



IOT BASED SMART ENERGY PREPAID METER

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Abstract— The Smart Prepaid Energy Meter with individual load measurement is designed to automate the energy billing process and provide real-time analysis of energy consumption. The system allows users to prepay for electricity and monitors the usage of individual appliances through load measurement. The integration of IoT technology ensures continuous monitoring and provides consumers with the ability to analyze their consumption patterns. This project helps in reducing human errors in meter reading, enhances energy conservation, and prevents electricity theft.

Keyword sot: Internet of Things, GSM: Global System for Mobile Communications, ESP32: A microcontroller with integrated Wi-Fi and Bluetooth, LCD: Liquid Crystal Display, kWh: Kilowatt-hour, BMS: Billing Management System, API: Application Programming Interface, AC: Alternating Current DC: Direct Current

I. INTRODUCTION

The rapid advancement of technology has significantly transformed various sectors, and the energy sector is no exception. With the increasing demand for energy and the need for efficient management of resources, traditional metering systems are becoming inadequate. The integration of the Internet of Things (IoT) into energy metering has emerged as a promising solution to address these challenges. IoT-based smart energy prepaid meters represent a revolutionary approach to energy consumption monitoring, billing, and management. Smart energy prepaid meters leverage IoT technology to provide real-time data on energy usage, enabling consumers to monitor their consumption patterns and manage their energy budgets effectively. Unlike conventional meters, which often require manual readings and can lead to billing discrepancies, smart meters automate the metering process, ensuring accuracy and transparency. This automation not only enhances user experience but also reduces operational costs for utility providers. Moreover, the prepaid model empowers consumers by allowing them to pay for energy in

advance, thereby promoting responsible energy usage and reducing the risk of unpaid bills. This system is particularly beneficial in regions with high rates of energy theft, as it incorporates advanced security features that can detect irregularities in consumption patterns and alert providers to potential fraud. The implementation of IoT-based smart energy prepaid meters also facilitates the integration of renewable energy sources into the grid, supporting the transition towards sustainable energy systems. By providing real-time data analytics, these smart meters enable better demand forecasting and grid management, ultimately contributing to a more resilient and efficient energy infrastructure. This research paper aims to explore the design, implementation, and impact of IoT-based smart energy prepaid meters. It will examine the technological components, benefits, challenges, and future prospects of this innovative solution, highlighting its potential to revolutionize energy management and consumption in the modern world. Through a comprehensive analysis, this study seeks to contribute to the growing body of knowledge in the field of smart energy systems and provide insights for stakeholders involved in energy distribution and management

II. LITERATURE VIEW

Literature on IoT-based smart energy prepaid meters identifies numerous designs and implementations focused on improving energy management and billing effectiveness. Major studies concentrate on real-time monitoring, user experience, and the integration of smart card systems to allow prepaid tracking of energy consumption. Key Studies and Innovations:

Smart Card-Based Systems: Studies show that smart card technology can make the prepaid energy meter process more efficient. Customers top up their smart cards, which are then utilized to retrieve energy consumption information. This process reduces errors in billing and increases user control over energy consumption.

Automated Metering Solutions: Recent research suggests multifunctional smart energy meters that automate the billing

and metering process. These systems use IoT connectivity to offer real-time information to consumers, minimizing the need for manual readings and enhancing accuracy.

Mobile Application Integration: Various studies highlight the significance of mobile applications for prepaid energy meters. The apps enable users to track their energy usage, low balance notifications, and effortless account recharging.

Challenges Addressed: Common challenges in conventional energy billing systems, including electricity theft, complex billing procedures, and high manpower requirements, are highlighted by literature. IoT-based prepaid meters seek to overcome these challenges with a more efficient and convenient solution.

Future Directions

Extension to Other Utilities: Future studies propose that the concepts of IoT-based prepaid meters can be extended to other utilities like water and gas for better management of resources overall.

Increased User Control: Features may be included to enable users to remotely control their electrical appliances via mobile apps, increasing flexibility and energy saving.

Cost Savings: Continuous innovation in these systems focuses on lowering service providers' operating costs while presenting consumers with an easier means of managing their energy bills.

This literature review highlights the revolutionary role that IoT-based prepaid energy meters can play in contemporary energy management systems

III. PROPOSED WORK

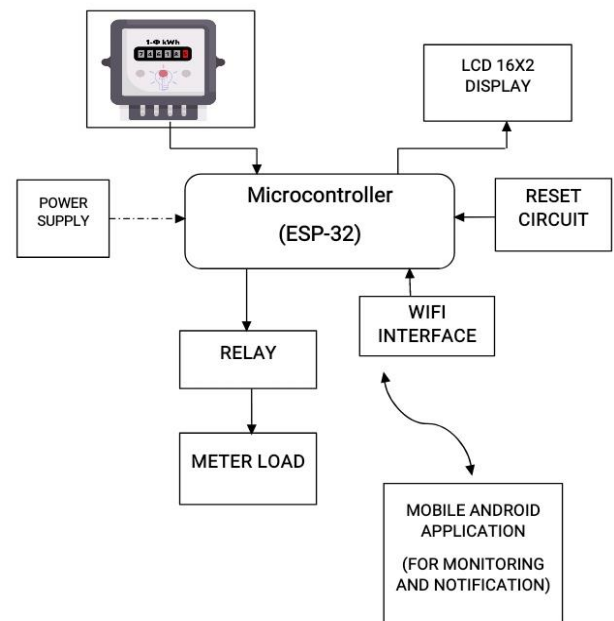
The proposed work involves developing an IoT-based smart energy prepaid meter using the ESP32 microcontroller. This system will enable real-time monitoring of energy consumption, facilitate prepaid transactions, and provide users with access to their energy usage data via a mobile application, enhancing user experience and energy management.

