# IOT BASED ENERGY METER

**Kiran Kumar Rapaka[1], Dr. S N Lakshmipathi Raju N[2], N Phani Kumar[3], M Mounika Varalakshmi[4]**

[1]M.tech, Dept of ECE,B V C Engineering college, Andhra Pradesh, India.

[2]Professor, Dept of ECE,B V C Engineering college, Andhra Pradesh, India.

[3]Assistant Professor, Dept of ECE,B V C Engineering college, Andhra Pradesh, India.

[4] Assistant Professor, Dept of ECE,B V C Engineering college, Andhra Pradesh, India.

**ABSTRACT:** *Nowadays IoT based applications are becoming more popular because it provides efficient solutions for many real time problems. In this project, an IoT based electric meter monitoring system using android application has been proposed that aims to reduce manual efforts for measuring the electricity units and make users concern about the excessive usage of electricity. Arduino Uno and an optical sensor are used to fetch the pulse of the electric meter. In order to reduce human error and cost in energy consumption, a low-cost wireless sensor network is implemented for digital energy meter and a mobile application that automatically capable of interpret the unit's meter.*

***Keywords:*** *IOT, Energy meter, voltage sensor, current sensor, WSN, wifi.*

## INTRODUCTION

Now the growth of population is increased day by day. Due to this reason, the residential places and industries need a large amount of current. Various systems are already introduced to save energy from residential electric meter devices. In traditional days, the energy meter device fits inside the users' premises. The consumption rate was taken by human beings and updated into the system. This system was extremely dependent on operator. The operator wet it to the users' locations for collecting the information. It is a very difficult process. To avoid this condition, the proposed system is used to measure the current consumption rate automatically. This system is used to collect the current consumption value and provide the alert message to the user with IoT. The IoT concept permits physical devices to be measured and managed vaguely across an already available network connection, creating direct communication between the real world and computer systems. The result of the IoT technique is getting an accurate result and avail financial benefit. This technology has developed from its starting stage and currently using this concept. Electricity is important in everyone's life. Without electricity, people cannot able live in this current world. This proposed system is used to collect the data from the user's location and use it for the bill

calculating process. The measured value will be stored on the server, and it is used for amount calculation also. This system measures the current consumption units accurately. This system removes human intervention. This proposed system displays the real-time current consumption data on the LCD screen. Wi-Fi modem can be used to check the consumed units and give threshold unit level via a webpage.

**Main objective:**

Central to the realization of our vision is the development of an affordable energy metering system, meticulously crafted from off-the-shelf components readily available in the market. The cornerstone of our system architecture is the ESP32 module, a versatile microcontroller renowned for its robust performance and extensive feature set. Augmenting this core component are specialized sensors, including current and voltage sensors, tasked with the precise measurement of energy consumption parameters. Additionally, the inclusion of relay modules enables seamless control over connected loads, facilitating remote management functionalities. The orchestrated integration of these components culminates in a cohesive system architecture, engineered to deliver real-time monitoring capabilities for energy consumption. Through the seamless transmission of data to a centralized platform, users gain unfettered access to actionable insights into their energy usage patterns. Furthermore, the provision of remote-control functionalities empowers users to exercise granular control over connected loads, fostering a culture of proactive energy management. In essence, our project represents a testament to the transformative potential of IoT technology in revolutionizing energy management paradigms. By democratizing access to advanced energy metering capabilities, we endeavour to empower users with the tools requisite for informed decision-making and sustainable energy utilization practices. Through the fusion of innovation and accessibility, we chart a course towards a future characterized by efficiency, precision, and environmental stewardship.

## LITERATURE SURVEY

[1] IoT Based Smart Energy Meter for Efficient Energy Utilization in Smart Grids

Authors: M. Mohanapriya, B. Anbuchezhian, Published in: 2019 International Conference on Intelligent Computing and Control Systems (ICCS). This paper presents an IoT-based smart energy meter that monitors real-time energy consumption and reports data to a central system for analysis and control in smart grids. The meter allows for efficient energy utilization and cost reduction.

[2] An IoT Based Smart Energy Meter for Energy Usage Efficiency

Authors: P. Kanakaraj, T. Rajini Girija, 2017 IEEE International Conference on Innovations in Green Energy and Healthcare Technologies (IGEHT). The study introduces an IoT-based smart meter system for real-time energy usage monitoring and data transmission, contributing to energy efficiency and conservation efforts. The system is designed to provide remote monitoring of energy usage patterns.

