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SMART ELECTRICITY METER AND MONITORING USING IOT

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Abstract: In the most of the developing countries, the effort of collecting electricity utility meter reading and detecting illegal usage of electricity is a very difficult and time consuming task which requires a lot of human resources. Energy meter reading and monitoring system using Internet of Things (IoT) presents an efficient and cost-effective way to transfer the information of energy consumed by the consumer as well as it provides facilities to detect the illegal usage of the electricity with the help of wireless communication.

Aim of this study is to measure electricity consumption in the household and generate its bill automatically using IoT and telemetric communication techniques. Also this study aims to detect and control the energy theft. The Arduino microcontroller is employed to coordinate the activities with digital energy meter system and to connect the system to a WiFi network and subsequently to the Internet and Server. It has the facility to disconnect and reconnect the electricity supply automatically. The proposed system is capable of continuously monitor and being notified about the number of units consumed to the energy provider and consumer. The energy consumptions are calculated automatically and the bill is updated on the internet by using a network of Internet of Things. This automation can reduce the needs of the manual labours.

Keywords - Microcontroller, ESP8266 Wi-Fi Module, Energy Metre, IoT, Energy Monitoring

I. INTRODUCTION

To measure the amount of energy consumed by domestic, commercial and industrial users, energy meter is being used. As the population of energy consumers are gradually increasing the smart energy meter helps to ease the energy management system. The paper depicts the solution for reducing human involvement in energy management for the domestic and industrial consumers. All the data monitoring is done via a web based portal provided with a dedicated internet connection. The system has to be made in such a way that the power consumption is analysed properly. Currently the system we use required human involvement which leads to the time consumption also, it has always been a necessity that a particular individual or person from the energy department should visit the consumer house and note down the readings and therefore errors can get introduced .So in order to overcome the stress, smart energy meter is introduced. In this work, the system uses Atmega328p microcontroller because it is energy efficient hence it consumes less power.

The system will combine with the energy meter which is already installed in place of residence. The consumer can easily access the figures of energy meter through a Blynk Application. The distribution companies are unable to keep track of the changing maximum demand of consumers due to this consumer is facing problems like receiving due bills for the bills that have already been paid. So to overcome these problems the remedy

is to keep track of the consumers load on timely basis, which will help to assure accurate billing. By considering the present scenario it is important to build an efficient energy meter.

The present project "Smart Energy Meter and Monitoring Using IoT" addresses the problem faced by both the consumers and the distribution companies. This system make it easier for the electricity department to read the meter readings monthly without a labour work. This can be achieved by the use of Atmega328p unit that continuously monitor and records the energy meter reading in its memory location. The consumers can continuously record the reading and the live meter reading can be access to the consumer on request.

II. LITERATURE SURVEY

Paper No.	Technology	Hardware Devices	Results
[1]	IoT, Cloud Computing, GSM.	LCD Display, ESP8266, Flash ADC. Alert system.	By using Arduino ESP8266 MC, it overcomes the disadvantages in traditional meters also all the details send to the customers mobile through IoT and GSM module.
[2]	IoT, Cloud Computing	OLED Display, ESP8266 12E, Current Sensor	This system provides wireless meter reading system that can monitor and analyze the data at every interval providing accurate results with less error.
[3]	Cloud Computing, Embedded System.	NodeMCU, LCD, ATMega328, Transformer.	This system keep track of unit consumption and accordingly generates bill which can be access by consumer by webpage and consumer can monitor date and bill in the graph on ThingSpeak app.
[4]	Cloud Computing, IoT.	Power Supply, Meter, Relay. NodeMCU	This system provides human automation through an app developed and power management done, also it can receive monthly energy consumption from a remote location directly to centralized office.
[5]	Embedded System, GSM.	Arduino, SMPS Board, PIR Sensor, ESP8266 WiFi Module, AC3712 Current Sensor	The load automatically shut off and message is send to mobile number that we put the code here voltage an current values are constantly uploaded in the ThingSpeak app regardless of weather results an overload occurs.

Prathik et al.,[1]Proposed "Smart Energy Meter Surveillance Using IoT".The proposed system gives information about energy consumption on daily basis, billing and payment through IoT, pre-intimation of shut down details and alert system.

Bibek Kanti Berman et al.,[2]Proposed "IOT Based Smart Energy Meter for Efficient Energy Utilization in Smart Grid " This system has used "ThingSpeak" Application which help us to store, collect, analyze data from arduino and other supporting hardware. At the time of connecting the load, information is transferred to the cloud using Wi-Fi module.

