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ELECTRIC METER USING SENSORS AND BYLNK

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Abstract- One of the most important devices in the upcoming technological world is the smart Energy Meter. The smart meter is an automated and advanced energy meter that gathers information from the end user's load and monitors their energy usage and then sends additional data to the service provider and/or system operator. This smart meter makes use of sensors and control device, along with a dedicated communication infrastructure. The accuracy of the analog and digital meters which are currently in use decreases over time. Furthermore, these meters are devoid of any safety features and are not compliant with customer use. The proposed system is managed wirelessly and also interconnected allowing monitoring of energy consumption and turn-off/disconnect equipment not essentially to be in operation and enable the user to manage energy consumption. In contrast to older traditional systems, it is also capable of providing increased and improved efficiency, enhanced protection, and user-friendly control employing IoT approach.

Keywords: Smart meter, Current sensor, Voltage sensor, blynk cloud.

I. Introduction

The most critical problem faces by today's world is irregular power. People in many countries don't get the primary needs of lights, fans, etc. Researchers expect the capabilities of existing energy production will fail to meet future demand without new energy sources. We can make use of available power efficiently. A system can be created to achieve efficient use of power which monitors the environment and controls the power device and turns ON only when needed. The electrical parameters like voltage, current and frequency from smart grid can be acquired remotely and send these real time values using IOT

II. Literature Survey

Smart meters are digital devices that can measure and record energy usage, and communicate this information to both the utility provider and the consumer. The following are some of the key findings from literature surveys of smart meters:

Buchmann.T.E et al. [1] presented Energy savings methodology several and found that smart meters can help consumers save energy and reduce their electricity bills. A review of studies by the International Energy Agency found that smart meters can lead to energy savings of up to 15% in households.

Carratù.M, M. Ferro, et al [2] presented empathy on Consumer engagement: Smart meters can also improve consumer engagement and awareness of their energy usage. A survey of consumers in the UK found that smart meters increased their awareness of their energy usage and helped them to make changes to reduce their energy consumption.

Castro.J.A, [3] presented Data privacy and security: Smart meters can collect sensitive information about consumer behaviour and usage patterns, leading to concerns about data privacy and security. A review of studies by the European Union Agency for Cybersecurity found that data privacy and security risks can be mitigated through the implementation of robust security measures.

Depuru.S.S et al [4] discussed points on Technical challenges: The implementation of smart meters can present technical challenges, such as ensuring compatibility with existing infrastructure and addressing issues related to data management and storage. A literature review by the University of Glasgow found that technical challenges can be addressed through collaboration between industry, government, and academia.

Gupta.P et al [5] discussed energy efficient and Cost-effectiveness: Smart meters can be expensive to install, and concerns have been raised about the cost-effectiveness of their implementation. A review of studies by the UK government found that the long-term benefits of smart meters, including energy savings and reduced carbon emissions, outweigh the costs of implementation.

III. Working Principle

A smart meter system using current and voltage sensors with Blynk Cloud typically works as follows as Voltage and current sensors are connected to the electricity supply lines to measure the voltage and current of the electricity flowing through a circuit. The sensors are connected to a microcontroller or microprocessor, which is programmed to read the voltage and current values and calculate the power consumption in real-time. The microcontroller is connected to an ESP32 or similar Wi-Fi module, which allows it to communicate with the Blynk Cloud server over Wi-Fi. The Blynk Cloud server receives the data from the microcontroller and displays it in the form of a dashboard on the user's smartphone or tablet, using the Blynk app. The user can then monitor the energy consumption of their household or building in real-time, and view historical data over time. The Blynk app can also be programmed to send alerts or notifications to the user's smartphone or tablet when the energy consumption exceeds a certain threshold or when there is an abnormal power usage pattern. Overall, a smart meter system using current and voltage sensors with Blynk Cloud provides an easy and convenient way for users to monitor and manage their energy consumption. Haney.A.B et al [6] providing real-time data and notifications, it can help users to save energy, reduce their carbon footprint, and lower their electricity bill

.2.1 Existing Systems

The existing system for electric billing meter involves the use of traditional electromechanical meters or electronic meters. The electromechanical meters use a rotating metallic disc that spins at a speed proportional to the amount of energy consumed. The number of rotations is used to calculate the amount of energy consumed, and this information is recorded on the meter's mechanical register. Electronic meters use solid-state components, such as microprocessors and digital displays, to measure energy consumption. They are more accurate and reliable than electromechanical meters and can provide additional features such as remote communication, tamper detection, and power quality monitoring. The readings from both types of meters are typically recorded manually by meter readers who visit each customer's premises periodically to collect data. The collected data is then processed and used for billing purposes. Hieta.K, V et al [7] discussed about the case study on Smart energy meter.

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2.2 Proposed System

Power consumption monitoring system that can measure the power usage of each of the loads individually. This system is designed around NODEMCU microcontroller board. If the overall consumption goes beyond a specified level user will be notified about this and fine will be added if still consumption is not reduced. This system can be used for detecting faulty electrical devices in a household that is consuming unusual amount of power. The below figure 1 represents the block diagram of the proposed system.

