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Smart Electric Unit Measurement for Understanding Cost and Reducing Power in House Hold Applications

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Abstract: ***As the title of the project suggests, "Smart electric unit measurement", the whole idea is to create a simple electric unit measurement which measures the amount of power consumed and gives us access to real time values every few seconds. The technology is lagging when it comes to the conversation of electricity. To upgrade the energy efficiency and to bring notice about the energy consumption made by the consumers, this technique can bring a huge improvement in the energy grid. We have used ESP 32 Module and have it interfaced with the Blynk application. The values of the current and voltage are sensed by respective voltage sensor and current sensor, and are sent to Blynk app using ESP 32 microcontroller for consumers to get the accurate readings of their consumption.***

Keywords: ESP-32, Real time monitoring, IoT device, Current sensor, Blynk Application

1.Introduction

The trivial electric meters are becoming obsolete with the advancement of new technology. There have been many developments in electric meters as a product. Earlier, as per the government regulations, there was a requirement of man power in order to generate bills. The problem with this was that, in a situation where the customer hadn't paid the previous month's bill the labor had the authority to cancel the customer's connection. This caused unwanted trouble since re-establishing a connection was a tedious process and often led to frustration in the consumers.

With the introduction of the Smart Energy Meters the pattern of energy consumption can be changed for the benefit of an individual as well as the society. Smart energy meters are devices which measure the energy consumed and upload the data collected into the cloud, making it easily available for the consumers to access through an application.

Smart Meter helps in lowering the energy expenditures by increasing the possibility of reduced consumption. It is an advanced energy meter that measures the energy consumption of a consumer and provides added information to the utility by using a two-way communication scheme. Consumers are better informed in their consumption of their energy, so they can make better decisions when they are using the energy. Suppliers on the other hand won't need the old-fashioned way of manually reading the energy consumed as they would get this information automatically. These meters enable accurate calculation of cost and provide previously unavailable transparency to the user. Users can track their consumption in real-time and control spending and build an informed strategy on power consumption.

Mr. Barman gave consumers an interface using IoT platform known as ThingSpeak where they could view their daily consumption of energy and also if there is any breach in their supply [1]. Mr. Mishra created a webpage and mobile app for interfacing with consumers where they can monitor the power usage from their home [2]. Consumer interfacing on the mobile app is introduced by Karthikeyan [3]. The universal smart energy meter can be configured and reconfigured remotely simply by SMS using GSM without changing hardware. [4].

In this project, we have designed and developed a simple smart meter prototype that uses ESP-32 microcontroller, a Current Sensor SCT013 and voltage sensor ZMPTB101b to measure the power consumed. Furthermore, we will be using a third-party application called BLYNK to access the readings derived from the ESP-32 module.

2.Proposed Smart Electric Unit Measurement

A.Circuit diagram of the proposed system

The circuit diagram of the proposed smart electric unit measurement is show Fig.1. We will be using ESP32 & display the required output data in the Blynk application. ESP32 helps us send the values to the Blynk application, as it has inbuilt Wifi module and Bluetooth within it. We will be using a SCT-013 current sensor which is a non-invasive AC current sensor that has a split core type clamp meter. We have also used

