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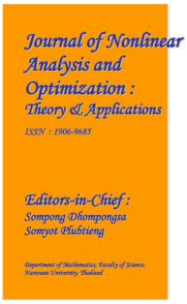

SMART IOT BASED ENERGY METERING SYSTEM FOR MICROGRIDS

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Abstract—
This article proposes an Microgrids offer sustainable energy solutions as alternatives to traditional power networks. At present, the number of smart meter users in the world is still limited. The traditional and conventional utility of the smart meters was mainly to establish a bi-channel communication – one is to provide the billing information of the electricity consumed through GSM modules to the end users and the other is to provide energy data and other related information to the supplying utility. The modifications are made in this project is to avoid two different channels of communication and instead of bi-channel communication it concentrates the entire data into one storage system i.e. a cloud server. The server facilitates both the users and the concerned utility which provides access to the real-time data from anywhere in the world and also an upgradation has been made to automatically detect and protect loads from transients in the line such as overvoltage, undervoltage and overcurrent with a load management algorithm utilizing the features of the smart energy meter IC.

Keywords—IOT, Energy metering, Sensor networks,
Real-time monitoring.

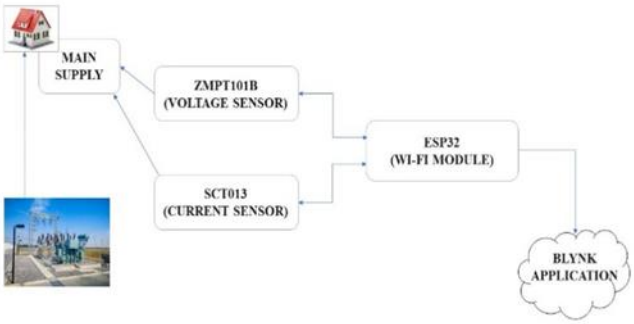
INTRODUCTION:

ESP32-based Energy Metering System : One of the main issues the world is currently facing is the energy emergency. Making efficient use of the energy that is already available is the best solution to this problem rather than producing more energy. Energy emergencies can be somewhat avoided by carefully monitoring our energy usage and minimizing energy waste. However, the main reason energy monitoring is ineffective is that consumers are unaware of how much energy they use.

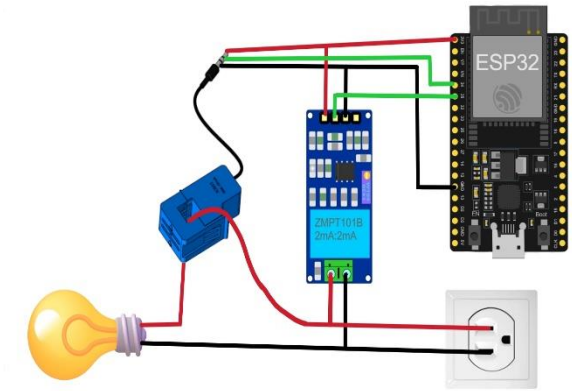
It is only after the electricity bills are sent that they will have a better understanding of their usage. In India, bills are only sent out once every two months or so. Customers will therefore be in the dark during this time. regarding how much energy they use. Nobody will go to the trouble of checking their electricity meter reading and comparing it to the previous reading in this fully digitalized era in order to gain an idea of their consumption. In order to effectively control the energy consumption, this entire process needs to be repeated multiple times each month. If customers could use a laptop or mobile device to check their energy usage instead of an energy meter, It will represent a significant advancement in energy management. Given that the majority of people are now online 24/7, being

able to track their energy usage online from anywhere in the world will be extremely helpful. This paper presents a lot concept-based method for reading electricity energy meters.

