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Smart Electricity Meter

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A B S T R A C T

Electricity is a very basic necessity in our daily life. In today's Generation, Individuals are consuming huge amounts of electricity and this may lead to a lack of electricity. This can be minimized to some extent by implementing Smart Electricity Meter using IoT. It is a device where data transmission is wireless and which makes the reading and billing system easier. It mainly helps in taking electricity readings which in turn helps consumers and suppliers where they are not required to come near to the meter for readings. And it also prevents human error in taking readings.

Keywords:Internet of Things, Data Transmission, ESP 32 Wi-Fi Module, Smart Meter, Meter Reading, Billing

1. INTRODUCTION

Smart Electricity Meter is a device used to measure the amount of electricity consumed. The main operation of this device is to transfer the electricity consumption through a wireless medium to a mobile application employing Wi-Fi technology.
In the present generation, the electromechanical meters that are used for electricity consumption are not efficient i.e., they require humans to come near to the meter for reading which is time-consuming and it also might lead to human error while taking those readings. This can be minimized to some extent with this project.
This Project mainly deals in capturing the readings and sending the same to a mobile application which may be further used for billing.

2. PROBLEM STATEMENT

Even though the Present electromechanical and digital meters that are used have some advantages, there are some problems with this, they are:

- The meter reading requires humans to come near to the place and take down the readings which are a time-consuming and tedious job.
- The Consumer might be careless in the usage of electricity by not knowing his consumption of electricity.
- The billing system will be less accurate with the involvement of humans which may lead to human error.
- Proper Understanding of the Usage is not clear.

3. OBJECTIVES

As mentioned in the Problem statement section, The Objectives are the solutions to those and they are:

- The meter reading will be easier as they are available wirelessly and also without going near to the meter.

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- It brings the awareness in consumption of electricity to the consumers.
- It can be used to implement an automatic billing system.
- It mainly saves lots of time and power for the electricity department and eliminates human errors.

4. IMPLENTATION

4.1. COMPONENTS REQUIRED

- ESP 32 Board (NodeMCU)
- LCD Display (16*2)
- Voltage Sensor (ZMPT101B)
- Current Sensor (SCT-013)
- Blynk Application
- Arduino IDE
- Resistors (10K and 100ohm)
- Capacitor(10µF)
- Jumper Wires
- Power Supply

4.2. COMPONENTS DESCRIPTION

- **ESP 32 Development Board:**

  It is a microcontroller which is low-cost system on Chip (Soc) developed by Espressif, it is the successor of ESP8266 Soc, and comes in both single-core and dual-core. It is 32-bit Xtensa LX6 Microprocessor with integrated Wi-Fi. The ESP32 is equipped with integrated RF components like Power Amplifier, Low-Noise Receiver Amplifier, Antenna Switch, Filters, and RF Balun. Therefore, the module is easy to build for any project as it requires very few external components. It is manufactured using (TSMC) Taiwan Semiconductor Manufacturing Company's ultra-low-power 40 nm technology.
- **LCD Display:**

  The term LCD stands for Liquid Crystal Display. This electronic display module is used in an extensive range of applications like calculators, mobile phones, and in most electronic appliances where a displaying is required. This display is mainly used for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive, simply programmable using Arduino IDE.
- **Voltage Sensor:**

  It is a AC Single Phase voltage sensor module and it is a high precision voltage Transformer used to measure the accurate AC voltage. This Module can measure voltage within 250V AC voltage & the corresponding analog output can be adjusted. The module is simple to use. It is lightweight with an onboard micro precision voltage transformer. This module is operated in temperatures ranging from 40 degrees to 70 degrees.
- **Current Sensor:**

