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Iot Based Smart Electricity Energy Meter Using ESP32 and Blynk Application

Sumanta Karmakar[1], Akshat Gohil[2], Ankita Biswas[3], Monish Roy[4], Priyanshu Bikram[5], Shambhabi Raj[6],Tarun Ball[7]

Assistant Professor[1], Students[2, 3, 4,5,6,7]

Department of Electronics and Communication Engineering

Asansol Engineering College

Corresponding Author's Email: *sumantakarmakar799@gmail.com[1]*

Abstract

The growing global concern for efficient energy consumption and environmental sustainability has spurred the development of innovative technologies to monitor and manage energy usage. In this context, this project presents the design and implementation of a smart energy meter using the Blynk application as an IoT interface. The integration of Blynk offers a user-friendly and accessible platform for real-time energy monitoring, data visualization, and remote control, enabling individuals and organizations to make informed decisions about their energy consumption patterns.

The smart energy meter system consists of an energy meter, a microcontroller, and connectivity modules. The energy meter serves as the primary data source, measuring electricity consumption and providing key parameters such as voltage, current, and power factor. The microcontroller, based on Arduino, acts as the central processing unit, collecting data from the energy meter and establishing a connection with the Blynk application through Wi-Fi or Ethernet connectivity modules. This connection enables seamless data transmission and synchronization with the Blynk server, facilitating real-time energy monitoring and control.

The Blynk application serves as the user interface for energy data visualization and management. Users can access their energy consumption

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information through a smartphone or tablet, making it convenient and accessible from anywhere. The application's intuitive dashboard provides interactive charts, graphs, and statistics that enable users to monitor their energy usage patterns and identify potential inefficiencies. Additionally, the Blynk application offers features such as setting energy consumption thresholds and receiving notifications when limits are exceeded, empowering users to take proactive steps towards energy conservation.

Remote control capabilities are another crucial aspect of the smart energy meter system. Through the Blynk application, users can remotely control connected devices or appliances, enabling them to schedule operations, turn off energy-consuming devices, or activate energy-saving modes. This functionality promotes energy conservation and facilitates the implementation of demand-response strategies in residential, commercial, and industrial settings.

The project's significance lies in its potential to revolutionize energy monitoring and management practices. By leveraging the power of IoT technology and the user-friendly Blynk interface, the smart energy meter system provides an accessible and efficient solution for individuals and organizations to optimize their energy usage. It empowers users to make informed decisions based on real-time data, reducing energy waste, and promoting sustainable practices.

Keywords- *IoT, Electricity Energy Meter, Blynk Application*

INTRODUCTION

In an increasingly digital world, the demand for efficient and sustainable energy consumption has never been more critical. Monitoring and managing energy usage play a pivotal role in reducing waste, promoting sustainability, and empowering individuals and organizations to make informed decisions about their energy consumption patterns. With the advent of Internet of Things (IoT) technology, it is now possible to create smart energy meters that provide real-time data and intuitive interfaces for users. This project aims to build a smart

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energy meter using the Blynk application as an IoT interface, offering an innovative and accessible solution to track and control energy consumption.

The smart energy meter is a transformative device that goes beyond traditional energy monitoring systems. By integrating the Blynk application, a powerful IoT platform, users gain remote access to energy consumption data, enabling them to monitor, analyze, and optimize their energy usage from anywhere in the world.

With its user-friendly interface and interactive features, the Blynk application empowers individuals, businesses, and even utility companies to make informed decisions about energy consumption, leading to a more sustainable and cost-effective approach to energy management.

The project's hardware setup revolves around the integration of an energy meter, microcontroller, and connectivity modules. The energy meter, a fundamental component, measures electricity consumption and provides vital data points such as voltage, current, and power factor.

The microcontroller, such as Arduino or Raspberry Pi, acts as the brain of the system, responsible for capturing energy meter data and establishing communication with the Blynk application. Connectivity modules, such as Wi-Fi or Ethernet, enable seamless data transmission between the microcontroller and the Blynk server, ensuring real-time energy monitoring and control.

With the Blynk application as the IoT interface, users can access their energy consumption data via a smartphone or tablet. The application provides an intuitive dashboard where users can visualize and analyze their energy usage patterns through interactive charts, graphs, and statistics.

Users can set energy consumption thresholds and receive notifications when those limits are exceeded, helping them identify potential energy inefficiencies and take corrective actions promptly. Furthermore, the Blynk application allows for remote control of connected devices

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or appliances, enabling users to turn off or schedule the operation of energy-consuming devices, promoting energy conservation.

