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ORIGINAL CONTRIBUTION

IoT-Based Energy Meter for Real-Time Current, Voltage, and Cost Monitoring

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ABSTRACT

Observing and monitoring your power utilization for verification is a not a easy task today since regularly checking the meter room is very tedious task Well, it is very important to know whether you are charged likewise so the need is very sure. Well, we have made a system that allows users to monitor energy meter readings over IOT. Our proposed system utilizes energy meter with microcontroller system to monitor energy utilization utilizing a meter. The meter is used to monitor units consumed, estimated cost, Line Voltage and current consumed. Simple web application named IoT Gecko shows the Live Output of these reading over the IOT.This enables user to effortlessly check the units consumed, estimated cost, Line Voltage and current consumed Live from anywhere through the site. In this way the energy meter observing framework enables client to adequately screen power meter readings and check the charging on the IoTgecko.com effortlessly.

KEYWORDS: IOT, Cost Monitoring System, ESP32, ZMPT101B, SIM800L, LM2596

1. INTRODUCTION

In recent years, the global emphasis on energy efficiency and sustainable practices has driven the development of innovative technologies to monitor and manage energy consumption effectively. One such advancement is the Internet of Things (IOT), which has revolutionized various industries by enabling real-time data monitoring and automation. In the energy sector, IOT-based energy meters have become essential tools for enhancing energy management practices through precise measurement and analysis. The Internet of Things (IOT) refers to the interconnected network of physical objects embedded with sensors, software, and other technologies that enable these objects to collect and exchange data. IOT technology is poised to transform everyday life, providing advanced services across numerous domains, including healthcare, smart cities, agriculture, and, notably, energy management. The "IOT Energy Meter with Current, Voltage, and Cost Monitoring System" is a cutting- edge solution designed to offer real-time insights into energy consumption patterns. This system allows users to monitor electrical parameters such as current and voltage while also providing cost analysis to promote efficient energy usage. The following key components and technologies make this system possible:

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Sensors and Actuators: Sensors in the energy meter detect and measure electrical parameters such as current, voltage, and power consumption. Actuators can be used to control electrical devices based on the data collected, enabling automation and optimization of energy use without human intervention.

Connectivity Technologies: To transmit data from the energy meter to a centralized system or cloud platform, various connectivity options are employed. These include Wi-Fi, Bluetooth, cellular networks, Zigbee, and LoRaWAN, ensuring seamless data transmission and accessibility.

Cloud Computing: Cloud platforms play a crucial role in storing, processing, and analyzing the vast amounts of data generated by the energy meter. Cloud computing provides the necessary infrastructure to handle data storage, analytics, and the deployment of IOT applications.

Big Data Analytics: Advanced analytics tools are employed to interpret the data collected from the energy meter. These tools, including machine learning algorithms and predictive models, help identify usage patterns, forecast energy demands, and suggest optimization strategies.

Security and Privacy Technologies: As the deployment of IOT devices increases, ensuring the security and privacy of the data becomes paramount. Technologies such as encryption, access controls, and intrusion detection systems are implemented to safeguard the data from cyber threats. By leveraging these technologies, the IOT Energy Meter with Current, Voltage, and Cost Monitoring System aims to provide users with comprehensive insights into their energy consumption. This not only helps in reducing energy costs but also contributes to sustainable energy practices by promoting efficient usage and minimizing waste.

OBJECTIVES: The objective of the IOT Energy Meter with Current, Voltage, and Cost Monitoring System is to enhance energy management practices by leveraging modern technology to improve efficiency, monitoring, and cost-effectiveness. Key goals include:

Efficient Energy Management: Monitoring and analyzing energy consumption patterns in real-time to optimize the use of electrical resources and reduce wastage.

Cost Reduction: Providing detailed cost analysis based on real-time data, enabling users to identify and eliminate unnecessary energy expenditures, thereby reducing overall energy costs.

Real-time Monitoring: Offering continuous, real-time monitoring of electrical parameters such as current, voltage, and power usage. This allows for immediate action to be taken in response to anomalies or inefficiencies.

Automation: Integrating automation capabilities to control electrical devices based on data insights, reducing the need for manual intervention and improving operational efficiency.

Data-driven Decision Making: Utilizing data analytics to make informed decisions about energy usage patterns, load management, and future energy needs. This helps in planning and implementing effective energy- saving strategies.

Enhanced Security and Privacy: Ensuring the security and privacy of data through advanced technologies such as encryption and access controls to protect against cyber threats.

