Electricity Monitoring System Using Internet of Things (IoT)

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Abstract

Out of several challenges electricity consumption is one of the vital problems in day to day life. In the article we have used Internet of Things (IoT) for monitoring the electricity consumption and save the wastage of electricity. Our paper is portrayed to quantify vitality utilization in the house and create its bill consequently utilizing telemetric correspondence which can help in decreasing vitality utilization in house as the proprietor is persistently being informed about the quantity of units that are expended. Its objective is to produce charge consequently by checking the power unit's utilization in a house also, in an approach to decrease the difficult work. The estimations are performed consequently and the bill is refreshed on the web by utilizing a system of Internet of Things. The bill sum can be checked by the proprietor anyplace internationally. Outline and usage of undertaking is fundamentally founded on Arduino, ESP8266Wi-Fi module and Current Sensor ACS712controller utilizing IOT idea. In power transmission human inclusion isn't required. Purchaser pays the power charge for the expended control. In the event that buyer neglects to pay the bill on time then power transmission can naturally kill. Likewise control burglary can be recognized if any altering happens it will send the data to the server and also it will cut the power consequently.

KEYWORDS- IoT, Arduino, Current Sensor, Node MCU, ACS712, ESP8266.

INTRODUCTION

Internet of Things (IoT) is an environment of associated physical articles that are open through the web. The 'thing' in IoT could be a man with a heart screen or a car with inherent sensors, i.e. objects that have been allocated an IP address and can gather and exchange information over a system without manual help or intercession. The inserted innovation in the items causes them to communicate with inward states or the outer condition, which thus influences the choices taken. Internet of Things can interface gadgets implanted in different frameworks to the web. Whenever gadgets/articles can speak to themselves carefully, they can be controlled from anyplace. The availability at that point causes us catch more information from more places, guaranteeing more methods for expanding proficiency and enhancing wellbeing and IoT security. IoT is a transformational drive that can enable organizations to enhance execution through IoT investigation and IoT Security to convey better outcomes. Organizations in the utilities, oil and gas, protection, fabricating, transportation, foundation and retail divisions can receive the rewards of IoT by settling on more educated choices, helped by the downpour of interactional and value-based information available to them.IoT stages can enable associations to diminish cost through enhanced process effectiveness, resource usage and profitability. With enhanced following of gadgets or objects utilizing sensors and network, they can profit by continuous bits of knowledge and investigation, which would enable them to settle on more intelligent choices. The development and intermingling of information, procedures and things on the web would make such associations more significant and essential, making more open doors for individuals, organizations and ventures.

I. RELATED WORKS

Realizing the full potential of IoT is critical to enhance the flexibility, asset management, operations, and reliability of intelligent electric power networks. To enhance the resiliency of electric power networks, it is essential to account for fluctuations introduced by decentralized generation from distributed energy resources (DER) integration. Smart inverters are a potential IoT solution to overcome this challenge. To enhance the enablement of electric power networks, IoT devices and technologies such as advanced distribution management system (ADMS) collect, analyse, and disseminate data to all electric power network stakeholders (e.g. customers, utilities and regulators). Insights gained from these data enable stakeholders to make more informed optimization decisions, resulting in efficient utilization of electric power network resources and more efficient network operations [1].

IoT can transform EPESs by providing a sustainable solution, viz. a dynamic stochastic energy management system (DS-EMS), which is both intelligent and cyber enabled, to meet the growing demands of access to affordable, clean and sustainable energy. The goal of DS-EMS is to maximize revenue generation, minimize energy costs, and reduce carbon emissions by optimizing the electric power flow in a way that minimum power is drawn from the power grid and maximum power is supplied to the power grid. Once the energy needs are satisfied, any excess generation form these distributed energy resources can be supplied to the power grid. The electric power exchanges to-and-from the grid are done based on time of use rates. With IoT, EPESs will become more efficient, reliable, secure, cost-effective, resilient, and sustainable [2]. A power meter is used to measure energy consumption for the purpose of calculating the bill in real time and making it available to both the user and utility. Users can also control the loads from any location through this internet-based approach. This can also be useful for the utility to shut down supply to specific individual homes, industries, etc. if they consume excess power [3].