One of the notable advantages of this project lies in its potential applications across various sectors. In homes, the smart energy meter empowers residents to monitor and optimize energy consumption, leading to reduced utility bills and environmental impact.

Businesses and industries can benefit from accurate energy monitoring to identify energy-intensive processes, optimize equipment usage, and streamline operations. Utility companies can leverage the data collected from smart energy meters to implement demand-response programs, better manage energy distribution, and create more sustainable energy grids.

One of the problems is the world faced is the interruption of electricity bills during Covid-19 pandemic Movement Control Order (MCO) period. Many concerns about overloaded electricity bills during the period are recorded due to this problem. This is because they unable to self-remote their energy usage to get correct reading of their electricity bill. To resolve this problem, a method has been proposed by many researchers where the user can check their usage of electricity and for billing purposes.

The proposed system is designed single-phase energy meter monitoring system based a smart meter or digital meter which is a tool that wireless monitor the user's daily amount of electricity and can display their dailyelectricity data from the smartphone. As a result, this would help to maximize the use of home energy and the effective energy management system where smart city concept follows.

In conclusion, the development of a smart energy meter using the Blynk application as an IoT interface represents a significant advancement in energy monitoring and management. This project combines the power of IoT technology with user-friendly interfaces, empowering individuals and organizations to make informed decisions about their energy consumption, reduce waste, and contribute to a more sustainable future. By harnessing the potential of smart energy meters, we can pave the way for a more efficient and environmentally conscious society.

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Objective

The objective of this project is to design and implement a smart energy meter system using the ESP32 microcontroller as a Wi-Fi and Bluetooth module, in conjunction with the Blynk application as an IoT interface. The primary goal is to enable real-time monitoring and control of energy consumption in order to promote energy efficiency, reduce waste, and facilitate sustainable practices.

The project aims to integrate current and voltage sensors with the ESP32 microcontroller to accurately measure and collect energy data. The ESP32, equipped with Wi-Fi and Bluetooth capabilities, establishes a connection to the Blynk application, allowing for seamless transmission of energy consumption data to the user's smartphone or tablet. The Blynk application serves as the user interface, providing a user-friendly dashboard that displays energy usage information in real-time.

The objective is to create an intuitive and interactive interface within the Blynk application, allowing users to visualize their energy consumption patterns through graphs, charts, and statistics. Additionally, the system will provide features such as setting energy consumption thresholds and receiving notifications when limits are exceeded, empowering users to take proactive measures in optimizing their energy usage.

By leveraging the capabilities of the ESP32 microcontroller, the Blynk application, and the integration of current and voltage sensors, this project aims to deliver a comprehensive smart energy meter system. The system will not only enable users to monitor their energy consumption but also provide them with the ability to remotely control connected devices or appliances, promoting energy conservation and enhancing overall energy management.

Overall, the objective of this project is to develop an efficient and user-friendly smart energy meter system that empowers users to make informed decisions about their energy consumption, reduce waste, and contribute to a more sustainable future.

Proposed System

In the proposed technique the customer can deal with their vitality utilization by knowing their vitality use time to time. The strategy not just gives two path interchanges amongst

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utility and purchaser yet in addition gives different capacities that are if the customer neglects to pay the power charge the vitality supply would be chopped down from the utility side and once the bill is paid the vitality supply is reconnected.

In addition with the existing system innovative to include an alert message to the user energy consumed for 15 days once, constant alert message with payments details and power usage until the payment is done. To avoid the further consumption of energy, we are setting a limit for each household and if the limit exceeds methods are used to cut down the appliances according to the user convenience both automatically and manually. If there is a fault in e-meter it also sends a notification to the user.

IOT Server - Cayenne.com is used as a cloud server. Cayenne is a first online builder/tool to create IOT projects. Voltage and current values are continuously stored in server. Alerts can be scheduled in a server.

The proposed framework for the most part works in two modes.

1. Automatic Mode
2. Manual Mode

Mode Selection –

Automatic Mode: In this mode it crossed to the limit automatically device will cut-off. The device is selected by user convenience.

Manual Mode: In this mode the switch is manually turned to manual mode. During the manual mode the customer can consumed as much as it is required by the presence of customer known.

Problem Analysis- The power board have used to the manual procedure and they oblige it despite the fact that there are numerous worries combined with it. In light of the human blunders in the wake of getting staff charge, it is the issue of client to get yet adjusted from the vitality supply board. All things considered client needs to visit the workplace, remain in line and get it rectified.

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The issue is a result of human intercession.

