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Prepaid Energy Meter Using IOT

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Abstract— *the need of advance technology and our dependency on the electrical appliances is gradually increasing. The use of electricity and its demand also increasing rapidly. This project presents a device that uses the Internet of Things (IoT) technology to design and implement IoT based prepaid energy meter which is also referred as smart meter. The measurement of energy and its billing is automated. The system employs the ATMega328p and ESP8266 for operation as dual core microprocessor unit where one core is used for energy sensing and measurements, while the other handles the network connectivity, storage of data, calculations and overall system performance. The main aim of the project is to make a compact system which will help in reducing the usage of electricity and bring transparency between the electricity providers and the customers. This meter needs to be recharged as similar to a mobile phone. Web portal designed for the payment of recharge. Customer can be able to see the usage of energy and the balance left in the web portal through their respective devices.*

Keywords— Digital energy meter, Web portal, Internet of Things, ESP8266, ATMega328p.

I. INTRODUCTION

The Internet of things (IoT) is just taking all the things in the world and connecting them to internet. It generally uses wifi module which is based on microprocessors. It comprises of the objects which gathers and shares the information to the remote system.

The demand for wireless based gadgets which work on Bluetooth, radio frequency, embedded system is increasing in day to day life. In that IOT technology has been developed recently and presently it is widely used. The electricity plays an important role in our life. Since the consumers are increasing rapidly now-a-days, it becomes very hard to meet their electricity requirements. It is impossible to survive without electricity and also it is important to save the energy losses and make it minimum. The consumer requirements also increases as the generation increases, so the technology should be improved. So we developed the system which is faster and advanced that runs on IoT. The electricity also contains some issues like Transmission, generation and distribution of electricity include the loss of electricity. To prevent the losses of energy, we need to monitor the consumption of energy and its losses, so that we can efficiently utilize the generated energy. Tempering the meters is a part of power theft and also it is illegal crime which has to be reduced. In billing process, the human operator goes to each and every consumer's house to take meter readings and providing them bills which takes a lot of time, cost and human labor. To solve these problems we have developed the system on the basis of IOT energy meter reading.

IOT based energy meter reading consists of three parts: Metering Unit, Communication Unit and Management Unit. Further, Metering Unit consists of two parts: Sensing Unit and Control Unit. Control Unit plays a major role in the system. The information is processed in this controller and can be sent to the other part of the system. It also stores the information in it. Communication Unit performs IOT operation in accordance with the Arduino controller. The monitoring of the meter is done with the help of Management Unit.

II. CURRENT SCENARIO AND PROBLEM DESCRIPTION

Distribution and maintenance of electricity is owned by local state electricity board. Electricity usage of a user is calculated by calculating KWH electricity used over the period of a month. This reading is stored locally on the meter. A worker from the electricity board takes this reading by visiting door-to-door and manually notes it. This data is then forwarded to the head electricity board for evaluation, after evaluation bill is generated on the basis of the readings taken on monthly basis. These generated bills are again sent door-to-door by members of workforce. Then the recipients pay their bills by their favorable payment option. This process consumes a lot of time and human efforts and bill is totally dependent on the reading of the

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workers. Also there is wastage of paper for printing the bills. So, whatever reading for a customer the worker takes, customer needs to pay for it and because of the post-paid method of payment for the electricity many users use electricity in very inefficient manner and sometimes they don't even pay for months. This results in loss to the electricity board and loss of electrical energy as well.

