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IJIEMR Transactions, online available on 15th Jun 2024. Link :
https://ijiemr.org/downloads/Volume-13/ISSUE-6

10.48047/IJIEMR/V13/ISSUE 06/06

Title **SMART ENERGY METER USING INTERNET OF THINGS**

Volume 13, ISSUE 06, Pages: 37-42

Paper Authors **P. Suresh Kumar, Kavalla Rajeswari, Karedla Pavani, Karri Rukmini**

Lagudu Jayendra Venkata Siva Swami, Sai Sri Jahnavi Budharayavalasa

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SMART ENERGY METER USING INTERNET OF THINGS

P. Suresh Kumar
Assistant Professor
Dept. Of Electrical and Electronics Engineering.
Vignan's Institute of Information Technology
Visakhapatnam, India.
suresh0260@gmail.com

Kavalla Rajeswari
UG - Scholar
Dept. of Electrical and Electronics Engineering.
Vignan's Institute of Information Technology
Visakhapatnam, India.
rajeswari202k@gmail.com

Karedla Pavani
UG - Scholar
Dept. of Electrical and Electronics Engineering.
Vignan's Institute of Information Technology
Visakhapatnam, India.
pavanikaredla5@gmail.com

Karri Rukmini
UG - Scholar
Dept. of Electrical and Electronics Engineering.
Vignan's Institute of Information Technology
Visakhapatnam, India.
rukminikarri1321@gmail.com

Lagudu Jayendra Venkata Siva Swami
UG - Scholar
Dept. of Electrical and Electronics Engineering.
Vignan's Institute of Information Technology
Visakhapatnam, India.
jayendralagudu57073@gmail.com

Sai Sri Jahnavi Budharayavalasa
UG - Scholar
Dept. of Electrical and Electronics Engineering.
Vignan's Institute of Information Technology
Visakhapatnam, India.
saisrijahnavi27@gmail.com

***Abstract* -- The old energy metering system has undergone a revolution with the emergence of Internet of Things (IoT) technologies, which have made remote tracking and control possible. In order to support real-time energy consumption tracking and management, this study offers an Internet of Things (IoT)-based energy meter that integrates smart sensors, communication modules, and data analytics. The proposed system enables users to remotely monitor their energy usage remotely through a web or mobile interface, providing insights into consumption patterns and boosting energy efficiency. Furthermore, the system incorporates features such as automated billing, anomaly oErrorbservation, and demand response, enhancing overall energy management and contributing to a sustainable future**.

Keywords – Arduino uno ,Relay,Current Sensor,Voltage Sensor, Bread board, LCD Display, ESP32 Wi-Fi module, Blynk app.

I. INTRODUCTION

The internet of things (IoT) is a network of connected smart gadgets that can communicate data. The 'thing' in IoT could be a person wearing a heart monitor or an automobile equipped with sensors, i.e. items allocated an IP address and capable of collecting and transferring data across a network without manual aid or intervention.The inherent technology in the objects allows them to interact with internal states or the external environment, which influences decision-making. Rapid expansion and development have made the energy dilemma a major concern. It is necessary to create a suitable system in order to analyze and manage power consumption.The current system is labor-intensive, error-prone, and time-consuming.[1]

The main aim of this project is to monitor a consumer's electricity consumption. An electric device known as an energy meter can often be used to track energy usage. One representative from the power board visits our house once a month to create the electricity bill. Thus, there are certain mistakes caused by this manual labor, such as the fact that we are unable to check our usage and are unaware if the bill he generated belongs to us.The user may receive notifications regarding the cost and frequent usage of power consumption by using this technology across the internet of things,helping them to reduce their high bill utilization.

The need for intelligent energy monitoring systems is rising along with the demand for energy efficiency. The goal of this project is to create an IOT-based energy meter that can track and show real-time power, voltage, and current values. The system makes use of an ESP32 for wireless connection, an Arduino Uno for main control, and Blynk for remote monitoring. Some common inaccuracies seen in traditional meters are as follows: [2]

- Taking a lot of time.
- Possibility of stealing.
- Make mistakes when interpreting the data and involving more people.
- The consumer is unable to receive a daily consumption update.

All things considered, IoT-based energy metres offer a revolutionary way to achieve cost savings, sustainability, and energy efficiency in both residential and commercial settings. These smart gadgets open the door to an energy environment that is smarter, greener, and more robust by utilising data analytics and communication.