Manisha Tejwani et al.,[3]Proposed "IoT Based Smart Energy Meter Monitoring and Billing System". This system access the energy consumed by the consumer from customer ID also consumer monitor the energy consumed per day and bill get generated on ThingSpeak App. The proposed model used to calculate energy consumption of household.

Nazia Sulthana et al.,[4]Proposed "Smart Energy Meter and Monitoring System Using IoT" The energy meter shows the amount of units consumed and transfers the data to both the consumer and to the electrical board using NodeMCU for data communication.

D. Sai Sowmika et al.,[5]Proposed "IoT Based Energy Monitoring System" Smart energy meter using IoT is designed based on to use the electricity in an optimised manner and reduce the power wastage.

III. SYSTEM ARCHITECTURE

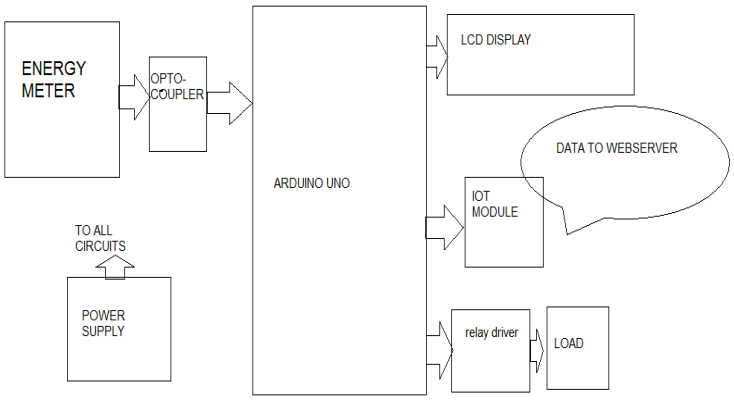

Fig 1 Block Diagram of Smart Electric Meter

ENERGY METER:- Energy Meter is the meter which is used for measuring the energy utilized by electric load. The energy is the total power consumed and utilized by the load at particular interval of time. Traditional Energy meter continuously gives pulse on CAL led placed on it as per consumption by the user or load.It will provide 3200 pulses for 1unit consumed (i.e.1000W). these pulses are in the form of led blinking.

ARDUINO UNO:- The Arduino Uno is a micro-controller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the micro-controller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started."Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0.

IoT MODULE:- The ESP8266 WiFi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller 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 comes with AT commands firmware which allows you to get functionality like arduino wifi shield, however you can load different firmwares to make your own applicaiton on the modules' memory and processor.This module has onboard 80Mhz low power 32 bit processor which can be used for custom firmwares. This also means that you can host small webpages without any external controller. This module ESP01S has 2 GPIOs accessible on pin headers.

LCD 16*2:- The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

POWER SUPPLY:- The input to the circuit is applied from the regulated power supply. The a.c. input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating d.c voltage. So in order to get a pure d.c voltage, the output voltage from the rectifier is fed to a filter to remove any a.c components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.

RELAYS:- Relays are elements connected to the output pins of the microcontroller and are used to turn on/off

all that being out off board which has sensitive components: motors, transformers, heaters, bulbs, high voltage components etc. There are various types of relays but all have same operating principles: when a current flows through the coil, it makes or breaks the electrical connections, between one or more pair of contacts. Relays usually demands both higher voltage and current to start operating but there are also miniature versions which can be activated with a low current directly obtained from a microcontroller port pins.

IV. DESCRIPTION

The technology is getting upgraded every time. As the existing system uses more time consumption every user who is experienced in the existing system thinks of the system which consumes less time and added more flexibility. The proposed system uses Atmega328p microcontroller that can process the impulses taken from the Energy Meter. The consumer's energy meter is monitoring continuously and the number of pulses/units is displayed on the LCD. In the traditional energy meter there is LED which blinks 3200 times I.e 3200 pulses gives 1 unit of power consumption. But for this system 10 pulses gives 1 unit of power consumption, As per this knowledge the microcontroller IC counts the number of blinks and according to the number of units consumed the bill get generated also the real time analysis can be accessed by the Blynk App. It will increase the awareness about the daily consumption of energy.