There are numerous protocols, either wireless or wired for connecting each home devices to transmit data. Typically, it is the mess once devices are connected in a wired way. So that, people tend to utilize the wireless protocols for home connectivity at the lower price. Currently, the most common short-range wireless networks are Zigbee, Wi-Fi, and Bluetooth technology [4]. Save money on energy use, while keeping your office or building comfortable. The cost of simply forgetting to turn off your classroom lights and electric appliances can really add up over time. Controlling temperature and lighting based on time of day or occupancy can really reduce energy costs. Automating your heating and lighting systems allows you to hand over the routine chores to a smart system and remove the cost of human error. Have your systems set automatically, or override the main settings with easy controls - Touchscreens, is no longer just for greenies, with the typical family power bill has risen by 78% in less than an Internet, web-enabled phones, or even the office telephone. Intelligent building efficiency is not just relegated to offices [5].

The specifications of the prototype system, the current sensor is ACS712 with a voltage sensitivity of 66-185 mV/A and ZMPT101B with linearity ≤0.2% (20% dot ~ 120% dot) used as the voltage sensor. For the communication system using 802.11 wireless system with type a, b, g and n brokers work based on data received and as a web server by processing the data in the form of a web-based graphics. They are classified into the voltage and current data. For three-phase voltage, data are labelled VR, VS, and VT, for currents labelled IR, IS, IT and IN. The specification of the broker is shown in Table II. In table II, the minimum system specification is Raspberry Pi 2 - Model B v1.2 - ARM Cortex-A53 with 1G RAM while for the type of wireless used is 802.11 g/n [6]. Conventionally, the smart temperature controlling by the smart meters increase or decrease pre-set temperature only based on several simple

behaviour planning methods. To provide comfortable experience with low power consumption, the operation of air conditioners compressor should be implemented by analysing outdoor temperature, room temperature, pre-set temperature and current usage habit of the guests. For example, during sleeping period, the user complains that he/she always feels cold at night when the air conditioner is specified at a low temperature. In our system, the cloud server is able to increase the target temperature by a little based on the integrated datasets analysis results [7]. Arduino is connected to Raspberry pi through USB cable. Raspberry pi (RPi) is working as a server. The data from the Arduino is display on the web page through RPi. The monitoring data upload to the cloud through RPi. The proposed system is for monitoring of solar energy using IoT. Solar panel helps to store the energy in the battery. Battery has the energy which is useful for the electrical appliances. Battery is connected to the Arduino. Arduino is a micro controller which is used to read the sensor values. Current sensor and voltage divider are connecting to the Arduino [8].

II. OUR WORK

3.1 MOTIVATION

Seeing our home monthly electricity usage in summers is kind of headache for us. Middle class family cannot afford the bills. We cannot monitor it from day today in the present charging framework the dispersion organizations can't monitor the changing most extreme interest of shoppers. The customer is confronting issues like getting due bills for bills that have just been paid and in addition poor unwavering quality of power supply and quality regardless of whether bills are paid frequently. The solution for every one of these issues is to keep track of the shopper’s stack on auspicious premise, which will be held to guarantee precise charging, track most extreme interest and to recognize edge esteem. These are every one of the highlights to be taken into record for planning a productive vitality charging framework. The present venture "IoT Based Electricity Energy Meter using ESP12 and Arduino" addresses the issues looked by both the customers and the appropriation organizations. The paper primarily manages brilliant vitality meter, which uses the highlights of inserted frameworks i.e., the mix of equipment and programming all together to actualize wanted usefulness. The paper talks about the correlation between Arduino and different controllers, and the use of Wi-Fi modems to present 'Brilliant' idea. With the utilization of wi-fi modem the purchaser and specialist organization will get the utilized vitality perusing with the individual sum, Consumers will even get a notice in the shape message through email when they are going to come to their edge esteem, that they have set. Additionality with the assistance of Wi-Fi, modem the shopper can screen his devoured perusing and can set the edge an incentive through site page. This framework empowers the power office to peruse the meter readings month to month without a man visiting each house. This can be accomplished by the utilization of the Arduino unit that consistently screens and records the vitality meter perusing in its changeless (non-unstable) memory location. This framework consistently records the perusing and the live meter perusing can be shown on the page to the purchaser on demand.