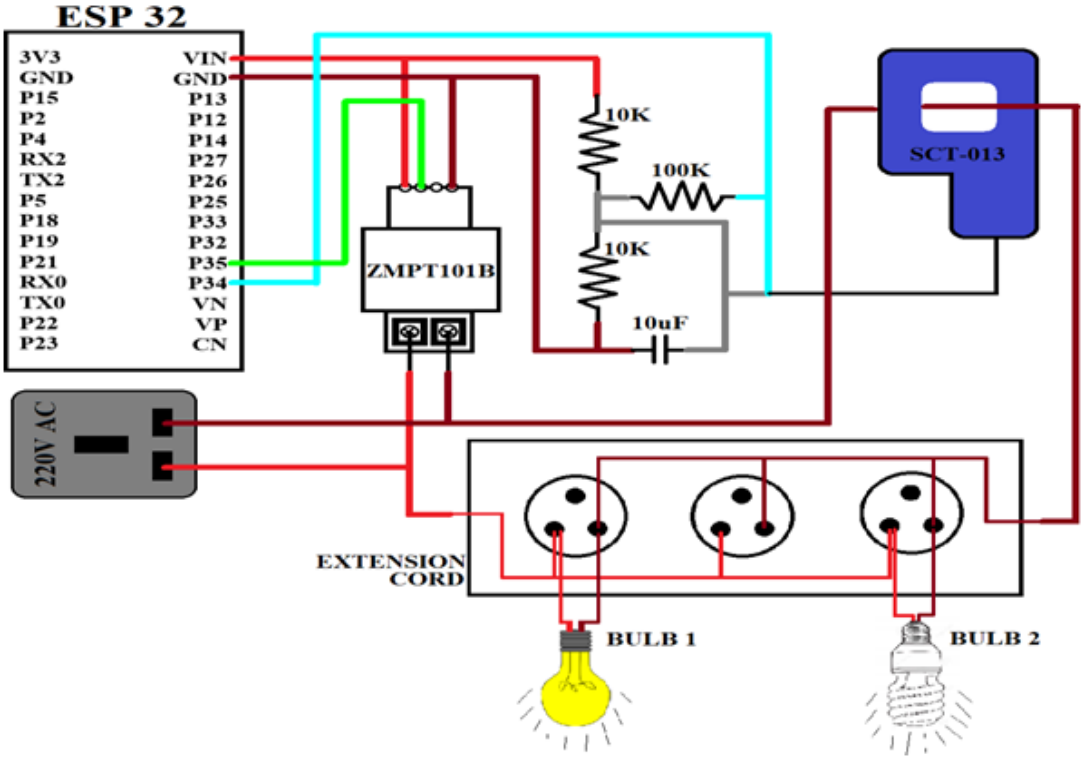

Figure 1: Circuit diagram of the proposed smart electric unit measurement

Block diagram of the proposed system

The block diagram of the proposed smart electric unit measurement is show Fig.1. We have made use of the current sensor and the voltage sensor to obtain the required values from the input. It is later sent to ESP32 where different required formulas are added and the code is developed to calculate the desired output data and is being looped to Blynk application.

ZMPT101B AC voltage sensor to measure the required AC voltage with a transformer. Therefore, using both the voltage and current sensor, we can measure the accurate readings required for the electric unit measurement. The Blynk application module will display the required voltage, current, power and total unit consumed in kWh.

