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IOT BASED MULTIFUNCTIONING ENERGY METER FOR DOMESTIC LOADS

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ABSTRACT :
A watthour meter, or energy meter, is an instrument that measures the amount of electric power used by the consumer. With millions of energy meters placed worldwide, large-volume meter detection and monitoring of readings are major problems.The implementation of a significant number of energy meters that make use of IOT metering technology is the suggested way to address this issue. In order to transform consumer interaction and energy consumption, this proposal suggests integrating an energy meter with Internet of Things technology into the metering system. Through the use of Internet of Things (IoT) technology, which is renowned for its low power consumption, cost effectiveness, long-range coverage, and efficient penetration, this technology makes it possible to transmit exact and secure data on energy use in real-time to load forecast. In order to measure and detect faults in energy meters for home loads,in this project uses one voltage sensor and a larger number of current sensors,which vary mostly according to the number of households. As a result, the system gets larger, less expensive, takes up less room, and requires labor-freeprocesses for each energy meter's readings. The utility provider can measure system quantities remotely and receive real-time consumption data from the device. By providing users with real-time usage data and guarding against overloaded scenarios, the system also benefits consumers.

Keywords: Energy meters,Internet of Things (IoT), Smart Meter, Load forecasting

INTRODUCTION:
Conventional meters for residential energy consumption are non-experimental A very small dataset is available, which is incapable of capturing the actual behaviour of a larger sample of a population. Consumers trust the utilities more than third-party companies' sales pitches. Hence, the utilities play an instrumental role in raising awareness about consumers' understanding of their energy consumption on a large scale.The introduction of smart meters into the electrical industry has introduced new challenges such as fault detection, non-intrusive load monitoring, occupancy analysis, power quality control, and malicious activities on bidirectional communication. The smart meter is an electronic device used to measure and record customers' electricity consumption data continuously and send the information to the utility provider for billing information. Energy meter digitization enables the implementation of energy-efficient programs and allows household customers to save money by consuming less energy during peak hours. Smart meters have applications to energy metering, peer-to-peer energy trading, bidirectional communication, anomaly detection, load shaping, demand-side management, dynamic pricing, load modelling, and forecasting. IoT-based meters read energy consumption from residential areas or home appliances.
"Smart meters" are based on bidirectional communication technologies. They gather data from the power grid and communicate with all other entities while providing different features to all the players in the energy market.

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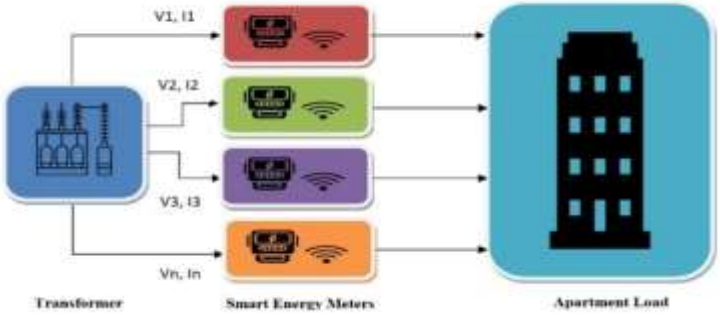

Fig: A schematic diagram of Generalized distributionnetwork subgrid including n energy meters EM1, EM2,…, EMn and equipped

In this article, we will talk about a distributed meter infrastructure that can provide various features, such as auto update and bidirectional communication. This infrastructure can be used to manage smart grids and provide a variety of algorithms for managing them.

LITERATURESURVEY:

"IOT Based Multifunctioning Energy meter for Domestic Loads," which details the development of digital technology and the Internet of Things. A distributed topology that is capable of dynamically absorbing various energy sources is required for the implementation of the future energy grid. IoT may be used for a number of smart grid applications, including demand-side management for electric power, smart meters, power consumption, and many areas of energy production. This article explains the fundamental goal of IOT-based energy metering, which is to monitor environmental factors, gather data on household appliance energy usage, and offer home users with the necessary services.

EXISTINGMETHOD :

As is well known, in the current situation, an electrical system bills and monitors itself using a digital energy meter that is manually operated. The manual method takes a long time and requires human labour to create a bill and keep an eye on it constantly. The goal of this project is to use IoT to construct an energy meter. This system uses IoT to display the current energy use to customers' mobile devices. This method allows us to do away with manual processes, reduce labour costs because no person is required, and operate at a distance, making it highly time-efficient. Energy meters will be used in the present and future when communication technology is used for electricity meters.