V. METHODOLOGY

Designing a smart electricity meter and monitoring system using IoT involves a systematic methodology. Initially, you need to plan the project, gather specific requirements, and determine your target audience. Hardware selection is crucial, including microcontrollers, current and voltage sensors, and communication modules. These components must be integrated to collect real-time data on electricity usage accurately. The microcontroller is programmed to process and transmit this data to a central server or IoT platform via various connectivity options. Data storage and management are essential, ensuring data security and redundancy. Building a user-friendly realtime monitoring dashboard is pivotal for user engagement, while data analytics can provide insights into consumption patterns. Robust user authentication and security measures are crucial for data protection, and energy billing can help users manage their usage effectively. Scalability, regulatory compliance, and thorough testing are vital aspects, and once the system is ready, deployment and ongoing maintenance ensure its reliability. User training and support complete the methodology for a successful smart electricity meter and monitoring system using IoT.

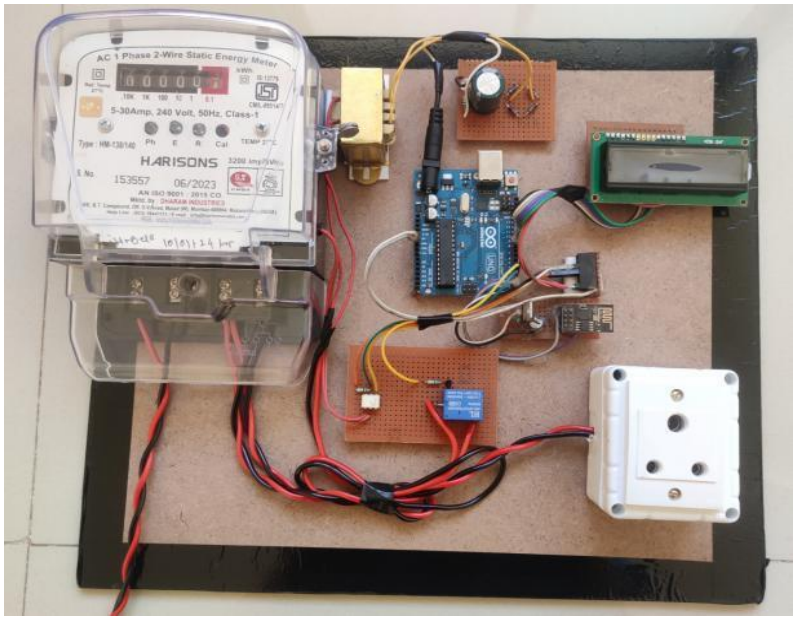

Fig 2 The Proposed System

VI. RESULT

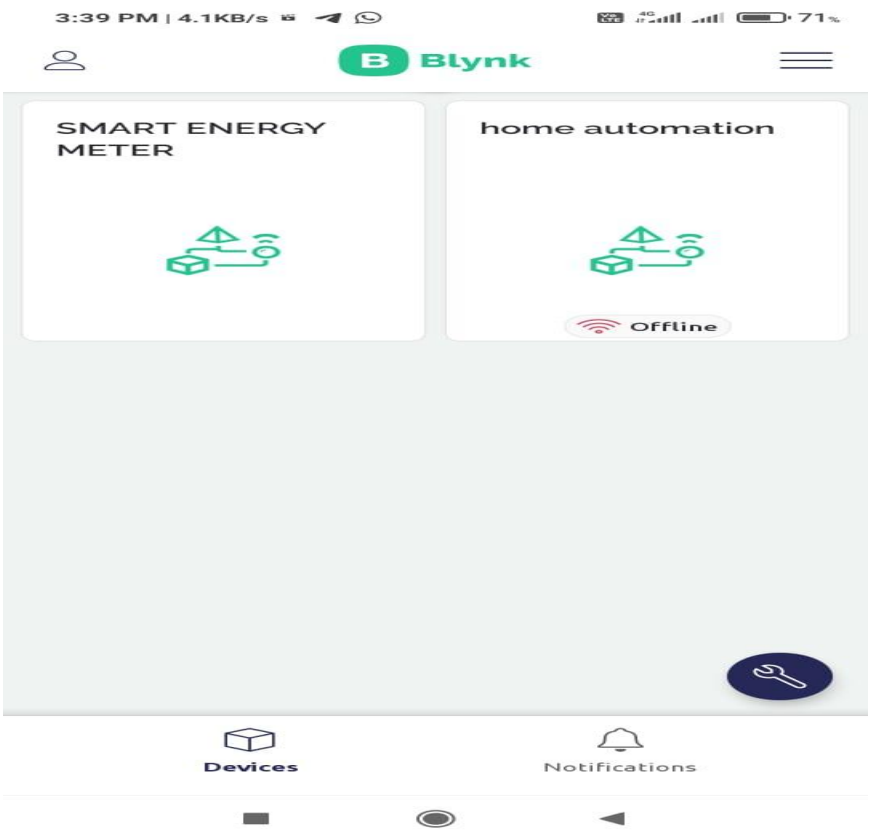

Fig 3 Blynk App GUI

First Login in “Blynk” App Enter the ID followed by password.

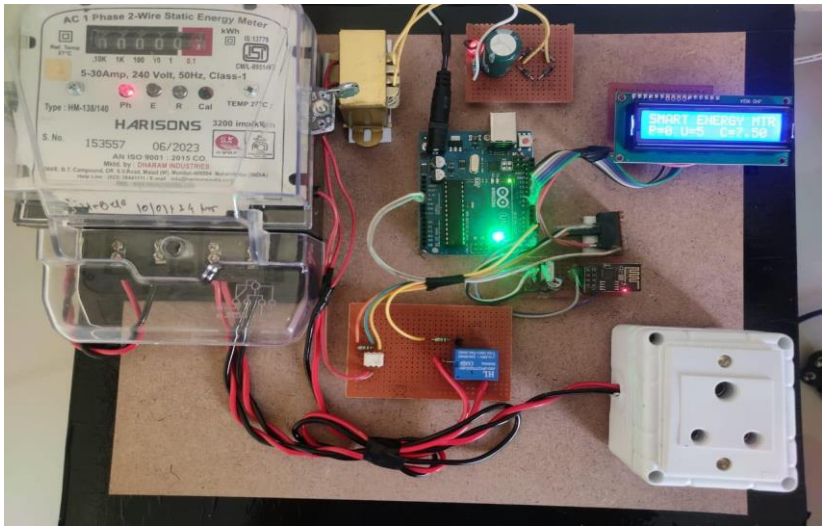

Fig 4 Initial Experimental Setup

Fig 5 The Display of Electricity Consumption

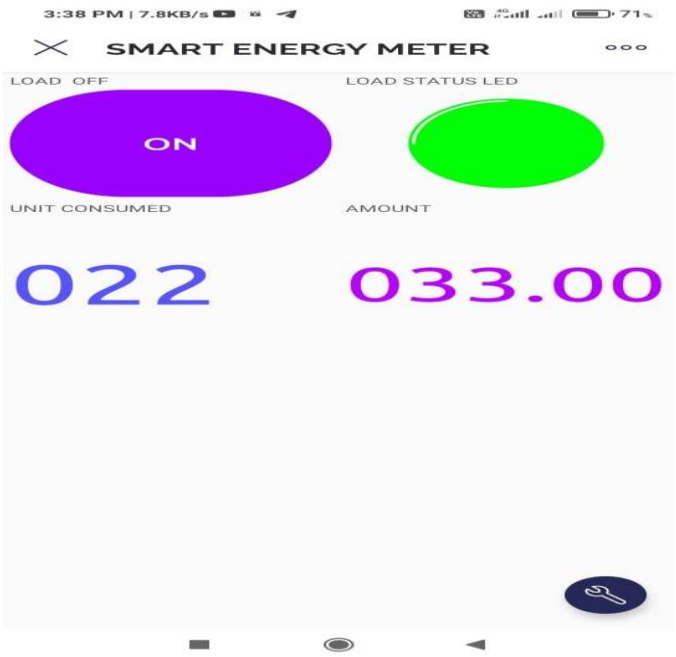

Fig 6 Results in Blynk App

VII. CONCLUSION

An electric meter is a device that measures the amount of electric energy consumed by a residence, a business, or an electrically powered device. Electric utilities use electric meters installed at customer's premises for billing purposes at the end of the month a person from the electricity department has to visit the consumer premises and note down the reading. This system makes troublefree for electricity department to access the energy consumed by the consumer from the customer Id also the consumer monitor the energy consumed per day and every day bill get generated on the webpage. The system reads the data from the energy meter without tampering it, the proposed model is used to calculate the energy consumption of the household. Hence the wastage of energy is less and it also bring awareness among all.

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