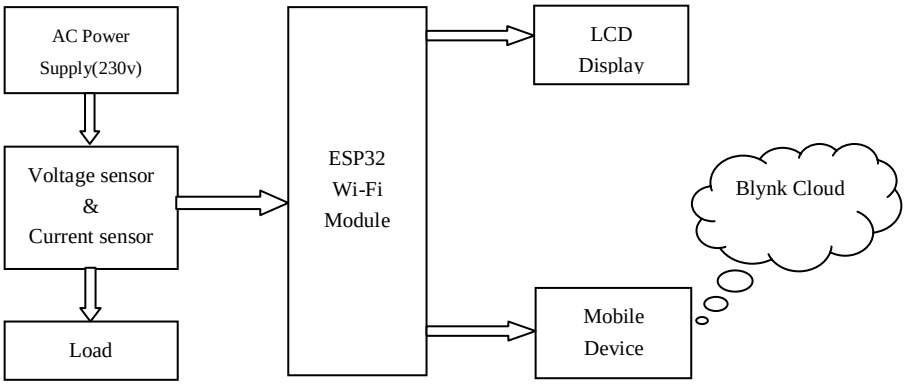
  It is a Non-invasive AC Current Sensor Split Core Type Clamp Meter Sensor that is used to measure AC. It can be measured up to 100 amperes. The Current transformers (CTs) are sensors for measuring alternating current. They are very helpful in measuring the whole building's electricity consumption. This sensor can be connectedstraight to the live or neutral wire without any high voltage electrical work. It has a primary and secondary winding with a magnetic core. The secondary winding is comprised of many turns of fine wire housed within the casing of the transformer. It can take up to 50A of AC current with voltage ranging from 0-1V. The working Temperature is ranging from -25 degrees to +70 degrees.

- **Blynk Application:**

  Blynk is a Mobile Application platform mainly used for IoT based projects using Raspberry pie, Arduino Microcontroller. It is a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets The mobile application is available in Android and iOS.
- **Arduino IDE:**

  For programming the ESP32 module or microcontroller, the Arduino integrated development environment (IDE) is used write code and upload it to the board. It is an open-source software, where it includes inbuilt libraries for ESP32, LCD and Blynk Application. It runs on Windows, Linux, and as well as in Mac OS. Embedded C language is used for programming in this project.

4.3. BLOCK DIAGRAM



4.4. WORKING PROCEDURE

The Device which is developed was tested with a load as a bulb(60W) as shown in the figures below. The ESP32 is programmed to collect voltage and current from the sensors. The project consists mainly of ESP32 Wi-Fi Module, Voltage Sensor, Current Sensor, Smartphone Application (Blynk), Resistors, Capacitors and power supply, The software used for the development of this project is Arduino IDE. The Voltage sensor and Current sensors play an important role in this system and are used for the measurement of Voltage and current.

Initially, a load such as a Bulb or any Electrical appliance is Connected to the Main Supply and Turned On. Then, Voltage and Current Sensors are Connected in between these components. And the Output pins of these sensors are connected to any analog pins that are available in the ESP32 module. The Sensor Output pins are connected to only analog pins because their output will be in analog form. And The ESP32 module is programmed using Arduino IDE. It is programmed in such a way that the data captured by the sensors is continuously displayed on both LCD and Mobile application (Blynk). ESP32 module is interfaced to both LCD and mobile device.

5. RESULT

The Device which is developed was tested with a load as bulb(60W) as shown in the figures below. The ESP32 is programmed to collect voltage and current from the sensors.
Initially when it is turned on, ESP32 Board will send request to the **Wi-Fi Network** with appropriate **SSID** & **Password**.
The output data of the sensors is processed and uploaded to **Blynk Application** continuously **5 seconds**. The data is observed on Serial Monitor as well as Blynk Application as shown in figures1 and 2.

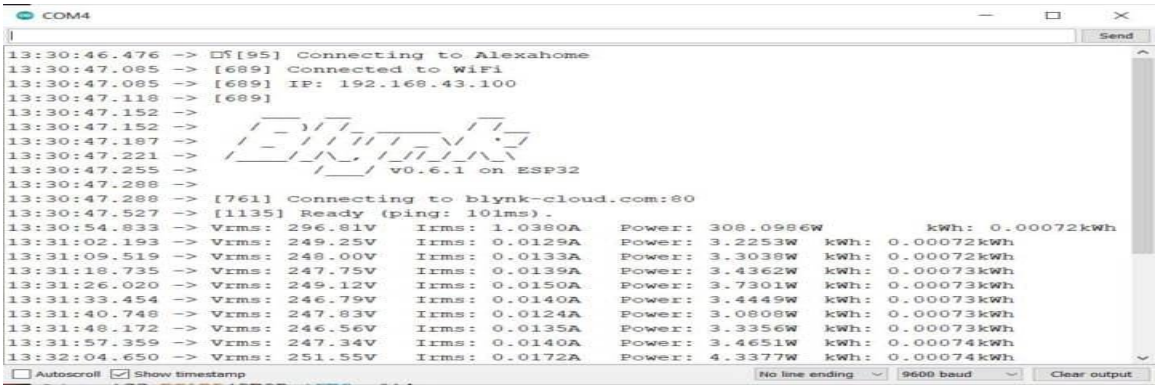


FIGURE 1.