Fig: Schematic diagram for proposed model

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PROPOSEDMETHOD:

This proposed IOT based energy meter system is used to automatically measure energy with the help of IoT. The proposed system is cost-effective and compact, so the installment becomes much easier. The IOT-based energy meter consists of the current sensor, voltage sensor,LCD display, ESP32 microcontroller, and Arduino Uno board. The 230 V supply is given to this system as well as the load. The ESP 32 consists of inbuilt Wi-Fi and Bluetooth module. It is a microcontroller that uses the IOT connection for data monitoring. It calculates the current, voltage, and power of the selected load. In this system, ESP32 is connected to a cloud platform named Blynk. Then the consumer can observe the data that is shown in the notebook on their mobile phones or laptops.

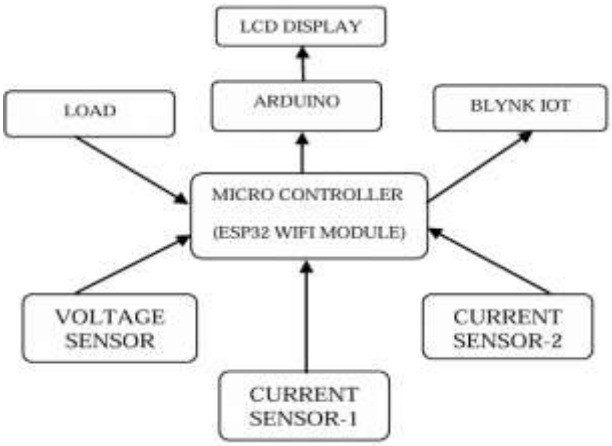

Fig: Block Diagram of IOT Based Multifunctioning Energy meter for Domestic Load

CIRCUIT DIAGRAM:

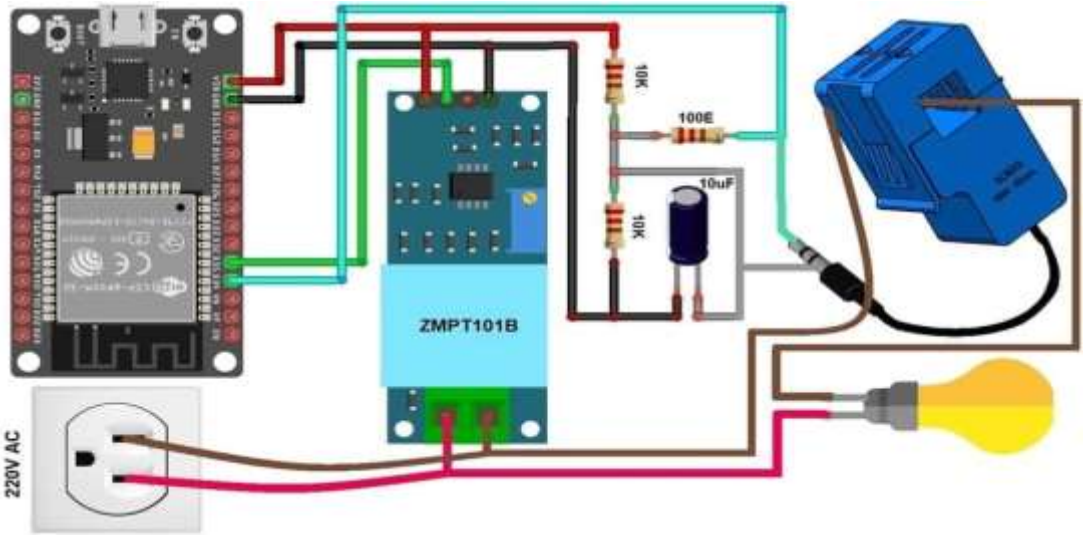

Fig: Circuit Diagram for IOT Based Multifunctioning Energy Meter

HARDWAREIMPLEMENTATION:

1. VOLTAGE SENSOR: Using a voltage transformer, the voltage sensor module measures the precise AC voltage. This is the best option for utilizing an ESP32 or Arduino to measure the AC voltage. The corresponding analog output of the modules may be changed, and they are capable of measuring voltage within 250V AC voltage. Easy to use, the module has a multi-turn trim

potentiometer to calibrate and tune the ADC output.

Fig: voltage sensor

2. CURRENT SENSOR: This device can detect AC current up to 100 amps. Alternating current is measured using sensors called current transformers, or CTs. They are very helpful for calculating the total power usage of a building. There is no need to do any high voltage work when connecting the SCT-013 current sensors directly to the live or neutral wire.

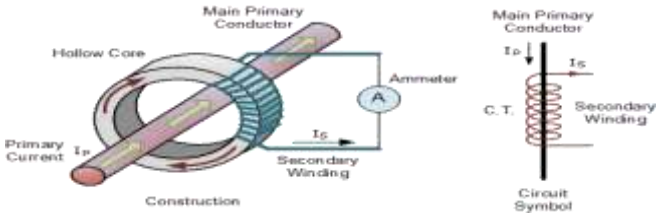

Fig: Current sensorFig: working of current sensor

3. ESP32 WIFI MODULE: This module processes sensor input and sends the required control signals to the peripherals. Using a wi-fi module, it is also utilized to link received data to the cloud. It is employed to establish a network between software and hardware.