III. BLOCK DIAGRAM

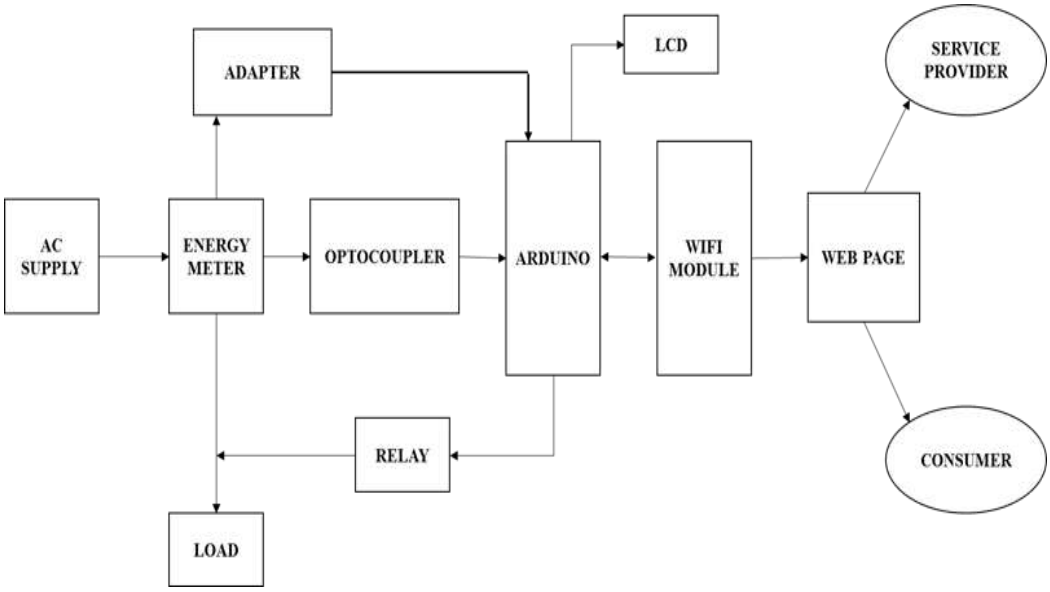

FIG. 1 Block Diagram

Prepaid Energy Meters continuously monitors and send the feedback of data to the customers. This device will be installed by electricity board. At the time of installation of this device, staff will generate a unique identification number for device. Staff will then embed this number into the device and will also create a user account for the customer containing customer name, email, mobile number and address. The newly created device and user will be linked together. After successful installation of device and verification of the user details, customer will be provided with a password for checking status of their device with the help of email provided by the customer. Now the device is ready to be used. User needs to recharge this device from a web app designed for this device in order to continue supply of electricity. If the balance of this device becomes zero, this will stop the supply of the electricity.

Electricity usage of customer will be sent to the server after a set time interval. Customer will then be able to log into their account from the web page and will be able to check their real-time electricity usage. This system aims to bring transparency of billing and usage between the customer and the electricity board. Customer will use less amount of electricity because of the prepaid nature of the billing system. Because of the psychological fact that if we pay for a resource before actually using it, we end up using less amount of resource as compared to post-paid method of payment. As a result, all the customer bill accounts will be cleared at the time.

IV. WORKING

Working of this device is based on the technologies like prepaid meter and Internet of things. This meter will be connected to Arduino UNO (A System on Chip Wi-Fi module). This Arduino UNO will be connected to local Wi-Fi access point. Every Arduino UNO will have a unique identification number, at the time of installation of this device, staff of the electricity provider will assign this device identity to user of that meter. This device needs to be recharged with some amount of money through the web portal of this device. This device will measure the electricity units on the blinking pulse rate of the LED of the meter and only allow the electricity to pass through if balance of that device is not zero. This device will be connected to a server through

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MQTT protocol (Message Query Telemetry Protocol). Arduino UNO will be programmed such that it will send usage hourly to the server. Server will store all the incoming messages in database. This device will be connected to the electric meter via a circuit that will connect a GPIO pin of this device to the kWh pulse LED. Usage of electricity will be calculated on the basis of the KWH PULSE LED blinking. Each 3200 times a LED blinks 1 unit of electricity will be added to the usage and cost of that 1 unit will be deducted from the device, which will be updated onto the server in real time with the help of MQTT protocol. In order to have successfully transition of data working internet connectivity is required via Wi-Fi access point. If no internet connection is available at the time of operation data will be stored locally and will transmit the data whenever internet connection will be available.