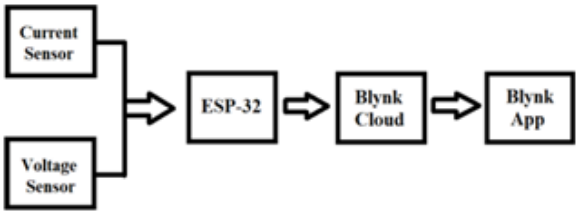

Figure 2: Block diagram of the smart electric unit measurement

B. Flowchart of the proposed system

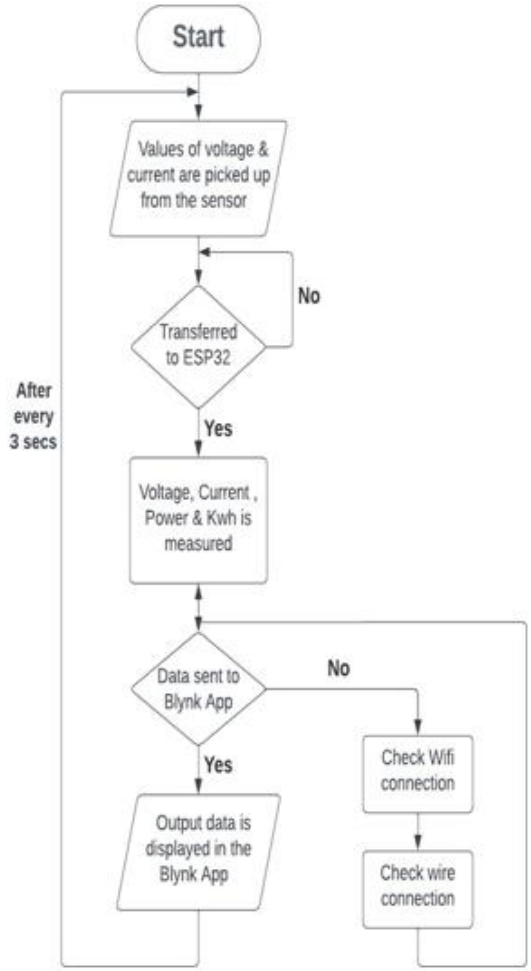

Figure 3: Flowchart of the proposed smart electric unit measurement

3.Description of Components Used in the Proposed System

The major hardware components involved in the proposed system as shown in Fig.1. are i) ESP 32 Module ii) Voltage sensor iii) Current sensor

A.ESP 32 Module:

They are small, have a lot of power (240MHz dual-core processor, 520K memory) and have built-in Wi-Fi which means they can directly connect to the internet. ESP32 is a series of low-cost, low-power system on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth. It is a successor to the ESP8266 microcontroller. Its Clock frequency is up to 240 MHz and an operating frequency range up to 600 DMIPS.

B.Voltage sensor:

Voltage sensor is also called as "On-board precision voltage transformer. Here we are using ZMPT101B. It calculates the amount of voltage consumption through the module and the sensor. The supply voltage ranges from 5-30V. The output of the voltage sensor is in the form of sine wave, we have taken in the form of value instead of sine wave. Sensor can withstand and measure AC voltage within 250V and the corresponding analog output can be adjusted.

C.Current sensor:

SCT-013: These are the sensors that measures alternating current. They are particularly used for measuring whole building current consumption or generation. It has primary winding, magnetic core and a secondary winding. The alternating current flowing in the primary produces a magnetic field in the core, which induces a current in secondary winding circuit. Then the data is sent to blynk application.

4.Simulation Results

Software code shown in Fig.2. used to implement smart electric unit measurement and are sent to blynk application to display the output values.

Figure 4: Snapshot of Arduino code for smart electric unit measurement

Here we have used Arduino IDE for the data to flow from ESP32 to Blynk application. This software or the IDE consists of text editor for writing a code and a toolbar with buttons for a common function and a series of menus. We have used another application-based platform called BLYNK, in order to take the readings from the module and the sensors. This data is made visible or access to the user-end.

Test Cases:

Case 1:

The connections are made as shown in the block diagram. The below image is the output result of a single load i. e., at the output side 60Watts bulb when it is connected. Hence the respective voltage, current and the power consumption the bulb is shown at the output window in the Arduino UNO app, as well as the Blynk application.

Figure 5: Test case 1 (Single load)

Case 2:

Same as in that of case 1, here we have connected a 9Watts bulb in order to see the difference between the respective parameters. The below image is the output result of a 60W bulb, corresponding to voltage, current and power.

Figure 6: Test case (Multi load)

Figure 7: Test case (without Multi load)

Case 3:

In this scenario, we have connected a multiload devices i. e., 9W and 60W bulb at the output. So that we can have overall usage of voltage, current and power. Hence, we can make out that, there is approximate equal in power, when there are 2 different devices connected. The below image is the output of a multiload.

Figure 8: Test case 1 (Multi load)

5.Conclusion

Smart electric unit measurement technique was implemented to make the measurement of electricity consumption simple and to understand consumer about the amount of energy consumed. To assure that all the above needs are initiated and the technique to be made cost effective while the required components are persuading the desired outputs. This can further swap the old energy meters with further developments. This in turn will encourage people to a whole new pattern of energy consumption behavior and by making the consumers being aware of their day-to-day spending on the electricity; they will start consuming power wisely, which will indirectly strengthen the energy grid built by the government sectors.

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