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IOT Based Smart Energy Meter Monitoring and Controlling System

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ABSTRACT:

In the present billing system the distribution companies are unable to stay track of the changing maximum demand of consumers. The buyer is facing problems like receiving due bills for bills that have already been paid also as poor reliability of electricity supply and quality albeit bills are paid regularly. The remedy for of these problems is to stay track of the consumers load on timely basis, which can held to assure accurate billing and if consumer not paying energy charges for what electricity they have consumed then we can control/cut-off electricity supply from distribution company. These are all the features to be taken under consideration for designing an efficient energy system.

The present project "IOT Based Smart Energy Meter" addresses the issues faced by the distribution companies. The paper mainly deals with smart energy meter, which utilizes the features of embedded systems i.e. combination of hardware and software to implement the desired functionality. With the utilization of SERVER & Wi-Fi modem, the buyer also as the service provider will get the used energy reading with the respective amount, Consumers will even get a notification, once they are close to reaching their threshold value, that they need set. Also with the assistance of the Wi-Fi modem, the buyer can monitor his consumed reading and may set the edge value through the webpage. This technique enables the electricity department to read the meter readings monthly without an individual visiting each house. This will be achieved by the utilization of a Node MCU unit that continuously monitors and controls, records the energy meter reading in its permanent (non-volatile) memory location. This technique continuously records the reading and therefore the live meter reading is often displayed on the webpage to the distributer for the asking.

KEYWORDS:Smart Energy Meter (SEM); automatic meter reading monitoring& Controlling; Internet of Things (IoT); Wi-Fi Modem; Node-MCU; Voltage Regulator; Rs485 & Rs232;

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I. Introduction

The electricity has become an integral part of human life. Therefore, its distribution and management have top priority in government policies globally. However, recently, its demand is increasing day by day which results in the formation of the latest technologies. Aside from electricity generation, automation into the energy distribution, control, and monitoring also are needed to enhance. Therefore, the installation of electronic type digital meters is one of the important steps of utilities towards automating the metering process. But its reading method remains a sort of a traditional meter reading process that's based upon Electronic Energy Meter. The internet of things (IoT) may be a network of varied interconnected devices that will exchange data over the web with the assistance of a cloud server. The aim is to use the prevailing internet infrastructure to enhance efficiency, accuracy and economic benefit additionally to reduced human intervention. When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of cyber-physical systems, which also gives birth to new technologies like smart grids, virtual power plants, smart homes, intelligent transportation, and smart cities.

The world is changing towards automatic wireless technologies, which prefer not only reducing human efforts but helps in making systems automatic and efficient. A system is claimed to be intelligent when it can decide what to try to with none instruction and may work automatically. An Electric or Energy meter measures the entire electricity in units employed by the appliances which consume electricity from the most power supply. Electromechanical and Electronic meter are two sorts of meter Available within the market to live the unit consumption.

II. Problem Statement

The traditional system requires a person to visit the site and take picture of the meter to record the actual reading for billing. It is an inconvenient solution in this age of technology. Hence, there is requirement for real-time monitoring of electrical data consumption and same person go for cut-out the supply when consumer had not paid the electricity bill. It this case person has go area by area to cut-off the energy meter/supply.

III. Working

Existing systems use the traditional methods to record the meter reading i.e. a person visits the site and clicks the image of the energy meter. While most of the conventional energy meters are replaced by the electronic energy meters, there is no connectivity between the Electricity Board and the Consumer Energy meter. This project will ensure that the monitoring and controlling of energy meter will be made easier through an Internet connectivity with the help of a cloud server.

The electronic energy meters can be made ‘SMART’ by using this technology and requires very little additional investment. Hence, making it an affordable solution for both the provider and the consumer.

The System consists of hardware and software part. The hardware parts, shows the diagram of energy meter project that the Distribution Company can monitor their home current power consumptions anytime and anywhere. For the software part, all the

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program located in Arduino UNO, using C language. Arduino UNO, because the main controller, connect energy meter, GSM module or Node MCU, and other sensors/peripherals in order that they can communicate one another. And Arduino UNO can only work after we uploaded the designed program into it. The actual Block Diagram of the construction of the project as shown in (figure 1).

While the modern smart meters are coming with inbuilt IP connectivity, the regular multi-function meters have RS232 communication capabilities. However, since the IP based meters of latest technology a majority of existing buildings already have the multi-function meters and hence it's needed to examine how to extract data from them. Further there is an advantage of RS232 over Ethernet. Note that RS232 is one among the foremost optimal communication media for facility networking, as against Ethernet where many UTP cables and switching hubs need to be deployed. A multi-function meter installed in electric panel room (of households, industries and practically any other commercial buildings utilizing electrical energy) measures various electric parameters like line voltage, current, frequency, power factor, power consumed, energy consumed.