Key Features:

- To Monitor All Meter Reading Online (No Need to Take Meter Reading Physically)
- To Disconnect Electricity Automatically if Bill is Unpaid or Balance Over
- To Recharge Meter Online
- Daily Consumption based Payment Deduction
- WIFI Based Connectivity
- BLYNK Server Based Mobile Application
- Embedded C Based Hardware Programming

- Eagle PCB Designing Software for PCB And Schematic Design

IoT BASED SMART ENERGY METER



The diagram illustrates an IoT-based smart energy meter system. It consists of several components working together to measure, monitor, and manage energy consumption:

Power Supply: Provides the necessary power to operate the system.

Energy Meter: Measures the energy consumption (in kWh).

Microcontroller (ESP-32): The central processing unit that controls the entire system. It receives data from the energy meter, processes it, and communicates with other components.

LCD 16x2 Display: Shows real-time energy consumption data.

Reset Circuit: Allows for resetting the microcontroller if needed.

Relay: Acts as a switch to control the power supply to the load based on the microcontroller's instructions.

Wi-Fi Interface: Enables wireless communication with a network, allowing data transmission to a remote server or mobile application.

Mobile Android Application: Used for monitoring energy consumption and receiving notifications.



but also supports the integration of renewable energy sources and smart home technologies, paving the way for a more efficient and sustainable energy future.

VII. REFERENCES:

- [1]. Nabil Mohammad, huAnomadarsiBarua and Muhammad Abdullah Arafat Department of Electrical and Electronic Engineering, "A Smart Prepaid Energy Metering System to Control Electricity Theft?", International Conference on Power, Energy and Control (ICPEC) 2013.
- [2]. Visalatchi S and Kamal Sandeep K, "Smart Energy Metering and Power Theft Control using Arduino& GSM?", 2nd International Conference for Convergence in Technology 2017.
- [3]. Mohammed Hossein and HosseinHejazi Design and Implementation of an Internet of Things Based Smart Energy Metering 6th IEEE International Conference on Smart Energy Grid Engineering in 2008
- [4]. Somchai Thepphaeng, Chaayod Pirak. Design and Implementation of Wireless Sensor Network and Protocol for Smart Energy Meter. 2011 International Conference on Circuits, System and Simulation IPCSIT Vol.7 (2011) © (2011)IACSIT Press, Singapore.
- [5]. S. Metering, S. Visalatchi and K. K. Sandeep, "\"Smart energy metering and power theft control using arduino& GSM,\" 2nd International Conference for Convergence in Technology (12CT), Mumbai, 2017, pp. 858-961.
- [6]. Somchai Thepphaeng; Chaayod Pirak. Design and Implementation of Wireless Sensor Network and Protocol for Smart Energy Meter. 2011 International Conference on Circuits, System and Simulation IPCSIT vol.7 (2011) © (2011)IACSIT Press, Singapore.
- [7]. Md Redwanul Islam, Supriya Sarker, Md Shahradian Mazumder, Mehnaj Rahman Ranim, "An IoT-based Realtime Low-Cost Smart Energy Meter Monitoring System using Android Application", International Journal of Engineering and Techniques - Volume 5 Issue 3, June 2019.
- [8]. Somchai Thepphaeng; Chaayod Pirak. Design and Implementation of Wireless Sensor Network and Protocol for Smart Energy Meter. 2011 International Conference on Circuits, System and Simulation IPCSIT vol.7 (2011) © (2011)IACSIT Press, Singapore.
- [9]. Chih-Yung Chang, Chin-Hwa Kuo, Jian-Cheng Chen and Tzu-Chia Wang Design and Implementation of an IoT Access Point for Smart Home. Applied Science; ISSN 2076-3417. www.mdpi.com/journal/applsci
- [10]. Su, J.H.; Lee, C.S.; Wu, W.C. The Design and Implementation of a Low-Cost and Programmable Home Automation Module. IEEE Trans. Consum. Electron. 2006, 52, 1239–1244.
- [11]. S. Metering, S. Visalatchi and K. K. Sandeep, "Smart energy metering and power theft control using arduino & GSM," 2nd International Conference for Convergence in Technology (I2CT), Mumbai, 2017, pp. 858-961.
- [12]. Mr. Rajesh Kumar, D. Modi, Mr. Rajesh Sukhadi, "A Analysis on IOT Based Smart Electricity Meter ", International Paper For Technical Research In Engineering, Vol. 2, Issue 3, 2016.
- [13]. Md Redwanul Islam, Supriya Sarker, Md Shahradian Mazumder, Mehnaj Rahman Ranim, "An IoT-based Realtime Low-Cost Smart Energy Meter Monitoring System using Android Application", International Journal of Engineering and Techniques - Volume 5 Issue 3, June 2019.
- [14]. Md. Masudur Rahman; Noor-E-Jannat; Mohd. Ohidul Islam; Md. Serazus Salakin, "Arduino and GSM Based Smart Energy Meter for Advanced Metering and Billing System", Int. Conf. on Electrical Engineering and Information & Communication Technology (ICEEICT), Jahangirnagar University, Dhaka-I Bangladesh, pp. 1-6, 2015
- [15]. Michael C. Lorek, Fabien Chraim and Kristofer S. J. Pister, "Plug Through Energy Monitor for Plug Load Electrical Devices," IEEE conference on SENSORS, pp. 1-4, 2015.