Sustainability: Promoting sustainable energy practices by providing tools and insights that encourage efficient energy use, thereby reducing the environmental impact.

Improved Reliability: Enhancing the reliability of the electrical system by identifying and addressing

issues promptly through continuous monitoring and analysis.

These objectives aim to create a more sustainable and efficient energy management system that is well-equipped to handle the challenges of modern energy consumption and conservation.

2. COMPONENTS USED

The key components used in the IOT Energy Meter with Current, Voltage, and Cost Monitoring System are:

ESP32: A powerful microcontroller with built-in Wi-Fi and Bluetooth capabilities. It is responsible for connecting to the Blynk cloud, controlling the sensors, and processing the data collected.

ZMPT101B: A voltage sensor module used to measure the AC voltage of the electrical system. It provides accurate voltage readings that are crucial for monitoring and analysis.

ZMCT103: A current transformer used to measure the AC current in the electrical system. It provides precise current readings that help in understanding the power consumption.

16x2 LED Display: A display module used to show real-time readings of current, voltage, and other relevant data directly on the device for easy monitoring.

1-Channel Relay Module: Used to control electrical devices such as a bulb. The relay module can switch the device on or off based on predefined conditions, such as the balance reaching zero.

SIM800L: A GSM module used for communication. It allows the system to send alerts and notifications via SMS, providing updates on the energy meter's status.

LM2596: A DC-DC buck converter used to step down the voltage to a suitable level for the ESP32 and other components, ensuring stable and efficient power supply.

3. SOFTWARE USED

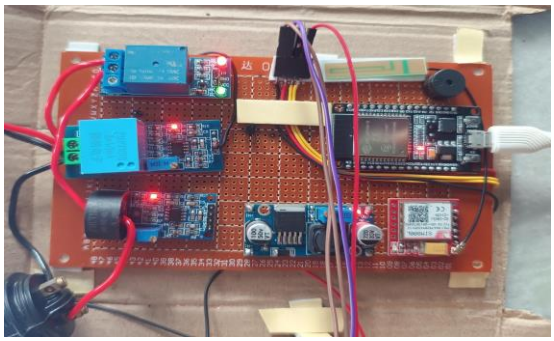
Blynk: Blynk is an IoT platform designed to control hardware remotely, display sensor data, and create automation projects. It provides a user-friendly mobile app where users can monitor and control their projects in real time. Blynk works with a wide variety of hardware, including the ESP32 used in this Energy Meter project include:

Virtual Pins: Blynk allows the mapping of sensor data (current, voltage, and power usage) to virtual pins, making it easy to visualize these parameters in the mobile app.

Cloud Connectivity: It connects the ESP32 to the internet, allowing real-time monitoring and control of the energy meter system from anywhere.

Automation and Alerts: Blynk can automate tasks such as turning off devices when the balance reaches zero. Additionally, Blynk can send notifications or emails when certain thresholds are met, such as high-power consumption or voltage anomalies.

Arduino IDE: The Arduino IDE is a widely used



development environment for programming microcontrollers like the ESP32. It allows developers to write, compile, and upload code to microcontroller boards. Features of the Arduino IDE in this project include:

Code Development: The Arduino IDE provides an easy platform to write and modify the C/C++ code

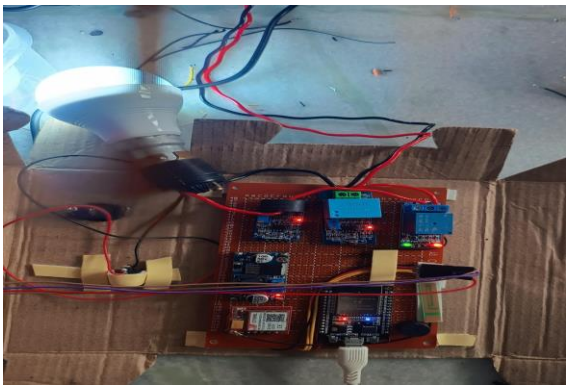
controlling the sensors and actuators in the energy meter system.

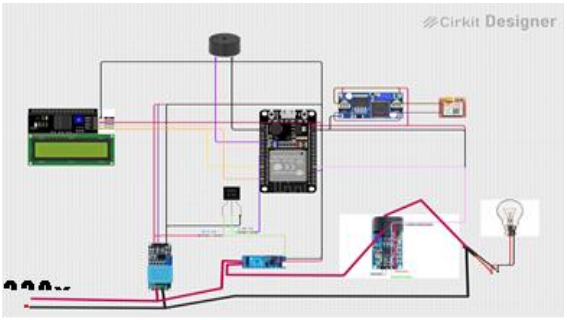
Libraries: In this project, libraries like BlynkSimpleEsp32.h, ZMPT101B.h, and ZMCT103.h are used, allowing integration with the Blynk platform and the various sensors.