2.3 Hardware Components

NODEMCU NodeMCU ESP32 is a development board that combines the ESP32-WROOM-32 module with a CP2102 USB-to-serial bridge. The ESP32-WROOM-32 is a powerful Wi-Fi and Bluetooth module that provides a dual-core processor, 520KB SRAM, 4MB flash memory, and a variety of input/output interfaces. The CP2102 USB-to-serial Bridge allows the board to be programmed and communicate with a computer through a USB interface. The NodeMCU ESP32 board is designed to make it easy to develop IoT applications, and it can be programmed using the Arduino IDE, Lua scripting language, or Micro Python. It also features built-in support for OTA (Over-The-Air) updates, which allows you to update the firmware on the board without needing to connect it to a compter. Overall, the figure 3.Node MCU ESP32 is a versatile and powerful development board that is well-suited for a wide range of IoT applications, including home automation, sensor networks, and robotics. Kang.S.H. et al [8] proposed the implementation of smart energy meter with the help of NODEMCU. Lane, J.J et al [9] explained national electricity demand.

Fig 1: NodeMCU ESP32

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2.4 Block Diagram

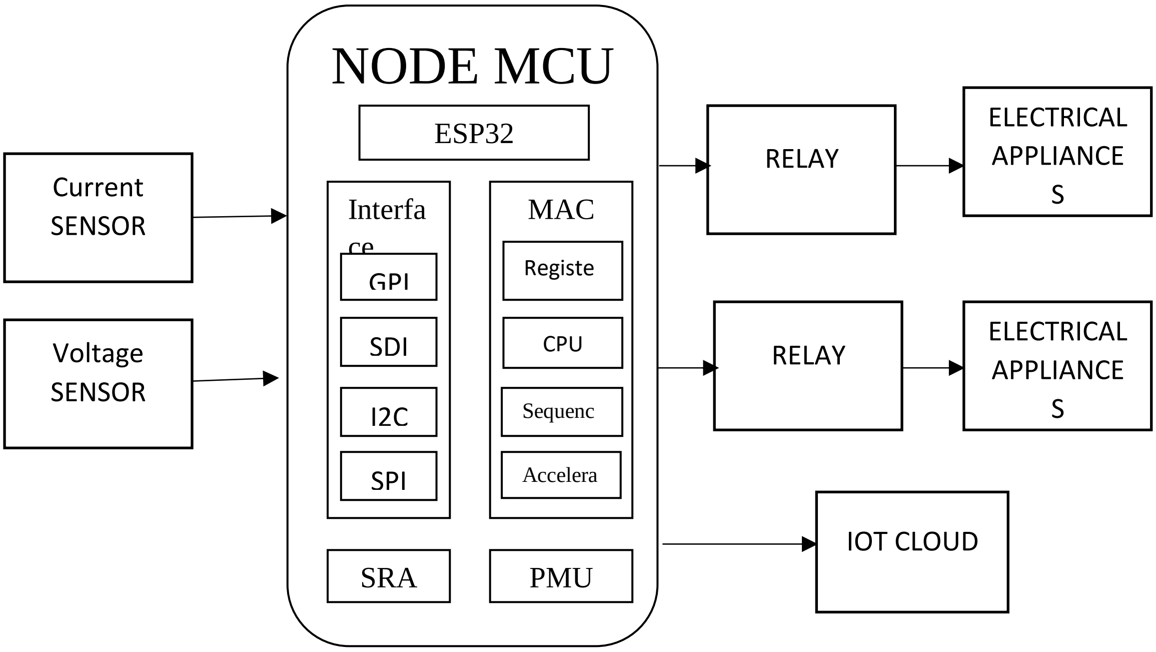

Fig 2: Block Diagram

2.5 Current Sensor

The ACS712 is a Hall effect current sensor module that is designed to measure both AC and DC currents. It is widely used in various applications such as motor control, power supplies, and battery chargers. The below figure 3 ACS712 current sensor operates by measuring the magnetic field generated by the current flowing through the conductor. The module has an integrated Hall sensor that detects the magnetic field and converts it into a voltage output. The output voltage is then amplified and filtered to produce an output that is proportional to the input current. The ACS712 module is available in different models that can measure currents ranging from 5A to 30A. It also features a low-resistance current path, which minimizes the power loss and provides accurate measurements. Libano.F et al [10] explained about energy meter Hardware and software. Additionally, the module has built-in protection against overcurrent and reverse polarity, which makes it safe to use. To use the ACS712, you need to connect the module to a microcontroller or other electronic device. The output voltage of the module can be read using an analog input of the microcontroller, and the current can be calculated using the formula provided in the datasheet. Overall, the ACS712 is a reliable and easy-to-use current sensor that is suitable for various applications. Mai, Vu et al [11] proposed cloud based model and the same will be enhanced using current sensor.