3.2 PROBLEM STATEMENT

We havesome issues as: Power robbery is a measure wrongdoing and it likewise specifically influences the economy of our nation. Transmission, age and conveyance of power incorporate the loss of power. To maintain a strategic distance from the misfortunes we have to screen the influence utilization and misfortunes, with the goal that we can effectively use the produced influence. Meter hardening is a piece of intensity burglary and furthermore illicit wrongdoing which we can limit. Charging is a procedure as a rule the human

administrator goes to each customer's home at that point giving charge it will require parcel of investment. To overcome these Problems, we have designed a model in which it monitors the electricity using Internet of Things (IoT).

3.3 SOLUTION DETAILS AND RESULTS

To determine these issues, we created framework on the base of IOT vitality meter perusing. IOT based vitality meter perusing comprises of three sections: Controller, Theft location and WIFI part. Controller part assumes a noteworthy job in the framework. Where all the data can send through this controller to the next piece of the framework and it additionally stores the data in it. WIFI part performs IOT activity as per the Arduino controller and Current Sensor ACS712. The vitality meter associated with robbery recognition part if any temper happens it will send the data to the organization and in addition it will make programmed move by making power off. the working of the ACS712 Current sensor as it is the key part of the venture. Estimating current particularly AC current is dependably an intense assignment because of the clamour combined with its inappropriate segregation issue and so on. In any case, with the assistance of this ACS712 module which was designed by Allegro thing have turned into significantly simpler. This module deals with the rule of Hall-effect, which was found by Dr.Edwin Hall. Concurring his standard, when a current conveying conductor is put into an attractive field, a voltage is produced over its edges opposite to the bearings of both the current and the attractive field. Let us not get too profound into the idea but rather, basically put we utilize a lobby sensor to quantify the attractive field around a current conveying conductor. This estimation will be as far as millivolts which we called as the lobby voltage. This deliberate corridor voltage is relative to the present that was moving through the conductor. The real favourable position of utilizing ACS712 Current Sensor is that is can quantify both AC and DC current and it likewise gives seclusion between the Load (AC/DC load) and Measuring Unit (Microcontroller part). As appeared in the image we have three sticks on the module which are Vcc, Vout and Ground separately. The 2-pin terminal block is where the current carrying wire should be passed through. The module work on +5V so the Vcc should be powered by 5V and the ground should be connected to Ground of the system. The Vout pin has an offset voltage of 2500mV, meaning when there is no current flowing through the wire then the output voltage will be 2500mV and when current flowing is positive, the voltage will be greater than 2500mV and when the current flowing is negative, the voltage will be less than 2500mV.We will be using the Analog pin of Arduino to read the output voltage (Vout) of the module, which will be 512(2500mV) when there is no current flowing through the wire. This value will reduce as the current flows in negative direction and will increase as the current flows in positive direction. The below table will help you understand how the output voltage and ADC value varies based on the current flowing through the wire.

