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IOT Based Smart Energy Meter

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Abstract: ***The labour involved in gathering utility metre readings for energy. The main goal of this project is to use the Internet of Things (IoT) to measure electricity consumption in home appliances and produce a bill automatically. IoT is an efficient and cost-effective way to transfer information about energy consumers wirelessly. A distributed architecture must be used to create the energy grid so that it can dynamically include various energy sources. IoT may be used for a variety of smart grid applications, including energy demand side management, distributed energy plant metering, smart metres for energy generation and consumption, and many areas of energy production.***
Keywords: ***Voltage Sensor Current Sensor, Relay, Internet of Things.***

I. INTRODUCTION

Customers who use the "IOT-BASED PREPAID ENERGY METRE" may manage their entire gadget from the web database and track their real-time energy use in the database. The necessary number of units can also be charged in that database to make things simpler. As a consequence, the user may observe how many units are still available and how many have already been utilised. Once the client has used all of the provided units, the supply will be cut off, and the customer will be informed through a warning letter that all of the purchased units have been used. The provider still has total control over the consumer and can cut off the supply at any time in the event of non-payment or any other issue. increasingly engineers will be faced with this difficulty as the market for energy-efficient systems expands and good control of device power and consumption becomes increasingly crucial. One method is to multiply the result in a processor to obtain power using an analogue to digital converter (ADC) for both current and voltage.

However, because the voltage and current will vary separately of one another, the communications latency and the alignment mistakes in the power calculation are caused by the overhead in acquiring the current and voltage data.

To reduce the time between voltage and current measurements, the processor must allocate enough processing power to ADC communications and power calculations. Even if the processor is dedicated completely to this duty, connections with other system components will result in delayed voltage and current measurements, reducing the accuracy of power monitoring. The processor will begin to become overloaded if you start adding other responsibilities to it, such averaging the device's voltage, current, and electricity as well as energy management. Using a digital current monitor to conduct the mathematical processing is a simpler technique to track power. This frees up the CPU to tackle other system tasks and notifies it when higher level system actions are required. Texas Instruments provides a selection of digital power and current monitors to address this problem. One such power, current, and voltage control is the INA233. The INA233 controls voltage, current, power, and energy using an interface that complies with I2C, SMBus, and PMBus.

II. LITERATURE SURVEY

A working model of an IoT-based smart energy metre was created by Birendrakumar Sahani and colleagues. The suggested model is used to estimate the household's energy use and even provides a useful figure for the energy unit. It decreases energy waste and increases public awareness.

A system was created by Mayur Rawte and colleagues to address a number of issues, including excessive electricity use, a lack of transparency in the use of labour, and the waste of resources and money.With the help of a device identification number and password, this technology enables confirmed clients to view the status of their electricity usage in real time. Internet-based web applications can be used for thisWhen an internet connection is restored, the Nazmat Toyin.al system switches to a local server and database, synchronising all information with the web server. The web server manages local billing; no online payment platform companies have been interfaced with.

The structure and how it will help in identifying an unauthorised use of electricity are described to Ms. Shahnaj Parvin. The report also lists the comparative benefits of the suggested approach over existing systems. Smart metering by Azfar Tufail.al offers some improvements over the traditional metering technique. The phrase "Smart Metre" refers to a modern energy metre that measures electrical energy usage and provides more information than a traditional energy metre.

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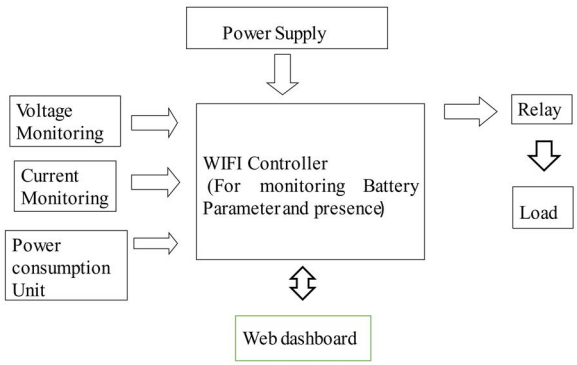
III. PROBLEM STATEMENT

Electromechanical metre reading devices are common in consumer premises in developing nations, and information is gathered each month by employing human labour. Therefore, that metre has various drawbacks, such as: Each consumer's metre needs to be read in order to calculate their power consumption. Metre reading variations and errors are more common when electromechanical metres are used. It is problematic for both the consumer and the supplier when calculated bills are utilised during periods of harsh weather when it is difficult to read metres. In the industrialised world, wireless technology has been created and is widely utilised for AMR systems and many other applications. However, currently also in developing nations, utilised in underdeveloped nations.