[3] Design and Implementation of IoT Based Smart Energy Meter

Authors: S. J. Vasant Kumar, V. S. K. Reddy, K. Harinath, M. V. Suresh, R. Rajya Lakshmi, Published in: 2020 International Conference on Smart Electronics and Communication (ICOSEC), This paper focuses on the design of an IoT-enabled energy meter that can monitor and control energy consumption. The system uses a microcontroller and cloud services to allow users to access energy usage data in real-time through mobile or web interfaces.

[4] IoT Based Power Monitoring and Control System for Smart Home

Authors: N. A. Samani, S. V. Dudhat, Published in: 2018 IEEE International Conference on Power, Control, Signals, and Instrumentation Engineering (ICPCSI), This work proposes a system that integrates an IoT-based energy meter with power monitoring capabilities for smart homes. It provides real-time data on power usage and allows users to control appliances remotely for energy-saving purposes.

[5] Smart Energy Meter Using IoT for Power Theft Detection and Monitoring

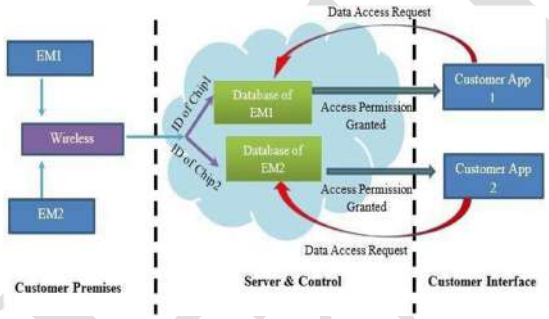
Authors: L. H. Sonawane, A. S. Kawadkar, A. S. Deshpande, V. V. Vaidya, Published in: 2019 International Journal of Engineering Research and Technology (IJERT), This paper explores an IoT-based energy meter that not only monitors power consumption but also detects energy theft. The system provides real-time data to utility companies for monitoring and controlling energy distribution effectively.

## Existing System

The present system only provides feedback to the customer at the end of the month. Also, the meter readings are taken manually. Consumer can know the units consumed by seeing their electricity bill only. Also, huge manpower is required to take the readings. There is no protection for energy meter tampering. The consumers cannot monitor the everyday energy consumption or usage. The major drawback of this system is the management of power consumption is difficult.

## Proposed System

In the proposed method, the consumer can manage their energy consumption by knowing their energy usage time to time. This method not only provides two way communications between utility and consumer but also provides other functions that are if the consumer fails to pay the electricity bill the energy supply would be cut down from the utility side and once the bill is paid the energy supply is reconnected. Another huge advantage of this system is that it notifies the consumer & utility at the event of the meter tampering. By this information the consumer & utility can control the tampering are reduce energy crises. The development of our IoT-based energy metering system necessitates a systematic approach encompassing component selection, hardware integration, software development, user interface design, and rigorous testing.




## WORKING METHODOLOGY

The size of IoT based meters and traditional meters is same and smart meters are digital. IoT based energy meter measures more detailed readings than Kwhr so that utility can plan the expansion of network and power quality. The IoT based Energy Meter is designed so that it measures voltage and date it's currents by the use of voltage and current sensors instead of potential and current transformers and then feeds these values of voltage and current into power factor controller IC and energy metering IC the power factor and power calculations respectively. The design of IoT based Energy Meter involves the measuring of load current and voltage using sensors and then feeding them to energy metering IC which converts into the real power consumed by the load. Power factor is measured by measuring the phase shift between voltage and load current. Microcontroller used to perform the calculations related to power and energy consumed and shows the reading on LCD as well as it sends the reading of IoT based Energy Meter with the help of Arduino board. Power, voltage, load current, power factor and units (kWh) are measured and displayed successfully. Meter reading are sent from Arduino board and received on mobile successfully. Two-way

communication is done by IoT based energy meter between the meter and utility administration as well as between meter and customer so that customer is able to check the status of his consumed energy units and can manage his load accordingly to reduce his bill. The main features of smart energy meter are listed as follows;