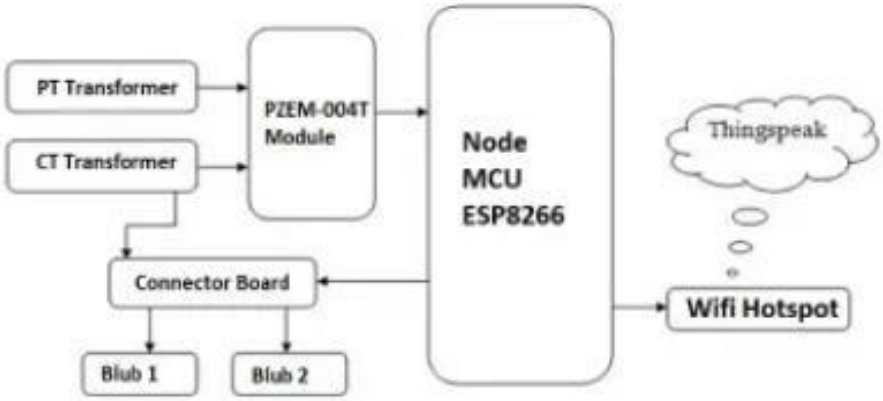

Figure 1. Block Diagram

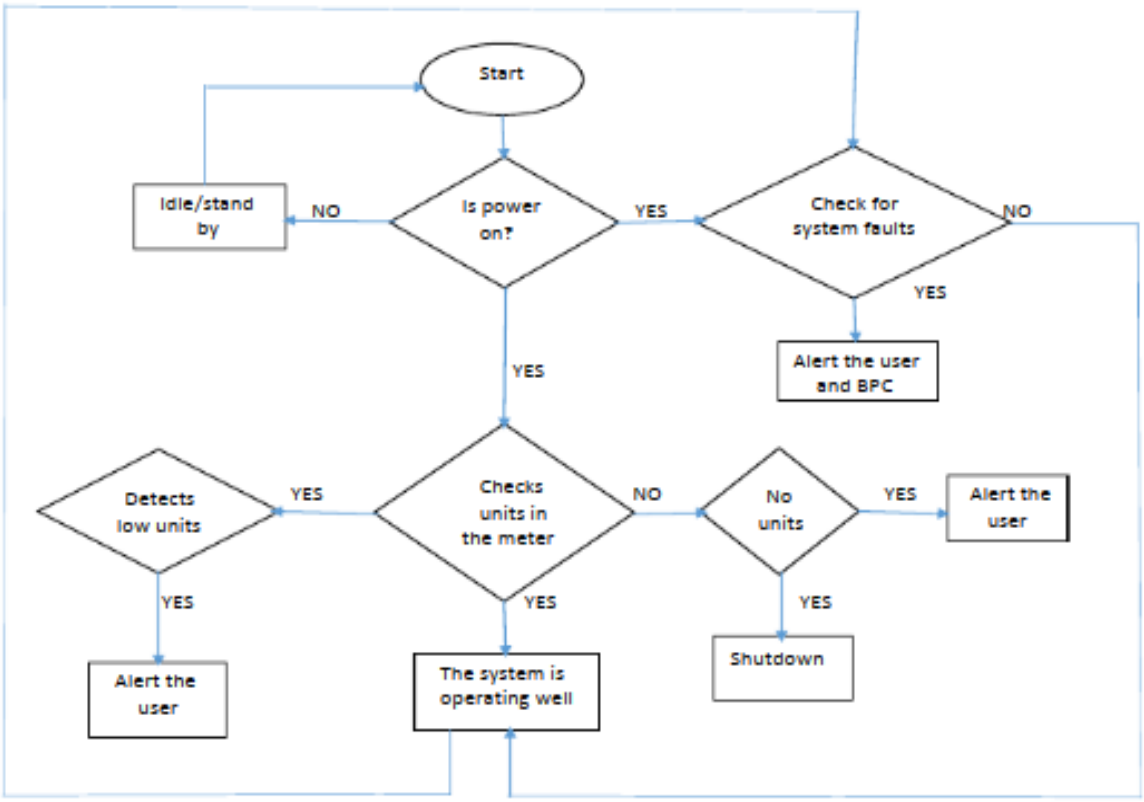

Fig. 2: flow chart

RESULT

Implementation

The smart electricity meter using Wi-Fi module can be easily deciphered in to two parts.

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The first part being the physical part and the second one being the Webpage.

The physical part

It consists of the Arduino board, ESP32 Wi-Fi module, 16*2 LCD display, buzzer and power supply. 3.1.1. Arduino Uno board Arduino is a microcontroller board and it is based on the AT mega 328P. It consists of 14 digital I/O pins and 6 analog input pins and a crystal oscillator of 16 MHz frequency, a power supply jack and a USB port to dump the code, ICSP header and a reset button. It can be powered with the power jack at the start and later can be powered with AC to DC adapter or with a battery.