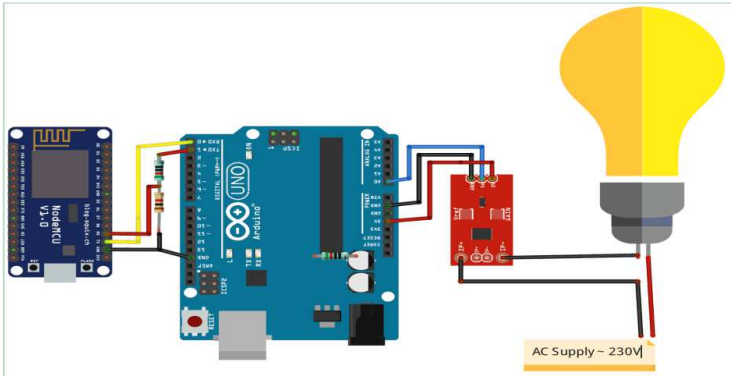

FIGURE.1 Circuit Diagram of Current Monitoring System

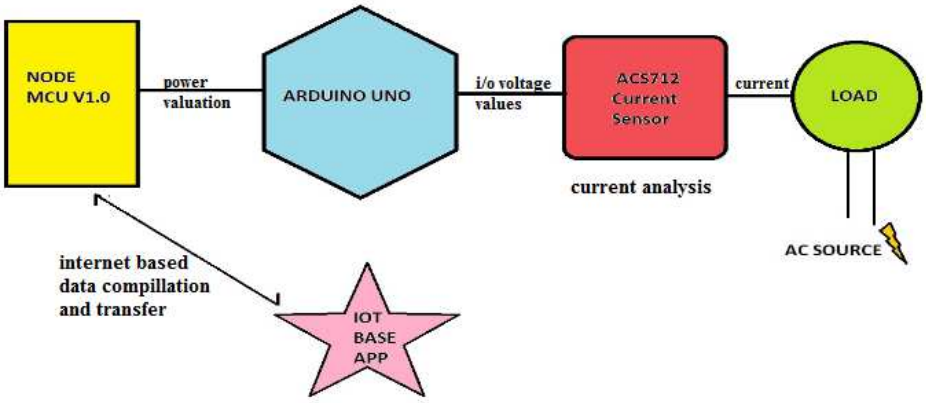

FIGURE.2 Flowchart of current monitoring system

Analog Value	Vout in mV	Current	Power Consumed
1023	5000	13.5135135	1
800	3190.06843	7.62199149	0.8
700	3421.30987	4.98005337	0.87
512	2502.44379	0.01320969	0.55
300	1466.27566	-5.5876899	0.32
301	1471.16325	-5.5612798	0.2
0	0	-13.513514	0.011

TABLE.1 Observed Data

FIGURE.3 Current usage Vs Time

FIGURE.4 Power usage Vs Time

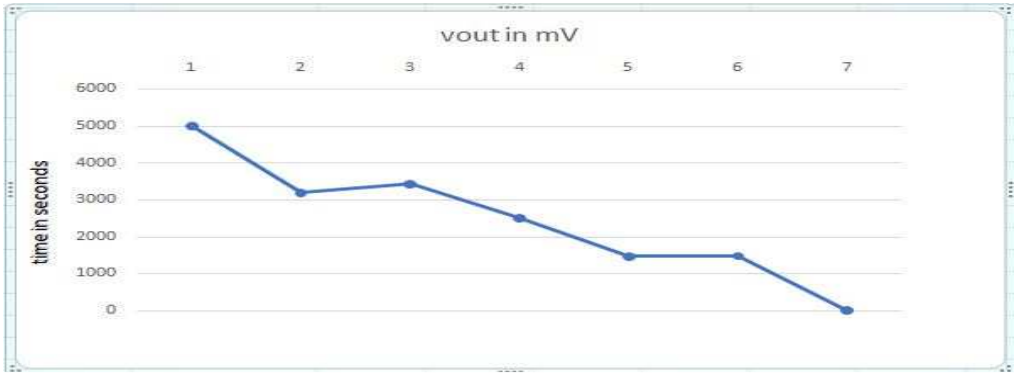

FIGURE.5 Voltage output Vs Time

Figure-1 shows the circuit diagram of current monitoring sensor which helps to monitor what and how our framework works.Figure-2 shows flowchart of current monitoring system that means how to monitor the current in our framework.Table-1 shows how efficiently observations are observed which are found much less than that of electric meter that we are using now.Figure-3 shows the variation between current and time which decreases and at a certain time it becomes zero which is energy efficient.Figure-4 shows the variation between power and time, it is energy efficient it will consume less power.Figure-5 shows the variation between output voltage and time. Thus, we come to know that the output voltage decreases with respect to time and it signifies the loss of current is minimised.

From the above observation and graphs, the energy usage for a certain time of interval can be monitored (i.e., 5 sec). As in India power cut off is a most common problem so it can be solved by our framework. It shows most minimise energy usage per unit but previously it used to show higher then what we are using now-a-days.

III. Conclusions and Future Work

In this article, we have worked on Real Time Electricity Monitoring System Using Internet of Things (IoT). While doing this type of framework, we have a single moto that is to monitor the electric usage and how to minimize the day-to-day electric usage. So, it can be very much beneficial to the middle-class peoples as they can monitor their unit cost of one hour or of full day. The implemented result shows that the consumption of energy, which is calculated by the meters we are using now, the meters that we have made consumes less energy. In future, self-made and owned cloud server which will help in input-output operation for the electricity monitoring system in IoT. Now currently we are depending upon the ada-fruit and IFTTT for input output operations. We will be also providing our own web-based client which will be accessible to both service provider and costumer.

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