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II. OBJECTIVE

This project's primary goal is to track a consumer's electricity consumption.With the help of Arduino Uno, ESP32, and Blynk, the suggested system seeks to create an Internet of Things energy metre has real-time energy tracking and control capabilities. The system will have an LCD display ,relay,voltage sensor ,and current sensor to monitor and show power,voltage,and current readings. Through Blynk app on smartphones, customers will be able to access the readings remotely thanks to the ESP32 module's wireless communication capabilities.[3]

III. SCHEMATIC DIAGRAM

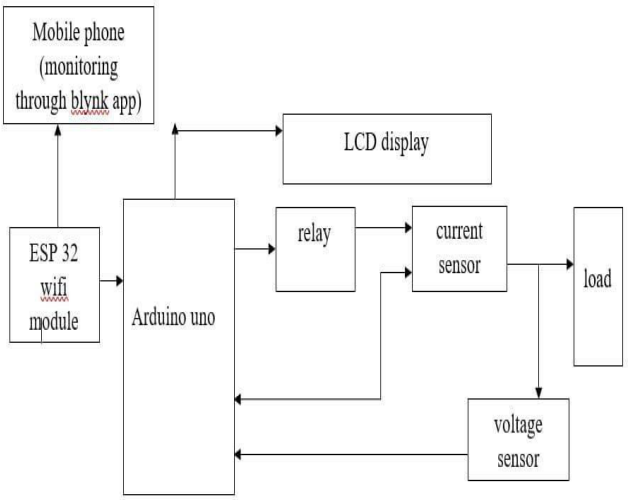

Fig.1. Functional schematic of energy meter.[4]

III. COMPONENTS USED

A completely functional system requires the following components to be set up:

1. ArduinoUno
2. ESP32Wi-Fi Module
3. Voltage Sensor
4. Relay
5. Current Sensor
6. LCD Display
7. Blynk App

- ARDUINO UNO - The energy meter's primary micro controller is the Arduino Uno. It is responsible for handling the relay that switches the electrical load, analyzing data, and communicating with various sensors and modules.

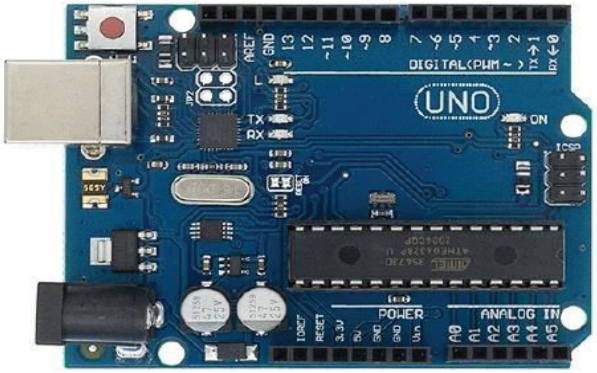

Fig.2. Arduinouno.

Benefits -

- Open source microcontroller board that is programmable.
- Inexpensive.
- Versatile.
- Simple to use.

Applications -

- Digital Robotics and Electronics.
- Counter in Parking Lot.
- Medical apparatus.
- Timer with traffic light countdown.
- Automation of the Home.

- ESP32 Wi-Fi Module - The ESP32 module makes wireless communication and internet connectivity possible. It permits data transmission from the energy meter to a cloud server or a mobile application for remote control and monitoring.[5]

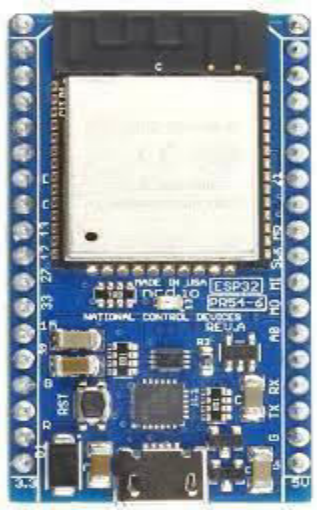

Fig. 3. SP32 Wi-Fi Module.

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Benefits -

- WiFi and Bluetooth connectivity.
- A dual-core CPU.
- Minimal power use.
- Rich peripheral interfaces.
- Included security elements.

Applications -

- Home automation.
- Industrial automation.
- Smart agricultur.
- Health care.
- Generic low-power IoT sensor hubs and data loggers.

