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SMART SOPHISTICATED POWER METER USING IOT AND CONTROLLING OF LOADS

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ABSTRACT

The Project is an innovative endeavour aimed at transforming the way energy consumption is monitored and improving the accuracy of billing. This system utilizes ESP32 microcontrollers, relay modules, energy meters, voltage sensors, current sensors, and light bulbs to provide real-time monitoring of energy consumption, calculate tariffs, and allow remote access. Conventional energy metering systems often lack clarity and ease of use for both consumers and providers. This project tackles these challenges by implementing an intelligent energy metering solution. The energy meter quantifies the amount of power consumed in watts, while voltage and current sensors gather data in real-time. The readings are presented on a web server, enabling users to remotely monitor their energy consumption. An impressive aspect of the system is its ability to automatically calculate tariffs. The system utilizes data from the energy meter and real-time pricing information to compute and exhibit the present tariff rates. Based on these rates, users can make well-informed decisions regarding their energy consumption. In addition, the system utilizes relay modules to remotely manage appliances. Users have the ability to remotely activate or deactivate appliances, thereby enhancing energy efficiency and reducing expenses. The project demonstrates the capacity of IoT technology to transform energy management. Through the provision of transparency, up-to-date data, and automated tariff calculations, this system enables consumers to exert influence over their energy consumption, decrease expenses, and contribute to the preservation of energy resources. This project is in line with the increasing need for sustainable and efficient energy usage, providing a practical solution for both residential and commercial purposes.

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Vol. 20, Issue.2, April 2024

INTRODUCTION

The core of this system is based on the integration of IoT and power metering, facilitating a smooth transmission of data between devices and the central monitoring infrastructure. The suggested smart power meter differs from conventional power meters by offering continuous and dynamic data acquisition, as opposed to static readings at periodic intervals. By utilizing IoT connectivity, the meter is able to establish immediate communication with a centralized platform, providing a comprehensive and up-to-the-minute perspective on energy usage patterns.

A notable characteristic of this system is its focus on load management. Incorporating load control techniques goes beyond just monitoring and enables a proactive approach to managing energy. The system can optimize the performance of connected loads by utilizing intelligent algorithms and receiving real-time input. This not only improves energy efficiency but also offers a means for managing demand from consumers, which helps to create a power infrastructure that is more resilient and responsive.

In this system, power meters have intelligence beyond data collecting. It gives users actionable insights for energy reduction and cost efficiency. Remote load control can also help with peak demand and grid stability issues.

In the pursuit of energy conservation, the smart and advanced power meter, which utilizes IoT and load control, has become a crucial instrument as the world moves towards a more sustainable future. This introduction provides an overview of the different parts, features, and benefits of the proposed system, emphasizing its potential to completely transform the way we measure, monitor, and control electricity usage in the present time.

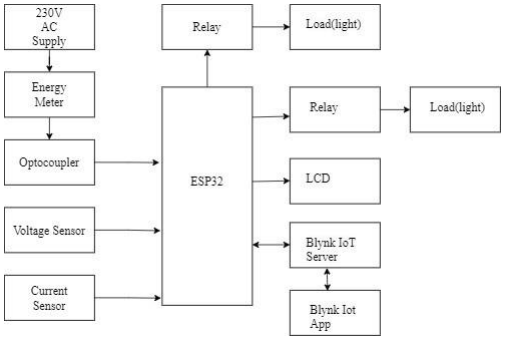


Figure.1 Block Diagram

International Journal of Engineering Research and Science & Technology
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Vol. 20, Issue.2, April 2024

LITERATURE SURVEY

1. GSM Based Smart Energy Meter and Automation of Home Appliances

The process of designing a smart energy meter and home appliance automation system that is equipped with GSM technology is complex and involves the meticulous integration of multiple components. The intelligent energy meter use a microcontroller, such as Arduino or Raspberry Pi, in conjunction with energy measuring integrated circuits (ICs) and current and voltage sensors to precisely gauge power consumption. Data is typically kept utilizing storage solutions like as SD cards or cloud platforms. Communication via the GSM network is enabled by a GSM module, such as SIM800 or SIM900. The system is specifically intended to transmit energy consumption data by SMS to either a selected server or a mobile application. Simultaneously, the home appliance automation module, governed by a separate microprocessor, incorporates relays, sensors, and actuators.