BLOCK DIAGRAM:
The block diagram of Energy Metering System: The IOT (Internet of Things) awareness through sensor's is shown in figure 1. The most important part of this project is the measuring load of a house with two different sensors at the same time.
It also provides safety precautions as well as with an indication.
Block diagram illustrating the working of Energy Metering System



CIRCUIT DIAGRAM:



The components used in this paper are as follow:

ESP32(WI-FI Module):
Espressif Systems created the widely used and adaptable ESP32 microcontroller. It belongs to the ESP (Espressif System Platform) family and is renowned for being inexpensive, having minimal power requirements, and having built-in Bluetooth and Wi-Fi. The following are the main attributes and details of the ESP32: Dual-Core Device: The dual-core LX6 microprocessor of the ESP32 enhances performance and multitasking. Wireless Communication: An inherent feature of the ESP32 is its Bluetooth and Wi-Fi connectivity. Because of this, it can be used for a variety of purposes, such as home automation, Internet of Things (IoT) devices, and more. Low Power Consumption: It is appropriate for battery-powered applications because of its energy-efficient design. It has multiple low-power modes to increase battery life.

ZMPT101B(VOLTAGE SENSOR):
A popular voltage sensor module for detecting AC voltage is the ZMPT101B. It is frequently used in a variety of electronic projects, such as automation and power monitoring projects. The following are some of the ZMPT101B voltage sensor's salient characteristics and details: The ZMPT101B is an AC voltage sensor, which means that its purpose is to detect voltages of alternating current (AC).

Measurement Range: The ZMPT101B's standard measurement range is 0 to 250V AC. Output: An analog output voltage that is proportionate to the AC input voltage is typically provided by the module. Usually scaled, the output requires calibration in accordance with the datasheet's specifications. Principle of Operation: The ZMPT101B steps down the input AC voltage with a transformer to a level that can be assessed by the integrated parts. In order to change the AC signal into a DC signal, it frequently has a rectifier and filtering circuit.

SCT-013(CURRENT SENSOR):

Electrical circuits frequently use the SCT-013 type of current sensor to measure alternating current (AC). Since it is non-invasive, there is no need to cut or disconnect the circuit that is being watched over in order to measure current. The SCT-013 current sensor has the following important characteristics and details: Sort: One kind of current transformer (CT) is the SCT-013. Its purpose is to convert a conductor's primary current into a secondary current that is proportionate to the original current. Measuring Range: There are several models of the SCT-013 with various current measurement ranges. There are other variations, but the 5A, 20A, and 100A ranges are the common ones. Non-Occupying Design the sensor's intended use is to clamp around the AC current-carrying conductor. This indicates that installing it is simple and doesn't require cutting or interrupting the circuit. An analog voltage or current signal proportionate to the AC current being measured is usually the SCT-013's output. To obtain meaningful readings, the output must be further processed or interfaced with a microcontroller.

In this paper, we are also using software components:

Arduino IDE

Programming Arduino microcontrollers is done via the software platform known as the Arduino Integrated Development Environment (IDE). It offers an easy-to-use interface for creating, gathering, and uploading code to Arduino devices. Here are some salient characteristics and details regarding the cross-platform compatibility of the Arduino IDE. Many users can access the Arduino IDE because it is available for Windows, macOS, and Linux. User-Friendly Interface the IDE's user-friendly interface makes it appropriate for both novice and seasoned programmers. Code Editor: This code editor facilitates the writing and reading of code by offering features like syntax highlighting, code completion, and auto-indentation. Integrated Examples Many built-in examples in the Arduino IDE assist users in learning how to use various Arduino libraries and functionalities. Manager of the Library Manager in the Arduino IDE makes it simple for users to install and maintain libraries for different sensors, modules, and parts. Monitor in Serial One of the IDE's tools for facilitating communication between the Arduino board and the computer is the Serial Monitor. It is frequently used for Arduino output monitoring and debugging. Manager of the Board the process of adding support for various Arduino-compatible boards is made simpler by the Board Manager. From a list, users can choose the exact Arduino board they're using. Simple Code Upload With just one click, users of the IDE can upload their code to the Arduino board. It seamlessly manages the uploading and compilation process. Integrated Support Links to the Arduino website and useful documentation are provided by the IDE, offering resources for learning and troubleshooting. Accessible Source The source code for the Arduino IDE is open-source and available for customization. This transparency promotes improvements and contributions from the community.