➢ VOLTAGE SENSOR – The voltage across the electrical system is measured by the voltage sensor. It offers the information required to determine power consumption.[7]

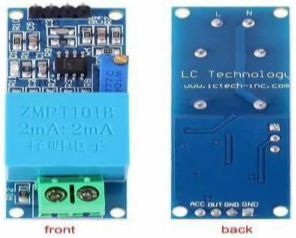

Fig. 4. Voltage sensor.

Benefits -

- Systems for control and observation.
- Precise Measurement.
- Output in Proportional Analog.
- Simple integration and flexibility enable flexible use at various voltages.

Applications -

- Monitoring Current Overload.
- Detection of ground faults.
- Electrical appliances used in homes.
- Industrial devices.
- Equipment for electrical testing and protection for relays.

➢ CURRENT SENSOR - The electrical system's current is measured by the current sensor.It is employed to compute power usage and track the load.[7]

Fig. 5. Current sensor.

Benefits –

- Monitoring current in real time.
- Avoiding circuit overloads.
- Enhancing energy economy.

Applications -

- Power metering.
- Diagnostic of the control system.
- Electric motor control for complicated loads.
- Measurement of current supply.

➢ RELAY - The electrical load is managed by the relay. With the help of user inputs or specified circumstances, it can be utilised to remotely turn on or off the load.[8]

Fig. 6. Relay.

Benefits -

- Separation of Electricity.
- Handling of High-Voltage Equipment.
- Harmony.
- Cost-Effectiveness.
- Simple Swap.

Applications -

- Systems of Automation and Control.
- Protection of Power Systems.
- Motor Guidance.
- Automation of the Home.
- Communications.

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- LCD DISPLAY - Localised real-time readings of power, voltage, and current are shown on the LCD display. It gives users a visual interface to track how much energy they use.[4]

Fig. 7. LCD display 20*4.

- BLYNK APP - The energy metre can be remotely monitored and controlled using the Blynk app. From a smartphone or tablet, it offers an easy-to-use interface for viewing data on energy use and managing the electrical load.[6]

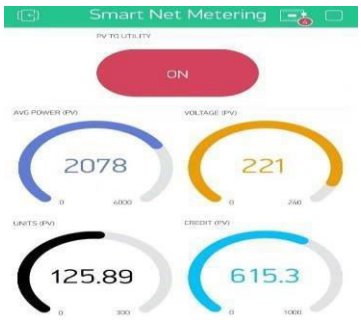

Fig. 8 . Blynk app.

Together, these elements form an Internet of better manage their energy use by offering real-time monitoring and control over energy consumption

V. PRACTICAL IMPLEMENTATION

The Arduinouno is then linked to the relay to regulate the electrical load's switching. Relays are used to switch on or off loads in response to user input or preset criteria.

The Arduinouno is connected to an LCDdisplay, which displays voltage, current, energy, and real-time power. To provide accurate information on energy consumption, the data are constantly updated.[9]

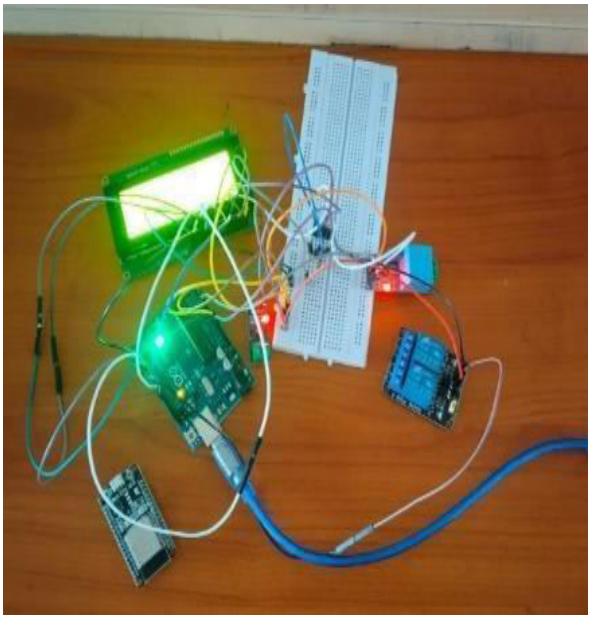

Fig. 9 .System is ON (Load not connected).

Next, to enable wireless connectivity, the ESP32 Wi-Fi module is linked to the Arduino Uno. When the ESP32 module is linked to the user's local Wi-Fi network, it can communicate with the Blynk app that has been loaded on their phone.