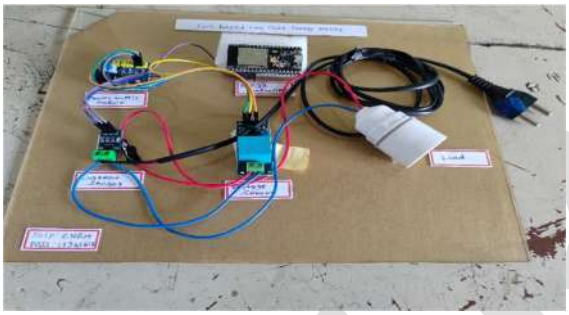


**Fig.1. Block diagram.**

**Working of IoT Energy Meter**

IoT based communications network is used to transfer the electricity consumed data to the utility administration as well as to the customer when demanded. Antenna, attached on or near meter box, can be used for improvement of signal strength in GSM communication. Smart metering communication is centralized meter reading, so meter readers don't need to visit each customer for data collection. However, for testing and maintenance meters may need to observe occasionally. The main duty of Energy Meter is to measure the meter reading and sends it to utility when demand as well as to costumer. The voltage and current sensors measure the RMS values of voltage and current and feed them to microcontroller, where calculations for active and reactive power are performed. In Smart Energy Meter we used sensors to measure voltage and current instead of current and voltage transformers.

**Voltage and current measurements.**

In this work, a current and voltage sensor is used to measure voltage and load current. We used SCT013-20A as current sensor that gives us RMS value of currents. Both AC and DC signals current measurement is precisely obtained by this current sensor. Current is measured by this sensor up to 20A. Overall power consumption, metering and measurements are taken by these sensors. Sensitive measurements of current are handled by using OPAMP stage. By adjusting the gain, we measure very small currents. SCT013-20A output voltage has linear variation with measured currents. Similarly, we measured voltage by SCT013-20A.

**Power factor measurements.**

Power factor is the cosine of angle between voltage and current. It actually measures how effectively the power is being converted into useful work. In our project we measured it by taking XOR of voltage and current waves with the help of microcontroller and LM358. We used LM 358 to convert weak sinusoidal signals to large square signals.

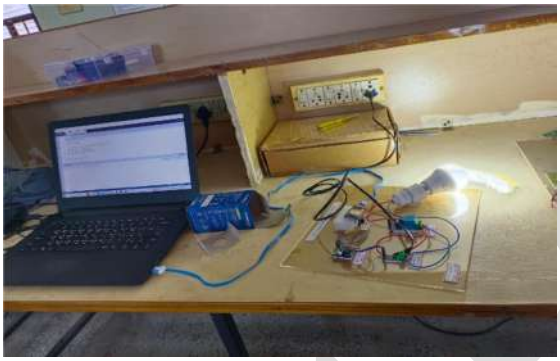


Fig.2. Overall IoT Meter Kit

**Display results**

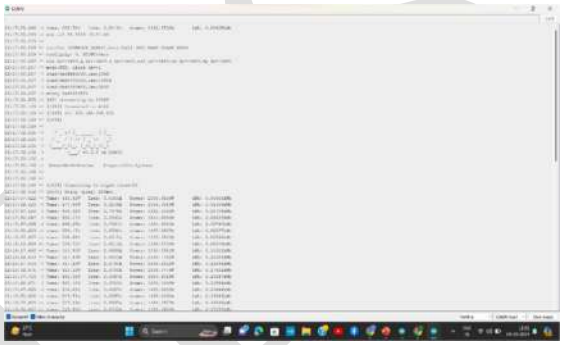


Fig.3. The above Figure displays the results in Laptop


Fig.4. Display results in Mobile

## CONCLUSION

The development of an IoT-based Smart Electricity Energy Meter, utilizing ESP32 and Blynk 2.0, signifies a significant leap forward in electricity consumption monitoring. By eliminating the need for manual readings, the system streamlines the process while ensuring accurate measurements through the integration of high-quality sensors. Moreover, the inclusion of the Blynk 2.0 dashboard facilitates remote access, empowering users to monitor their energy consumption from anywhere, at any time. This transformative solution holds immense promise in revolutionizing the way energy usage is monitored and managed, heralding a new era of efficiency and convenience in electricity consumption tracking

## FUTURE SCOPE:

The future of IoT-based low-cost energy meter development is rich with opportunities for innovation and advancement. One promising avenue is the enhancement of data analytics capabilities within these meters. This includes features like predictive maintenance, anomaly detection, and energy forecasting. By leveraging the vast amount of data collected by these meters, stakeholders can proactively identify and address potential issues, minimizing downtime and optimizing energy efficiency. Moreover, integrating emerging technologies such as machine learning and artificial intelligence can significantly augment the capabilities of IoT-based energy meters. With sophisticated algorithms, these systems can extract valuable insights from extensive datasets, enabling personalized energy management solutions tailored to individual preferences and usage patterns. This personalized approach not only enhances user satisfaction but also drives substantial energy savings by optimizing consumption based on real-time data and predictive modeling.

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