Serial Monitor: The Serial Monitor in the IDE is useful for debugging by displaying real-time data like current, voltage, and power usage from the sensors.

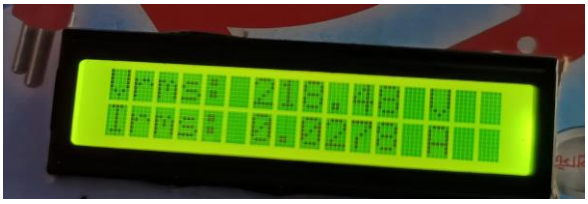
These software tools work together to provide a comprehensive solution for monitoring and managing energy consumption, offering real-time data and control capabilities to enhance energy efficiency and cost-effectiveness.

4. CIRCUIT DIAGRAM

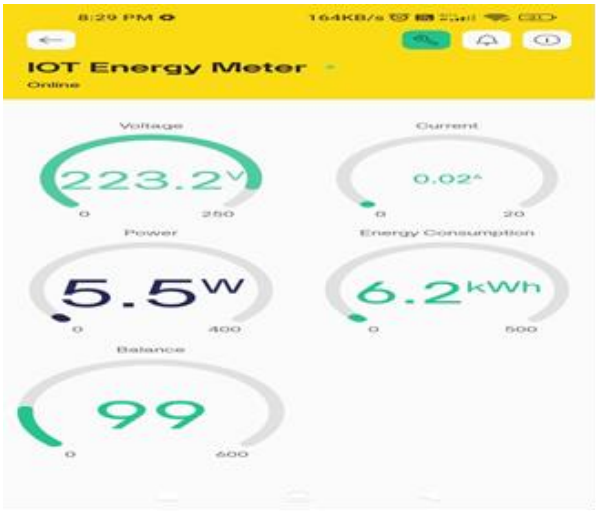




16 x2 LED DISPLAY OUTPUT



5. OUTPUT ON BLYN



6. CONCLUSION

The "IoT Energy Meter with Current, Voltage, and Cost Monitoring System" project successfully demonstrates the integration of IoT technology with energy management solutions. By leveraging components such as the ESP32, ZMPT101B, and ZMCT103, we have developed a system that not only measures current and voltage but also provides real-time cost monitoring. The integration with the Blynk app allows for user-friendly access to data, empowering users to monitor their energy consumption from anywhere. The automatic

disconnection of the bulb when the balance reaches zero adds an essential safety feature, ensuring energy conservation and preventing unnecessary costs. This project highlights the potential of IoT in enhancing energy efficiency and promoting sustainable practices. Future enhancements could include advanced data analytics for predictive energy usage, additional sensors for environmental monitoring, and integration with smart home systems for a more comprehensive energy management solution.

REFERENCES

[1] Geeks for Geeks. (n.d.). Introduction to Internet of Things (IoT) - Set 1. Retrieved from [GeeksforGeeks]

[2] IBM. (n.d.). Internet of Things. Retrieved from [IBM](https://www.ibm.com/topics/internet-of- things)

[3] Blynk. (n.d.). Blynk: a low-code IoT software platform for businesses and developers. Retrieved from [Blynk](https://blynk.io/)

[4] Geeks for Geeks. (n.d.). Soil Moisture measurement using Arduino and Soil Moisture Sensor. Retrieved from [GeeksforGeeks](https://www.geeksforgeeks.org/soil-moisture-measurement-using-arduino-and-soil-moisture-sensor/)

[5] Last Minute Engineers. (n.d.). In-Depth: How Soil Moisture Sensor Works and Interface it with Arduino. Retrieved from [Last Minute Engineers] (https://lastminuteengineers.com/soil- moisture-sensor-arduino-tutorial/)

[6] Wat Electronics. (n.d.). Rain Sensor: Circuit, Types, Working & Its Applications. Retrieved from [WatElectronics](https://www.watelectronics.com/rain-sensor-circuit-types-working- applications/)

[7] Elprocus. (n.d.). Rain Sensor: Working, Pin Configuration and Applications. Retrieved from [Elprocus](https://www.elprocus.com/rain-sensor-working-pin-configuration-applications/)