IV. METHODOLOGY

In this initiative, consumers' prepaid energy use, which aids in energy management, is the focus.In order for the consumers to keep track of how much energy they use, they will have to pay for the energy they will require up front. Customers can see a graphic representation of the energy usage in real time. The block diagram of a pre-paid energy metre is shown in Figure 1. If there is any energy misuse, the provider can quickly stop providing it directly to the customers. Relays are used in this project to connect the load to the ac source. Only two loads are used in the test scenarios in this context. Since the raspberry pi lacks an A/D converter, the MCP3008 is utilised to connect to the raspberry pi.
embedded converter The MCP3008 is interfaced with the two current and voltage sensors, which continuously monitor the power and communicate data to the cloud via the thing talk web server. Additionally, the app has an on/off button, which is automatically controlled by the web server.

V. BLOCK DIAGRAM



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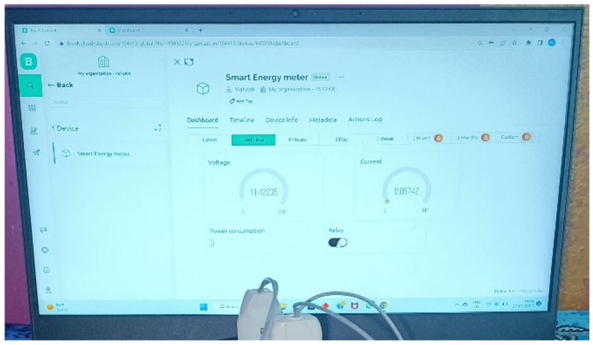
VI. WORKING

1) *Voltage measurement:* The ESP32 can measure voltage using a voltage divider circuit to scale down the input voltage to a range that the ESP32's analogue input pins can handle, similar to the Arduino-based metre. The analog-to-digital converter (ADC) on the ESP32 is used to read the voltage value after the voltage is proportionally divided by resistors in the voltage divider.

2) *Present Measuring:* Similar to the Arduino-based metre, current can be measured using a current sensor or a current transformer (CT). An analogue voltage output proportionate to the current passing through the sensor or CT is provided. The ESP32's ADC can read this analogue voltag.
3) *ADC Conversion:* The ESP32's ADC transforms the analogue voltage outputs from the voltage divider and current sensor/CT into digital values for processing.
4) *Power and Energy Calculation:* As described in the Arduino-based metre, the ESP32 can compute the instantaneous power and energy consumption using the voltage and current measurements collected. Utilising the digital values retrieved from the ADC, the calculations are completed.
5) *Data show and Communication:* The ESP32 may communicate measured data to a computer or smartphone for additional analysis or show it on an LCD display. It can communicate data by wireless communication modules like Wi-Fi or Bluetooth to a remote server or a mobile application, or it can use serial communication (UART) to deliver data to a computer via USB.
6) *Data logging and analysis:* The ESP32 can log data to an SD card or EEPROM for long-term monitoring, similar to the Arduino-based metre. Later analysis of the saved data can be used to spot usage trends, gauge market conditions, or determine energy expenditures.

VII. RESULT

This method primarily tracks the electrical characteristics of appliances and then determines the number of units used. Given the multiple benefits of WSNs, we have created smart metres that can forecast how much energy will be used. However, Wi-Fi technology for networking and communication is a low-cost, adaptable, and durable system to continuously monitor and regulate based on customer requirements. Wi-Fi technology has low power features that enable it to be widely used in home and building environments. The planned energy monitoring system is put into practise in the lab for analysis. As depicted in Fig.



VIII. CONCLUSION

This idea allows us to take the reading from the energy metre with less physical labour, which saves money. The primary competitive aspect to increase market share in the current power markets will be service differentiation. Prepaid metres, with their benefits over traditional ones, are anticipated to enable electricity companies in differentiating themselves and providing users with value-added services.