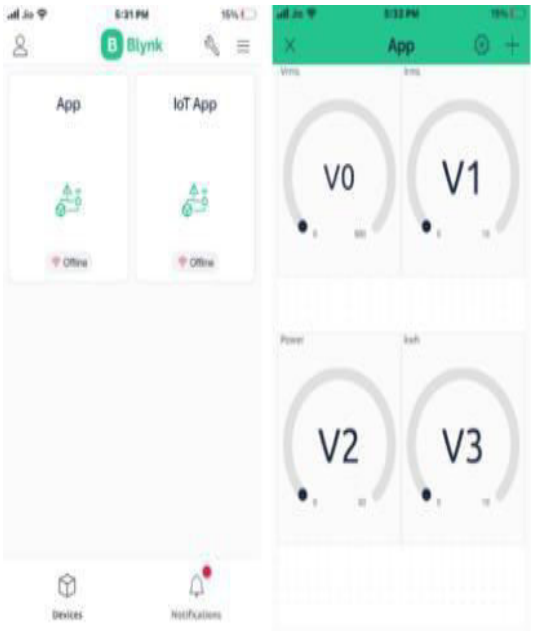

Fig. 10. Mobile Dashboard Setup of Blynk app.

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IV. FLOW CHART

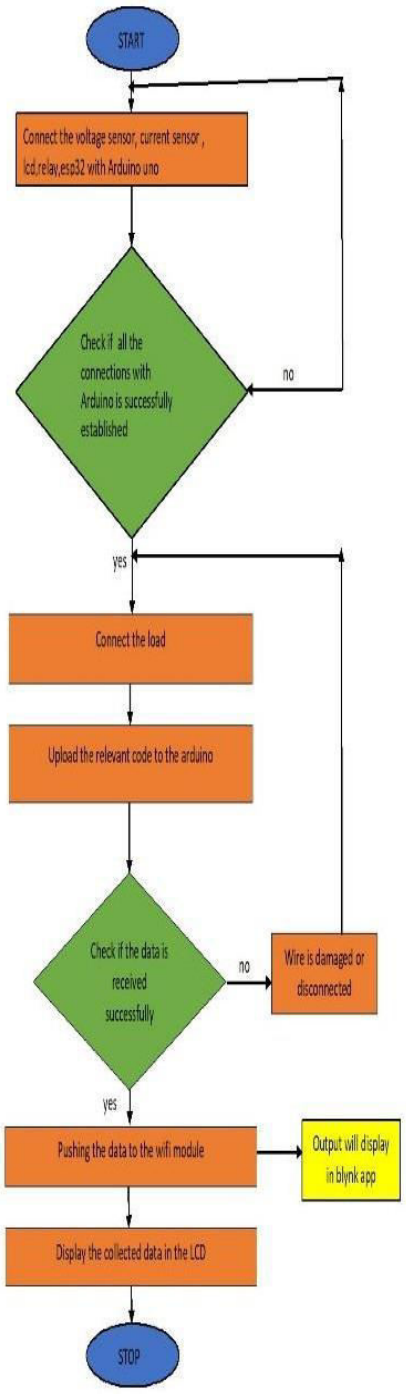

Fig. 11. flow chart.

V. RESULT

Energy, real-time power, voltage, and current data are ccessfully measured and displayed on the LCD display using Internet Of Things-based energy metre system. The Blynk app on a smartphone can also be used to remotely monitor and operate the system.

Fig. 12. System is ON (Load connected).

Fig. 13. Remotely monitored and controlled using the Blynk app on a mobile phone.

VI. CONCLUSION

This study presents a wireless metre reading system that can collect, process, and analyse data at regular intervals to produce findings that are accurate and devoid of errors.

Among this smart system's benefits are -

- conservation of energy.
- Significant time and energy savings.
- Energy meter controlled automatically
- Detection of electricity theft.

Among the drawbacks are -

The system may require some time to upload the data, contingent upon the speed of the Internet and the module baud rate.

The idea of the Internet of Things can also be used to a variety of work environments, including traffic control systems, automated water level detectors, and home automation.

The Internet of Things (IoT)-based energy metre project shows how to combine an Arduino Uno, an ESP32, and a number of other sensors and modules to build a clever energy monitoring system. The technology improves energy management and efficiency by providing users with real-time energy consumption data in addition to facilitating remote monitoring and control.

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