ESP 8266 Wi-Fi module:

The ESP 8266 Wi-Fi module is a low cost component with which manufacturers are making wirelessly networkable microcontroller module. ESP32 WiFi module is a system-on-a-chip with capabilities for 2.4GHz range. It employs a 32 bit RISC CPU running at 80 MHz. It is based on the TCP/IP (Transfer control protocol) . It is the most important component in the system as it performs the IOT operation. It has 64 kb boot ROM, 64 kb instruction RAM, 96 kb data RAM. Wi-Fi unit performs IOT operation by sending energy meter data to webpage which can be accessed through IP address. The TX, RX pins are connected to the 7 and 8 pins of the Arduino microcontroller.

16*2 LCD Display:

LCD (Liquid crystal display) screen is an electronic display module and finds a wide range of applications. 16*2 display means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5*7 pixel matrix. The 11, 12, 13 and 14 pins of the display are used as data pins for Arduino interfacing. It is used to display the wattage.

Working Of E-Meter:

The meter which is utilized for estimating the vitality and uses by the electric board is known as the vitality meter. The vitality is the aggregate power expended and used by the heap at a specific interim of time. It is utilized as a part of residential and mechanical AC circuit for estimating the power utilization. The meter is more affordable and precise. Essential unit of energy is watts. One thousand watts is one kilowatt. In the event that we utilize one kilowatt in 60 minutes, it is considered as one unit of vitality devoured. These meters measure the

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prompt voltage and streams. This power is incorporated over a period which gives the vitality used over that day and age.

Future Scope OfImprovement:

This project practically describes the usage of "IOT BASED SMART ENERGY METER". The technological advancement in every field is a non-stop process. Smart electricity meter using IOT is based on new and efficient technology to achieve future prospective.

The proposed model automates the process of billing and detects tampering, eliminating the manual intervention. It also allows remote monitoring of energy meter.

In future, the proposed system can be extended to be used as prepaid energy meters. These meters can be recharged according to the user's need thus saving any additional cost in the billing

Following are the future scope in order to save electric power and to detect theft:-

- There can be a system where Automatic Switching of electric equipment's by the use of IoT is applied.
- To make a system where user can receive SMS, if one crosses threshold of electricity usage.
- To make a IoT system where user can monitor energy consumption and pay electricity bill online
- User receives SMS when theft detected at consumer end.
- Application of IoT based theft detection buzzer with Energy Meter.

The project is focused on the government's plan to turn the major cities of the country into smart cities. The project provides the entire energy readings at one's finger tips. The project can be further extended to detect the energy meter tampering. A smart app can be designed to provide various alerts based on the readings from the device.

A unified can be provided to the customers for both viewing the energy usage and a platform to pay the bill online follow the digital India initiative. In one case the service provider can evaluate the bills which are not paid and can disconnect the energy connection remotely.

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CONCLUSION

The main cause for the design of IOT based E-meter is to reduce the power consumption in house. It avoids the human intervention reduces the cost, save human power. It works both automatically and manually. This meter sends billing directly to mobile before due date without causing human intervention.

This computerization for diminish the work costs as well as makes the framework more effective and exact. The system is mainly intended for smart cities with public Wi-Fi hotspots. The project is based on the internet of things concept. This is aimed at replacing the old energy meters with an advanced implementation. It can be used for automatic power reading by which one can optimize their power usage thereby reducing the power wastage. The readings from the meter are uploaded to Thingspeak.com where a channel with the energy usage for a particular energy meter can be viewed by both the service end and the customer. Conclusion In the era of smart city advancement, this project is concentrated on the connectivity & networking factor of the IoT.

In this project, an energy consumption calculation based on the counting of calibration pulses is designed and implemented using PIC16F*&A MCU in embedded system domain. In the proposed work, IoT and PLC based meter reading system is designed to continuously monitor the meter reading and service provider can disconnect the power source whenever the customer does not pay the monthly bill and also it eliminates the human involvement, delivers effective meter reading, prevent the billing mistake.

The Project has achieved following objectives:-

1. Ease of accessing information for consumer from energy meter through IoT.
2. Theft detection at consumer end in real time.
3. LCD displays energy consumption units and temperature.
4. Disconnection of service from remote server. Future enhancement In the present system, IoT energy meter consumption is accessed using Wi-Fi and it will help consumers to avoid unwanted use of electricity. The performance of the system can be enhanced by connecting all household electrical appliances to IoT.

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