2. Running State Evaluation of Electric Energy Meter

The "Running State Evaluation of Electric Energy Meter" entails a thorough evaluation of the meter's performance while it is actively operating. This assessment covers multiple crucial factors to guarantee the dependability and precision of the meter's measurements. Important factors to consider include ensuring the correctness and exactness of measurements, regularly performing calibrations according to industry norms, and evaluating the reliability of communication interfaces like RS-485 or Modbus.

3. Home energy management leveraging open IoT protocol stack

Home energy management systems that utilize open Internet of Things (IoT) protocol stacks are an innovative method for managing energy usage, encouraging sustainability, and improving user control. The incorporation of IoT technology is crucial in such systems as it enables intelligent connection between devices and facilitates effective data transmission. By employing open protocols, the potential for different systems to work together and be compatible is guaranteed, which promotes a more inclusive and adaptable environment. Given the increasing need for energy, it is especially important to prioritize intelligent and automated energy management.

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Vol. 20, Issue.2, April 2024

4. IoT Based Smart Energy Meter Using NodeMcu

The present paper discusses the challenges encountered by distribution companies and customers in relation to IoT-based smart energy meters. The study centers around the smart energy meter, which integrates hardware and software to deliver specific functionality through the use of embedded system capabilities. The article provides a comparison between Arduino and other controllers to introduce the concept of Smart. It also explores the applications of GSM and Wi-Fi modems in this context. Both the consumer and service provider can retrieve the energy consumption reading and its corresponding amount by utilizing a GSM modem. Consumers have the option to get text-based notifications through GSM when they are nearing a predefined threshold value.

PROPOSED SYSTEM

The proposed method allows consumers to effectively regulate their energy consumption by continuously monitoring their energy usage. This technology facilitates bidirectional communication between the utility and the consumer, while also offering other functionalities. For instance, if the consumer fails to settle the power bill, the utility has the capability to disconnect the energy supply. Conversely, if the bill is paid, the energy supply can be promptly reconnected. Another significant benefit of this system is its ability to promptly alert both the consumer and the utility in the case of meter tampering. Based on this knowledge, consumers and utilities may effectively manage tampering and mitigate energy problems.

The monitoring and control of electricity consumption is revolutionized by a smart energy meter that utilizes Internet of Things technology. These meters are equipped with sensors that monitor numerous characteristics such as current, voltage, and power factor, allowing them to deliver precise and real-time data. The incorporation of IoT allows these meters to establish connections with the internet or local networks, facilitating the smooth transmission of consumption data to cloud-based services. Users can monitor their energy usage patterns and receive real-time notifications using online or mobile applications. One notable characteristic of these smart meters is load control, which enables users to remotely manage and regulate linked loads. This feature enables users to enhance energy efficiency, detect inefficiencies, and actively participate in creating a more sustainable and effective energy system.