Blynk application

Blynk is a platform that facilitates the creation of Internet of Things (IoT) applications with an emphasis on ease of use and simplicity. With little to no coding knowledge, you can make smartphone applications to manage and keep an eye on your hardware projects. Blynk Application the Blynk app, which is available for iOS and Android, acts as the user interface for your Internet of things projects. With a range of widgets, you can monitor and manage linked devices. Cloud Blynk uses an infrastructure that is cloud-based. The Blynk app and your hardware devices can communicate more

easily thanks to the Blynk Cloud. You can add a variety of widgets from Widgets Blynk to your project to create a unique user interface. Button, slider, display, graph, and other examples are available. Blynk Reference Works Blynk offers its libraries for a variety of hardware platforms, such as ESP32, Raspberry Pi, Arduino, and more. The process of adding Blynk functionality to your projects is made easier by these libraries. Token of Authentication Every project on Blynk has its own authentication token. To establish a secure connection between your hardware and the Blynk Cloud, you'll need this token.

REQUIRED LIBRARIES:

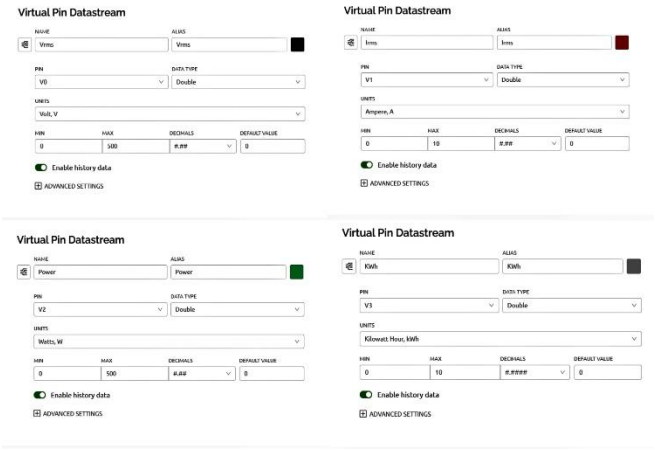
The EmonLib Library:

Energy Meters for electricity are powered by 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 available and should be read and processed after continuously measuring the voltage and all of the current input channels in the background and calculating a true average quantity for each.

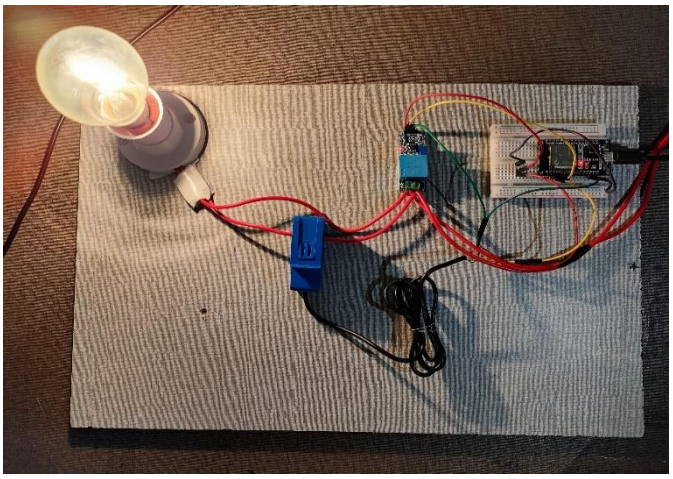
The Blynk Library:

The most widely used Internet of Things platform is called Blynk, and it allows you to connect any kind of hardware to the cloud, create apps that control it, and scale up product management. Connecting more than 400 hardware models, such as Arduino, ESP8266, and ESP32, to the Blynk Cloud is possible with Blynk Library.