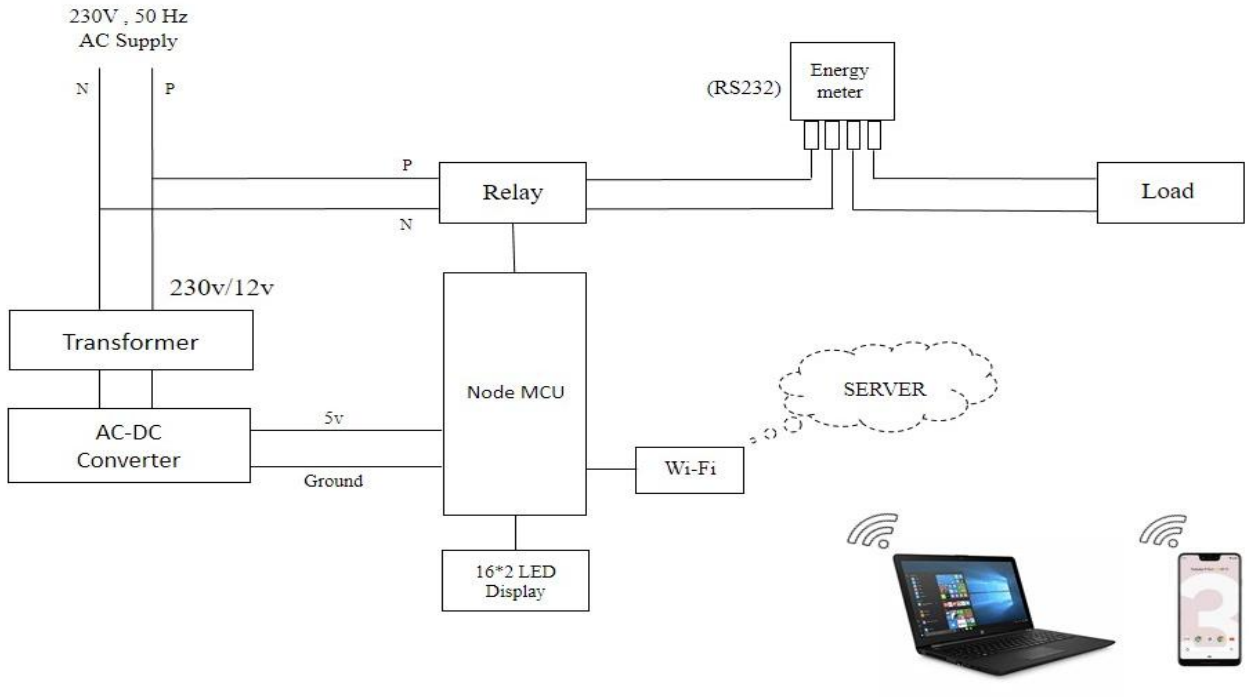


Figure 1:- Block Diagram

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We can fetch the smart energy meter reading with the help of RS232 communication technology we can take meter reading into microcontroller for that purpose we have to convert meter output (RS232) into USB Type-A for this we have to connect the RS232 to USB-A converter. As shown in below.



Figure 2: Energy Meter to Microcontroller

After taking that reading into the Microcontroller the captured data the transferred through the Node MCU Wi-Fi ESP8266 to Receiving site (Personal PC or Computer & Android/IOS Mobile, from receiving site means from Distribution Company we can cut-off the power supply.

i. Energy Meter

The present project "IoT Based Smart Energy Meter" addresses the issues faced by both the consumers and therefore the distribution companies. The paper mainly deals with smart energy meter, which utilizes the features of embedded systems i.e. combination of hardware and software so as to implement desired functionality. The paper discusses comparison of Arduino and other controllers, and therefore the application of GSM and Wi-Fi modems to introduce 'Smart' concept. With the utilization of GSM modem the buyer also as service provider will get the used energy reading with the respective amount, Consumers will even get notification within the form text through GSM once they are close to reach their threshold value, that they need set. Also with the assistance of Wi-Fi modem the buyer can monitor his consumed reading and may set the edge value through webpage. This technique enables the electricity department to read the meter readings monthly without an individual visiting each house. This will be achieved by the utilization of Arduino unit that continuously monitor and records the energy meter reading in its permanent (non- volatile) memory location. This technique continuously records the reading and therefore the live meter reading are often displayed on webpage to the buyer for the asking. This technique can also be wont to disconnect the facility supply of the house when needed.