To help the utilities implement this system, encourage customers to choose prepaid metres on a voluntary basis and provide tariff or non-tariff incentives to those customers who prepay their electricity changes.

reduces the workforce.

It is user-friendly, and we can improve the project so that the power department can inform the customer about the creation of their bill.

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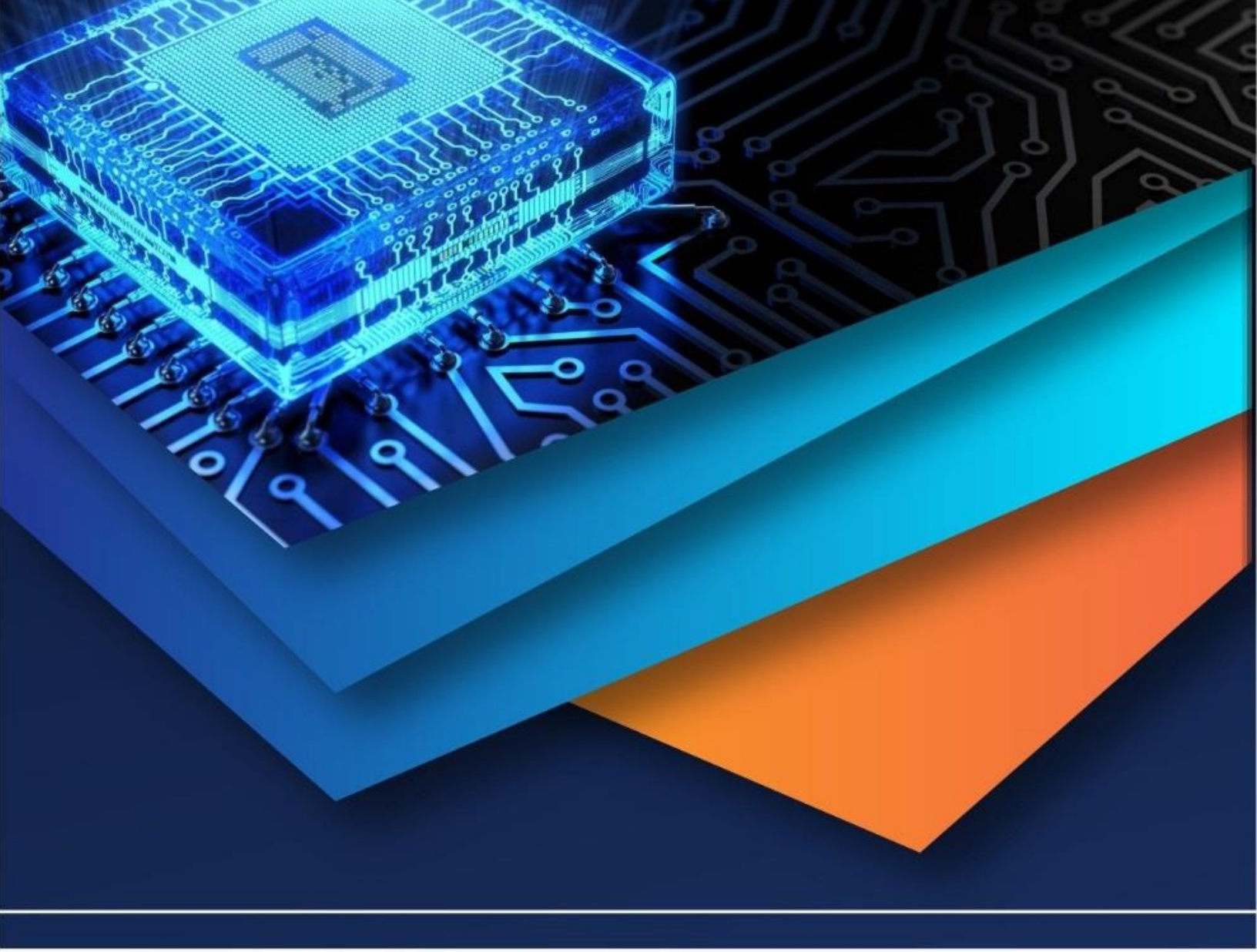

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