Fig:ESP32 WIFI Module

4. ARDUINO UNO: Based on the ATmega328p, the Uno is a microcontroller board. It features six analog inputs, a 16 MHz quartz crystal, a USB port, a power connector, an ICSP header, a reset button, and fourteen digital input/output pins, six of which may be used as PWM outputs. This microcontroller comes with all the necessary components to support it; all you need to do is use a USB cable to connect it to a computer or an AC-to-DC converter or battery to power it.

Fig:Arduino Uno

5.LCD DISPLAY:A 20x4 LCD module has four display rows, with the ability to show twenty characters in a row and eighty characters in a display. This liquid crystal module employs parallel interface with the HDD44780 controller, which is used to show monochrome text displays. To display the relevant information about energy use, an LCD 20*4 display is employed.

Fig: LCD Display

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SOFTWARE IMPLEMENTATION:

1. EmonLib Library: An electricity energy meter uses the Emonlib Library. EmonLib, a Continuous Monitoring of Electricity Energy, repeats a series of voltage and current measurements every five or ten seconds. EmonLib notifies the sketch that the measurements are ready and should be read and processed after continually measuring the voltage and all of the current input channels in the background and calculating a true average quantity for each.

2. Blynk Library: Blynk is the most widely used Internet of Things platform for cloud-based device connectivity, creating apps for hardware control, and scalably managing your deployed items. More than 400 hardware models, such as Arduino, ESP8266, and ESP32, can be connected to the Blynk Cloud using Blynk Library.

Fig: Output in Blynk software

RESULT ANALYSIS:

To verify the accuracy of the system, it was examined under various load conditions and results obtained were compared.

S.No	Load Condition	Voltage in Volts
1.	Under No Load	1.2 volts
2.	R Load	224.25 volts
3.	R-L Load	222.91 volts

Fig: Hardware implementation setup

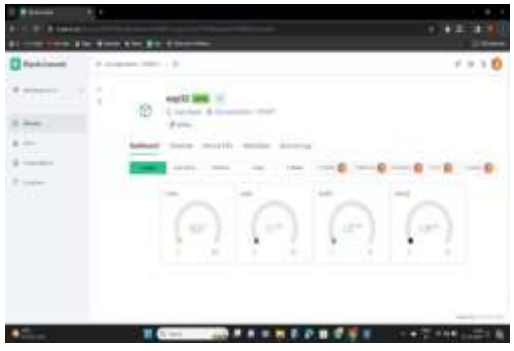

Fig: Energy monitoring using Blynk at No Load

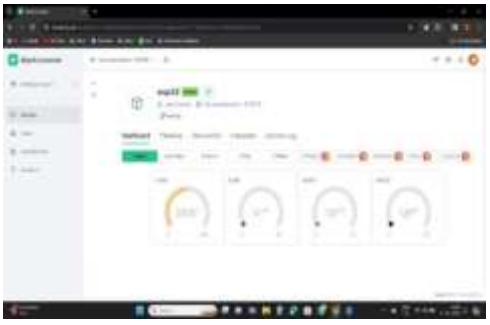

Fig: Energy monitoring using Blynk at R Load

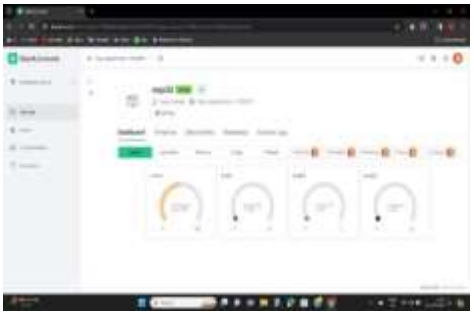

Fig: Energy monitoring using Blynk at RL Load

CONCLUSION:

The aim is to create a user-friendly billing system with least human errors, implementing modern technology. And it is done by using the voltage sensor and current sensor and are used to measure the Electrical Energy consumption. ESP32 is used to connect this data to cloud. And the same data is displayed on LCD through Arduino.

In conclusion,theintroductionofInternet of Things (IoT)-based multifunctional energy meters signals a new era of efficiency, sustainability, and connection in the home energy sector and marks an evolution in the field of energy management. Smart meters open the door to a smarter, more sustainable and more resilient energy future by enabling utilities to optimize network operations and giving consumers the power to take charge of their energy consumption by accessing the transformative potential of IoT technology.

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