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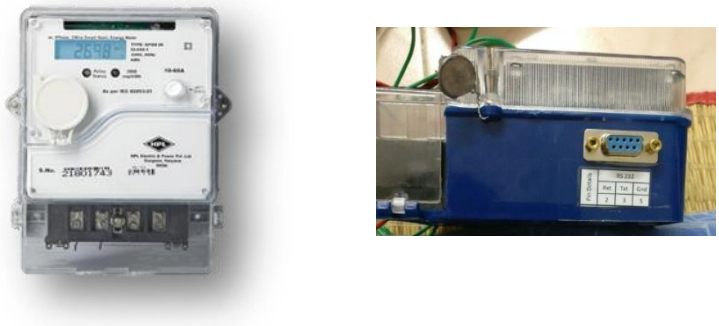


Figure 3:- Energy Meter

ii. **Arduino**

The receiving side contains a laptop or a smartphone that will allow access to the cloud server in order to see the monitoring parameters and the state of devices. In case a fault occurs on the sender side, the receiver will be notified with a notification on the device using as long as the client is logged in with the unique id.



Figure 4:- Arduino

iii. **RS232 to USB type A**

This USB to Serial converter allows you to attach an RS-232 serial device like a Smart Energy Meter to a USB port on your desktop or laptop. RS-232 Serial Connector. Connect RS-232 serial devices like Smart Energy Meter and network switches using the widely supported USB standard found in most laptops and desktops today.

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Figure 5:- Rs232 to USB Type A

IV. Literature Review

Existing systems use the traditional methods to record the meter reading i.e. a person visits the site and clicks the image of the energy meter. While most of the conventional energy meters are replaced by the electronic energy meters, there is no connectivity between the Electricity Board and the Consumer Energy meter. This project will ensure that the monitoring and controlling of energy meter will be made easier through an Internet connectivity with the help of a cloud server.

The electronic energy meters can be made 'SMART' by using this technology and requires very little additional investment. Hence, making it an affordable solution for both the provider and the consumer.

V. Requirements

a. Software Requirements

i. Operating System: Windows XP Professional or Above
ii. MIT App Inventor.
iii. Arduino IDE.
iv. Blynk Software: Android 4.1.1 or above
v. Modbus software Android/MacOS

b. Hardware Requirements

i. Node MCU (ESP8266) Wi-Fi module

The prototyping hardware is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially was based on the ESP-12 module of the ESP8266, which is a Wi-Fi integrated, widely used in IoT applications.

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Figure 6:- Node MCU ESP8266

ii. Arduino UNO Micro- controller



Figure 7:- Arduino

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits.The receiving side contains a laptop or a smartphone that will allow access to the cloud server in order to see the monitoring parameters and the state of devices. In case a fault occurs on the sender side, the receiver will be notified with a notification on the device using as long as the client is logged in with the unique id.

iii. LCD Display

Liquid crystal display (LCD) which has size of 2x16. I.e. two lines each with 16 characters. The LCD has been utilized in 8 bit mode i.e. 8 data lines are required. Aside from 8 data line one RS, one RW & one enable line is additionally required. The RS line is employed to pick whether the info or instruction is being transferred between the controller and therefore the LCD. The RW line is employed to point if data is read from the LCD or written into the LCD. The RW pin is pulled low when data is being sent to the LCD. The enable pin is essentially a latch pin which tells the LCD that the info is out there on the info lines. The resister R7 is employed to line the intensity of the BACKLIGHT.

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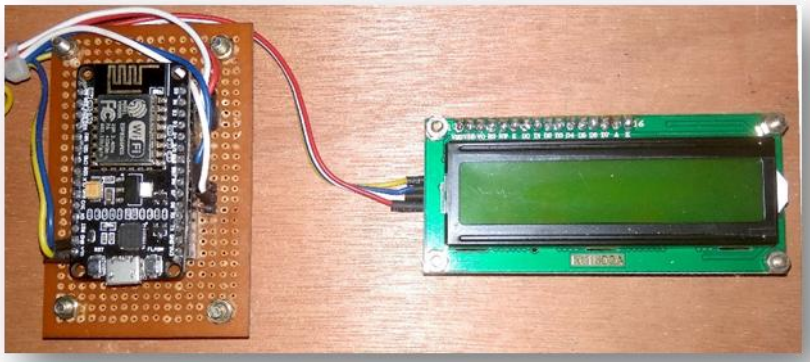


Figure 8:- LED Display

VI. Results

i. When circuit in working condition.