Fig 3: ACS712 Current Sensor

2.6. Voltage Sensor

The ZMPT101B voltage sensor is a module designed to measure AC voltage. It is commonly used in projects that require monitoring of electrical systems, such as in power distribution, automation, and home automation. The sensor uses a transformer to step down the voltage to a level that can be measured by the module's built-in operational amplifier. The output of the module is an analog voltage that is proportional to the input voltage. The module has a linear output, which means that the voltage output is directly proportional to the input voltage. The ZMPT101B voltage sensor has a measurement range of 0 to 250V AC, with a rated voltage of 220V AC. The module has a high accuracy of ±0.5% and a low power consumption of less than 0.5W. To use the module, it should be connected to an analog input of a microcontroller or an ADC (analog-to-digital converter) module. Moore, A. E. et al [12] offered integrating energy meter, the output voltage of the module can be converted to the actual AC voltage using a calibration equation that takes into account the module's gain and offset. Overall, the ZMPT101B voltage sensor is a useful component for measuring AC voltage in various applications. However, it should be noted that it is not suitable for measuring DC voltage. The below figure 4 represents the ZMPT101B Voltage Sensor

Fig 4: ZMPT101B Voltage Sensor

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2.7 Relay

Fig 5: Relay

The Figure 5 Relay is an electrical switch that is operated by an electromagnet. It is commonly used in electronic circuits to control high-voltage and high-current devices, such as motors, lamps, and appliances. A relay consists of a coil of wire, an iron core, and one or more sets of contacts. When a current is passed through the coil, it creates a magnetic field that attracts the iron core, which in turn closes the contacts. This allows the relay to switch on or off a separate circuit that is connected to the contacts. Relays can be used to control a variety of electrical devices, including AC and DC motors, solenoids, and lamps. They can also be used in safety circuits, where they are used to shut down machinery in the event of an emergency. Relays come in a variety of types, including electromechanical relays, solid-state relays, and reed relays. Electromechanical relays are the most common type, and are typically used in applications where high switching currents and voltages are required. Solid-state relays are smaller and more reliable than electromechanical relays, and are often used in industrial applications. Reed relays are used in low-power applications, where they offer fast switching speeds and low contact resistance. Overall, relays are a versatile and reliable component that can be used in a wide variety of electronic circuits to control high-voltage and high-current devices Navani.J.P, N.K. et al [13] explained about the losses during conduction. Serra.H, J et al [14] has explained about domestic power consumption.

III. Results and Conclusion

3.1 BLYNK Cloud

Fig 6: blynk Webpage

Blynk Cloud is a cloud-based service that provides a platform for developers and makers to build and manage IoT (Internet of Things) projects. It is designed to be user-friendly and easy to use, even for those without extensive programming experience. The Blynk Cloud platform allows users to create and control IoT projects using a smartphone app, which can be customized with widgets such as buttons, sliders, and graphs. Users can connect their projects to a variety of sensors, actuators, and other IoT devices, and control them remotely using the Blynk app. One of the key features of Blynk Cloud is its ability to integrate with a wide range of hardware platforms, including Arduino, Raspberry Pi, ESP8266, and others. This allows users to build and control a wide range of IoT projects, from simple sensors to complex automation systems. Blynk Cloud also offers a number of advanced features, such as push notifications, email alerts, and data logging. Shang-Wen Luan et al [15] has given inference on, automatic reliability calculation system for advanced metering infrastructure" Users can set up triggers and actions based on real-time data from their IoT projects, allowing them to automate tasks and create custom alerts. Shoeb S. Sheikh[16] explained about "implementation of wireless automatic meter reading systemverall, Blynk Cloud is a powerful and flexible platform for building and managing IoT projects. Its user-friendly interface and wide range of hardware integrations make it an ideal choice for makers and developers of all skill levels. The above image figure 7 represents the webpage of the blynk

Fig 7: Hardware setup

The switching status of the load and therefore the energy consumed by every single devices in real time is uniquely displayed on the mobile screen and also in blynk webpage. The above image figure 7 represents the hardware setup of the project. Also the switching (on/off) mode also made within the same on/off status. Son Y.S et al[18] providing "Home Energy Management System based on Power Line Communication," The entire power consumption is calculated and therefore the total power is displayed. Tae-Seop et al[19] Venkatesh.S.S [20] have presented on smart meter technique. The entire complete control of the system is done within the mobile itself. From this, the estimated bill of the fees are often calculated and also it's going to encourage all users to lessen your energy consumption.

IV Conclusion

The future scope of smart energy using current and voltage sensors and Blynk cloud is quite promising, as advancements in technology and innovation are constantly driving new possibilities in this field. The integration of smart energy systems with renewable energy sources such as solar, wind or hydroelectric power could provide more sustainable and eco-friendly options for energy consumption. Smart energy systems can be designed to adapt to changes in energy supply and demand and can help optimize energy usage. The incorporation of AI and ML technology into smart energy systems could help in predicting energy demand, and enable automatic control of energy consumption. This can improve the energy efficiency of households, buildings and industries. The integration of smart energy systems with smart grid technology can enable real-time monitoring of energy usage and demand, allowing energy providers to balance energy supply and demand more efficiently.

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