Blynk Setup:



PROTOTYPE:



WORKING:

IoT technology and the Blynk platform are combined by a smart IoT-based energy meter with the Blynk application to enable smooth monitoring and control. With the help of sensors to measure electricity consumption, the energy meter sends data to the Blynk cloud over an Internet of Things connection. Users can access real-time energy consumption data by installing the Blynk application on their mobile device. With the Blynk app, users can set thresholds, monitor their electricity usage remotely, and receive notifications. By enabling convenient and effective energy management, the energy meter and Blynk app work together to empower consumers to make informed decisions and encourage energy conservation. By utilizing the Blynk platform's capabilities, this integration improves user engagement and control over energy usage for an easy-to-use and intuitive encounter.

smart IoT-based energy meter with the Blynk application energy meter with Blynk app that is smart and Internet of Things based. Sensors are included in the energy meter to measure things like voltage, current, and power usage. The microcontroller of the device, which has IoT capabilities, then processes these measurements. The energy meter can connect to the Blynk cloud platform thanks to its IoT functionality. Secure real-time energy data transmission requires this connection. Intermediary Blynk platform facilitates communication between the user's Blynk application and the energy meter. To interact with the energy meter, users must install the Blynk app on their mobile devices, which offers an intuitive user interface. Users can set up notifications or alerts based on predefined thresholds, view historical data, and keep an eye on their current energy consumption all through the app.
Users can turn devices on or off, create schedules, and optimize energy usage from any location with internet access by using the Blynk app, which functions as a remote-control center. This integration encourages proactive energy management in addition to providing users with real-time insights into their patterns of energy consumption. By providing users with additional convenience and accessibility, the Blynk application helps them make educated decisions about how much electricity they use, which ultimately promotes sustainability and energy efficiency.

RESULT:

Blynk Application:

Without Load:

The ZMPT101B voltage sensor and SCT current sensor are frequently used in this smart IoT-based energy metering system to measure voltage and current parameters, respectively.

ZMPT101B Voltage Sensor:

Without Load: In the absence of a load, the voltage sensor still measures the supply voltage. It is important to remember, though, that in the absence of a load, noise and fluctuations may have an impact on the measurement's accuracy.

SCT Current Sensor:

Without Load: System noise or leakage currents may cause the current sensor to detect a small amount of current in the absence of a load. Still, the readings are usually insignificant in comparison to those that have a real load.

With Load:

ZMPT101B Voltage Sensor:

With Load: The ZMPT101B voltage sensor measures the voltage across a load when it is connected. Usually, an analog voltage signal proportionate to the measured voltage is produced. The energy meter's microcontroller or processing unit then processes this analog signal to determine the precise voltage value.

SCT Current Sensor:

With Load: The SCT current sensor is clamped around the conductor carrying the current when a load is connected. In proportion to the current passing through the conductor, it generates an analog signal. The energy meter's microcontroller then processes this signal to ascertain the real current.

CONCLUSION:

In conclusion, real-time monitoring of energy consumption through customizable dashboards that give users instant access to critical parameters is made possible by the implementation of a smart IoT-based energy metering system using the Blynk application. Users can keep an eye on and manage their energy consumption from any location with an internet connection thanks to the remote accessibility feature. The dashboards can be customized and provide an easy-to-use interface for displaying different metrics. Blynk's user-friendly development approach guarantees accessibility for both novice and seasoned developers, and its smooth integration with a variety of IoT devices and platforms makes it versatile. In line with industry demands for intelligent and networked solutions, the Blynk-powered system provides an advanced and adaptable energy management solution.

FUTURE SCOPE:

- As of now we have implemented Energy Metering System with Blynk application where we can monitor the energy consumption data in real-time.
- We can extend this project by adding load management algorithms using IOT (Internet Of Things)

Technologies :

✓ Load Balancing Algorithm
✓ Transient Detection Algorithm
✓ Cloud Data Storage Retrieval Algorithm
✓ Billing Information Algorithm
✓ Communication Protocol Algorithm
✓ Security Algorithm

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