Figure 9:- LED Indication

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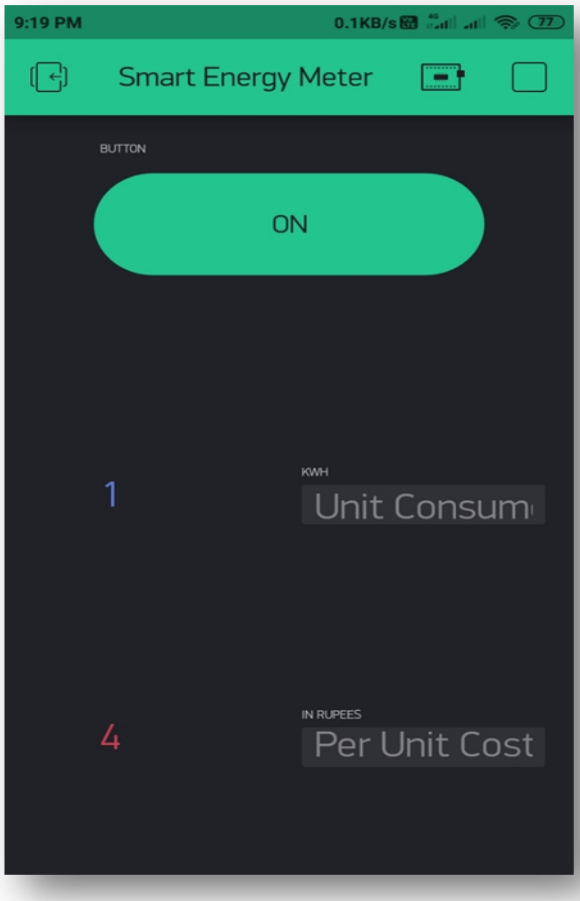


Figure 10:- Receiving Site

ii. After cutting consumer circuit from Distribution Company.



Figure 11:- LED Indication

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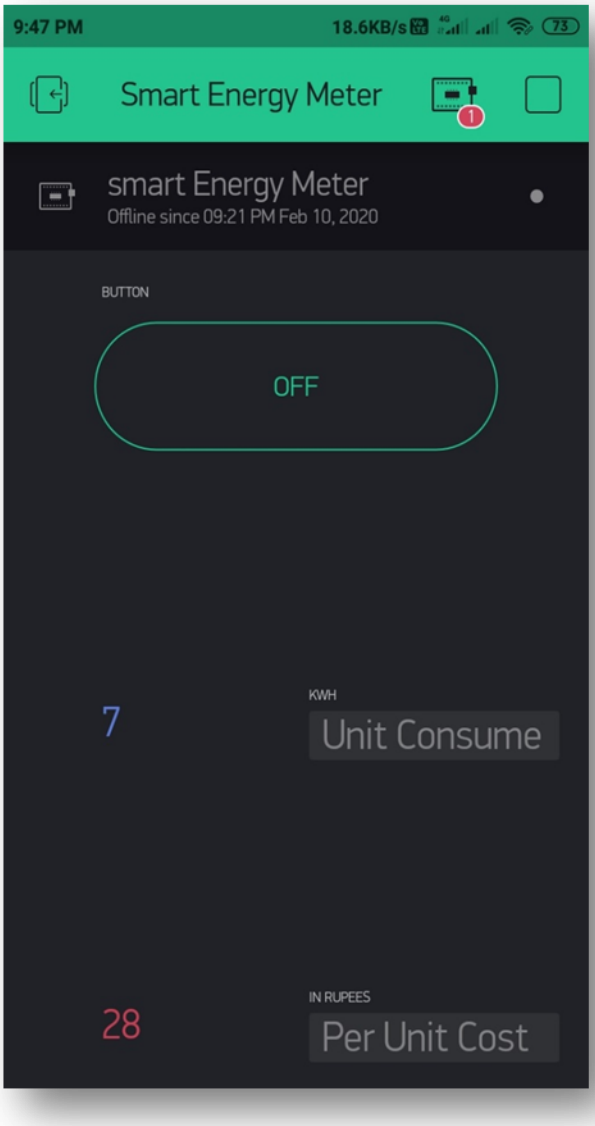


Figure 12:- Receiving Side Cut-off Structure through mobile App

VII. Advantages

i. There is no need of human operator to go to the consumers address to take down the reading or for disconnect the energy supply if consumer has not pail energy charges. Hence extra labor cost is reduced.

ii. Electricity providers can offer new schemes on usage of electricity.

iii. The Distribution Company can monitor the usage remotely.

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VIII. Disadvantages

i. Cost.
ii. Requirement of Auxiliary Supply.
iii. Need of Internet Connectivity in Sender and Receiver side (Distribution Company).

IX. Applications

i. Smart energy meter can be controlled and monitored from directly distribution Company.
ii. This method helps to Monitoring and controlling of Energy meter so it can be Implement in Electric Vehicles Monitoring System.
iii. Smart Energy Meters are already implemented in some states of India so this technic can help to improve Energy Thefts & ETC.

X. Conclusion

We could able to monitor the energy requirements of each consumer with very small time gap. With the easy governance we could able to made decision for the next year power supply requirements according to that only we could able to give the information to generation units to avoid un interrupted power. Policies that are updating by the distribution unit could also be updated with few steps followed through web. Which makes the system up gradation easy.By using IOT in not only industries, but our day to day life, it increases the comfort level and customer satisfaction. It will help accuracy and safety levels. The paper concluded with making the system functionality as user friendly and provide long term product efficiency.

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