International Journal of Engineering Research and Science & Technology

ISSN 2319-5991 www.ijerst.com

Vol. 20, Issue.2, April 2024

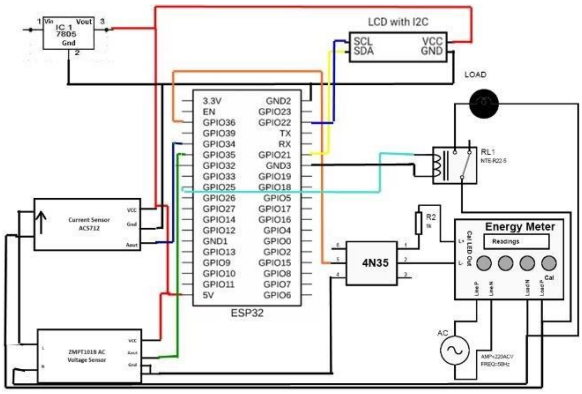


Figure.2 Schematic Diagram

RESULTS

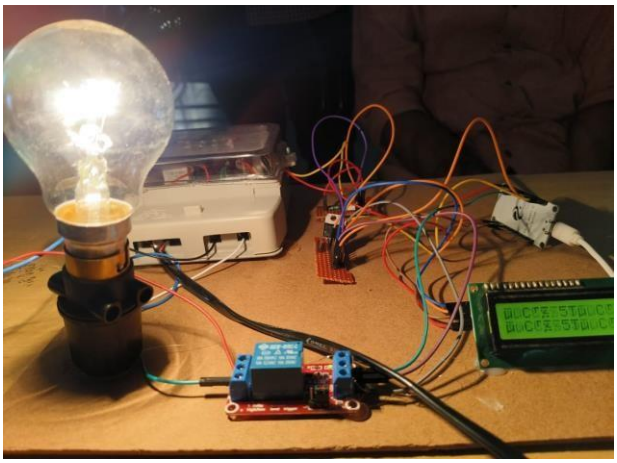


Figure.3 Project Setup

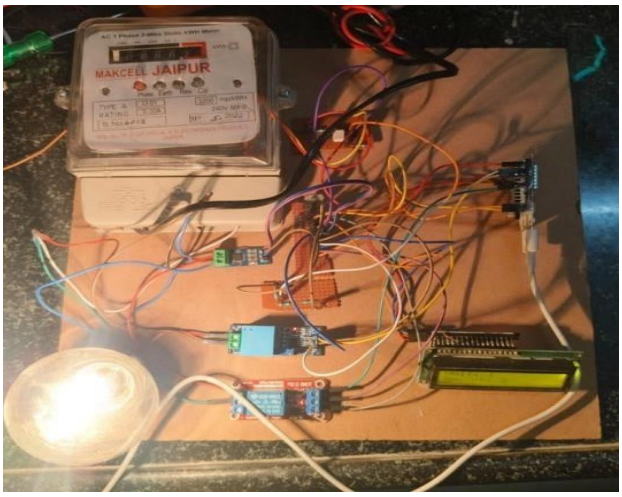


Figure.4 Displaying units values & Bulb ON

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Vol. 20, Issue.2, April 2024