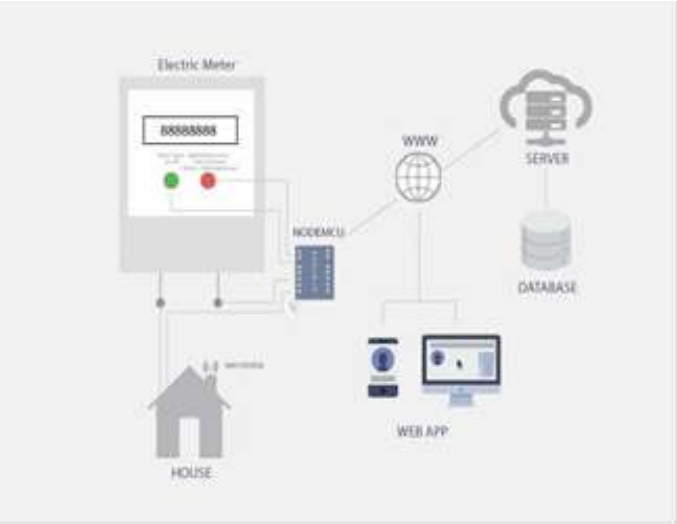

FIG. 2 Architecture of Smart Energy meter based on Internet of Things

V. CIRCUIT DIAGRAM

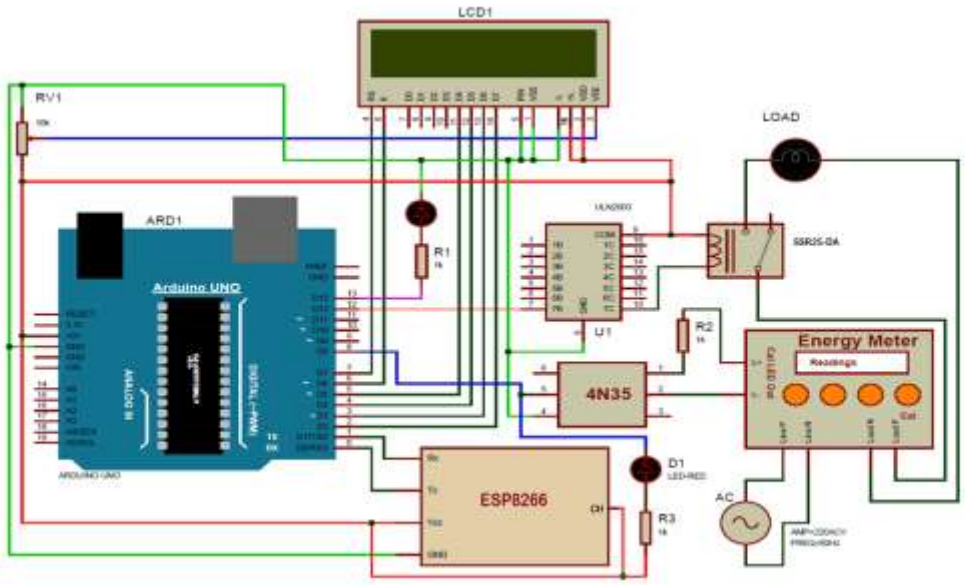

FIG. 3 Circuit Diagram

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VI. COMPONENT

6.1 Arduino Uno

FIG. 4 Arduino Uno

Arduino UNO is based on ATmega328P. It is a micro-controller board. Board consists of 14 pins which is used for input and output of the data. Out of which 6 input pins of Arduino are used as PWM outputs, analog inputs uses 6 pins. It consist of a quartz crystal micro-processor of 16MHz and also has USB connection, a power supply input, an ICSP header and reset button. USB connection is used to connect the Arduino to computer to get start. We can give the power supply to it with the help of AC to DC adapter. We can also use the batteries to get started. Arduino UNO board doesn't use FTDI USB to serial driver chip in comparison with other boards.

6.2 WIFI ESP8266

FIG. 5 Wi-Fi Module

Wi-Fi module ESP8266 is a micro-controller chip which consist of TCP/IP stack. The main importance of Wi-Fi module is it performs IOT operation for our project. It is connected to Arduino with the help of serial bus.

