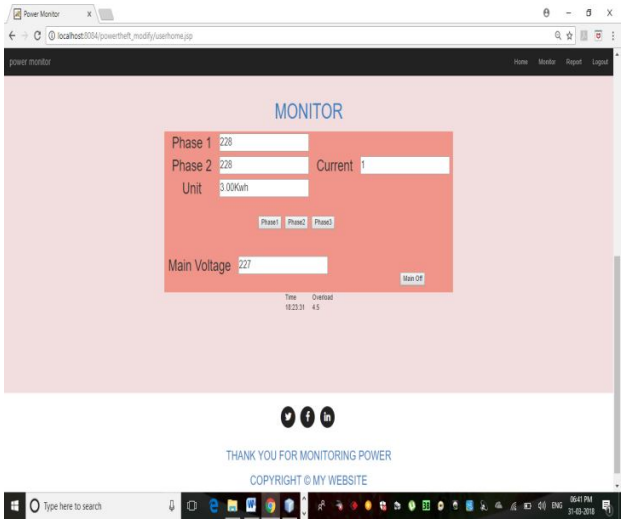

Fig 14: Unit Consumption Display

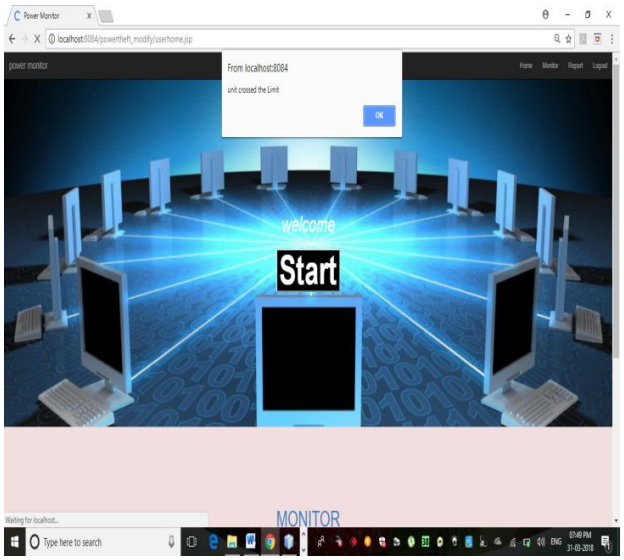

Fig 15: Overload Alert

VII. CONCLUSION

In this project, we have implemented the real time data transfer between a distribution board and the user via a product. The product that is the arduino micro controller has been interfaced with various sensors like voltage sensor, current sensor which helps in reading the voltage and the current measure that analyzes and monitors the appliances in the home. The user is able to monitor the power usage as well as change the phase and receives alerts regarding the same. Also, the system automatically cuts off the load in case of over usage of current and intimates the user. This monitoring system of domestic distribution board will help the user, especially women and elderly people to monitor and operate the distribution board simply through their mobile phones. This proposed system is cost effective and does not need any type of knowledge and also does Dynamic Real-time connect between the distribution board and the user. This proposed system enables the user to get all the information about the distribution board at a single shot. Overall, the proposed system helps in monitoring the distribution board efficiently.

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