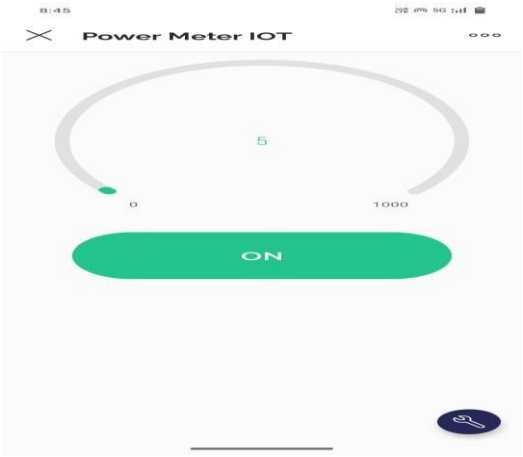


Figure.5 Units values on Blynk app

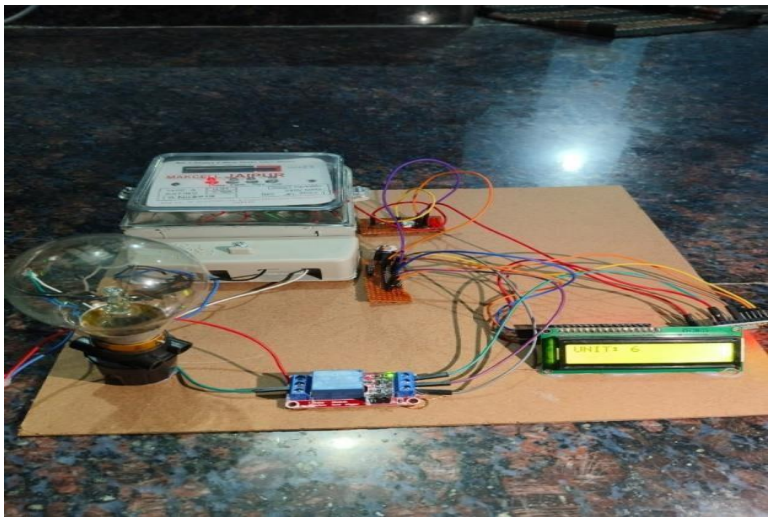


Figure.6 LCD displaying Units value and the bulb is OFF

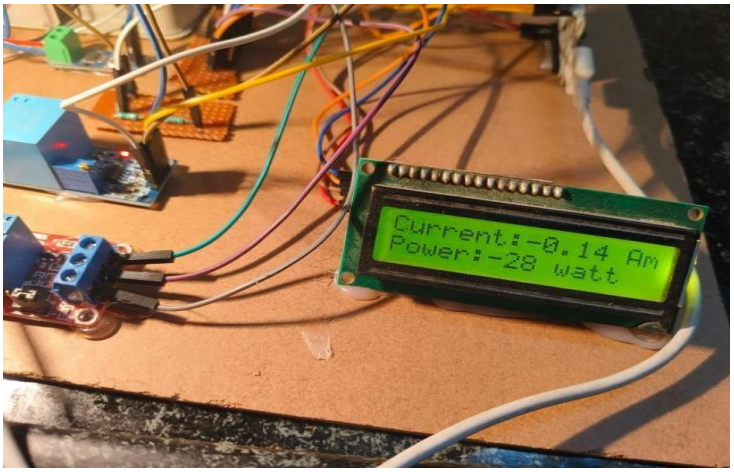


Figure.7 Displaying current & power values

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Vol. 17, Issue.2, April 2024

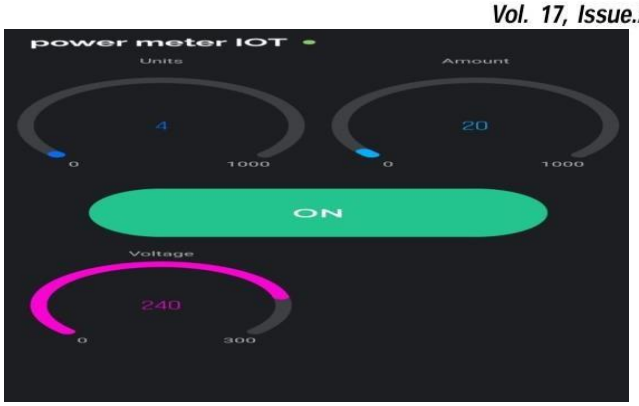


Figure.8 Displaying values on blynk app

Table.1 Numerical Representation of Input Corresponding Outputs

ELEMENT	INPUT	OUTPUT
Units	If Units>5	Light is OFF
Units	If Units<5	Light is ON
Blynk Button	If Units>5	Light is OFF
Blynk Button	If Units<5	Light is ON

ADVANTAGES

- Real-Time Monitoring
- Energy Efficiency
- Cost-Effective
- Automated Data Collection
- Remote Connectivity and Control

APPLICATION

- Residential Buildings
- Commercial and Industrial Sectors
- Industrial Facilities
- Consumer Empowerment
- Renewable Energy Systems

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Vol. 17, Issue.2, April 2024

CONCLUSION

The deployment of an advanced sophisticated power meter utilizing IoT for load control signifies a substantial progress in energy management and effectiveness. This project facilitates real-time monitoring of energy consumption by integrating Internet of Things (IoT) technology with power monitoring systems. Users are able to establish specific limits for load control, which allows them to make well-informed choices regarding energy consumption and encourages the adoption of more environmentally friendly behaviours. The system's capacity to automatically control or deactivate devices when consumption exceeds predetermined limits ensures efficient energy utilization, minimizing waste and expenses. This integration combines Internet of Things (IoT) technology with power monitoring systems, allowing for immediate examination of energy usage. The ability to establish limits for load management gives users the power to make informed decisions, promoting more sustainable energy practices.

FUTURE SCOPE

The potential for advanced smart power meters integrated with IoT for load control is highly promising, offering numerous opportunities for technological improvement and societal influence. Progress in data analytics will allow for a more detailed comprehension of energy consumption patterns, enabling accurate load management strategies and revealing possibilities for customized energy solutions. The integration of machine learning algorithms offers great potential, enabling these systems to accurately forecast and adjust to energy requirements in real-time, optimizing the distribution of loads and improving overall efficiency. Furthermore, promoting compatibility with a wider range of intelligent appliances and devices will enhance the capabilities of users, allowing for effortless integration and management of various energy-consuming devices.

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