6.3 LCD Display

FIG. 6 LCD

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A 16X2 LCD is connected with Arduino to display the energy meter readings, availability of balance, etc.

6.4 Relay

FIG. 7 Relay

A relay is an electrical device that uses an electromagnet to move the switch from the off to on position or vice-versa instead of a person moving the switch. It requires relatively small amount of power to turn on. But the relay can control something that draws much more amount of power in comparison to it.

6.5 Optocoupler

FIG. 8 Optocoupler

Optocoupler is a device which transfers electrical signals between two isolated circuits by using light. It protects against high voltages from affecting the system receiving the signal.

VII. FLOW CHART

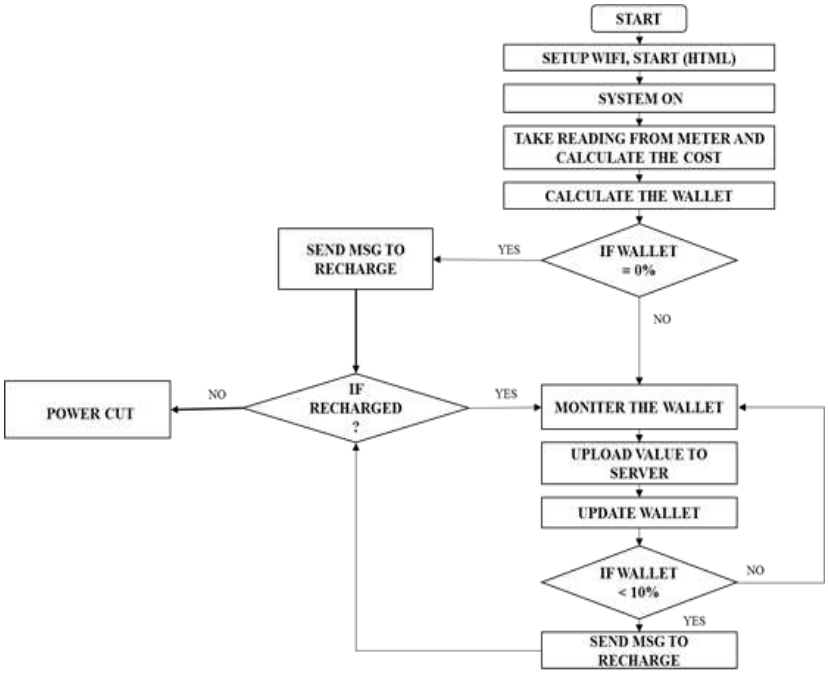

FIG. 9 Flow chart

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VIII. ADVANTAGES

1. Provides security
2. Saves power and time
3. Highly reliable
4. Recharge anytime
5. Track Energy Usage.

IX. CONCLUSION

The project is mainly concentrated on IOT network. We convert conventional energy meter which is electromagnetic into a digital meter. We are taking automatic reading and also connection and disconnection of meters is done using Arduino with the help of relay. So meter reading has become faster. The customers as will be using the information as per their requirements and they will be having freedom to check the bill, when the meter has been connected and disconnected before the due date. All the information will be displayed by using web portal. Finally concluding our project that we have read the meter bills which also be uploaded on the website using IOT concept.

X. FUTURE SCOPE

The project mainly aims to provide the overall infrastructure of the energy meter presently used. The main improvement for the future is going to make energy meter readings and connection and disconnection and also the pre information providing to the users all is going to happen on Wi-Fi internet. And the overall improvement information will be providing to the energy meter will be easy for them to handle the things. Also in future we can go with some standard apps or standard tools, where in which it makes work easy for energy meter people by reading the meter readings faster than the fastest method. The connection and disconnection of every meters on payment and on nonpayment will be fast as compared to the present method. Software can be modified to view balance on request as well as improve billing system and collection efficiency. We can also provide the customers with the different packages and discounts to lower the consumption of electricity.

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