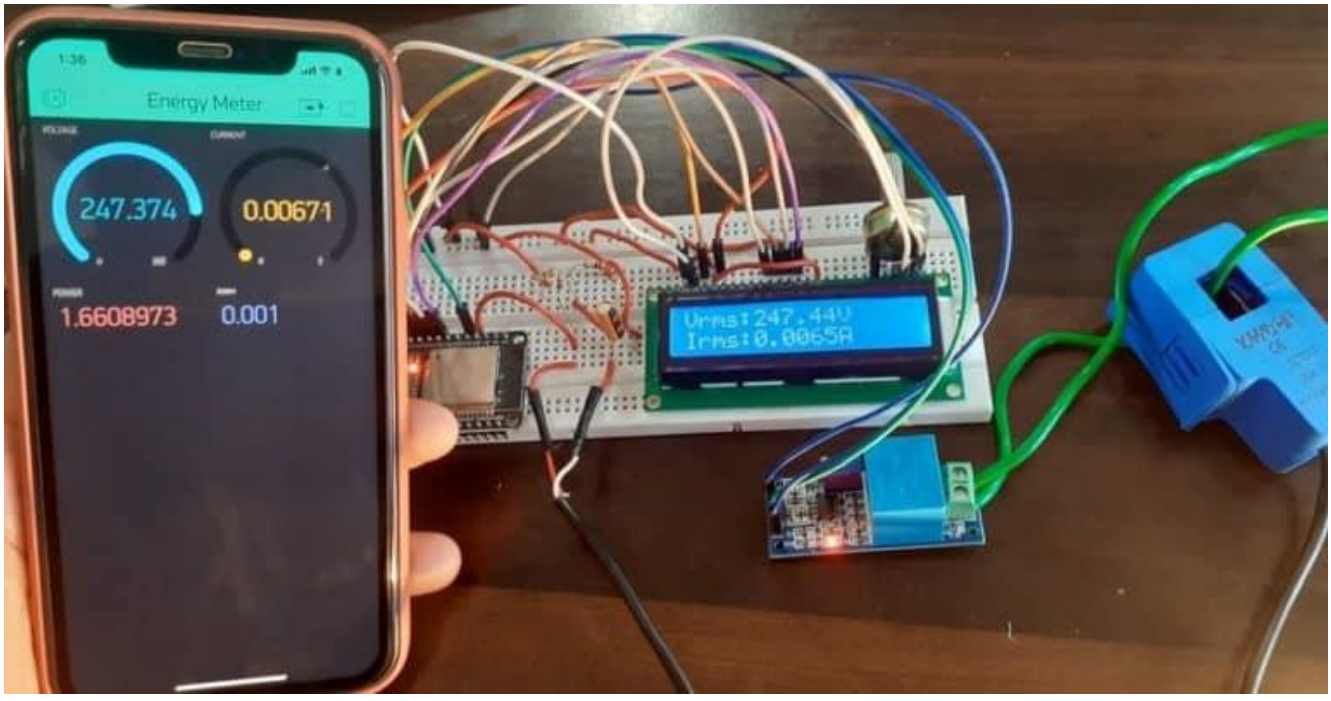


FIGURE 2.

Thus, we can use this **IoT Based Electricity Meter** to monitor the electricity consumption of any household or commercial appliances.

6. CONCLUSION

A wireless device is designed to monitor the electricity consumed and this data is sent to the smartphone application through the Esp32 module.
This system allows the Individuals and Suppliers to monitor and track their energy usages. By using this device, Individuals will be able to know their usage and they can limit their usage without exceeding it. The information about consumption helps the Individuals to reduce their consumption which further leads to saving energy and money.

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