IJIREEICE ISSN (O) 2321-2004, ISSN (P) 2321-5526

International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified ⁜ Impact Factor 7.047 ⁜ Vol. 10, Issue 6, June 2022

DOI: 10.17148/IJIREEICE.2022.10614

IOT BASED ENERGY METERING FOR SINGLE PHASE LOAD USING CLOUD COMPUTING WITH GCP

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Abstract: The Internet of Things (IoT) concept, which has recently gained popularity in our lives, has created the potential to design and build energy-efficient smart devices, systems, and even whole cities. As a result of the important need for energy conservation, this project proposes a concept for an Internet of Things (IoT) based energy efficient wireless smart metering system that utilises the Internet of Things. It competes with the current metres in that it is a low-cost, fully integrated metering system that is completely integrated with the rest of the infrastructure. This service makes it possible for electrical supply companies to create user-friendly Android apps, as well as a website and database for their customers.Through this paper, we hope to bring in the Proof of Concept of a Precision Energy Metering for a greener and a brighter future. According to the proposed system design, accuracy is 97 percent, and the cost is about 25 percent less expensive than the cost of a comparable system design available on the global market. When compared to the prior iteration, the proposed design reduced power consumption by 16 percent.

Keywords: IOT, Cloud Computing, Smart Energy meter, GCP.

I. INTRODUCTION

In developing nations such as India, providing everyone with access to power is a significant issue in and of itself. The demand for electricity rises in tandem with the growth of the population and the expansion of the industry. Inefficient distribution results in a significant income disparity between the ordinary and the affluent [1]. Only a few segments of society have access to an infinite supply of power, and as a result, they are not concerned about the exploitation of this resource.

The dramatic expansion in urbanization over the last several years necessitates the development of sustainable, efficient, and intelligent solutions in areas such as transportation, government, the environment, quality of life, and other related areas. Since the inception of the Internet of Things idea in the early 2000s, the Internet of Things has grown to include a wide range of sophisticated and widespread applications for smart cities. It refers to the capacity of machines, networks, and sensors to communicate with one another, both with and without the involvement of a human being. The following is a simplified description of the Internet of things (IoT) fundamental simplified workflow: object sensing, identification, and transmission of object particular information, trigger an action, and finally, the smart device or system performs its service. The energy consumption of Internet of Things applications is increasing, and the number of IoT devices, as well as their needs, continues to expand. As a result, a new smart city must have the capacity to properly use energy while also dealing with the issues that come with it. The traditional electromechanical energy meters provide a significant contribution to the dissipation of energy in the environment.

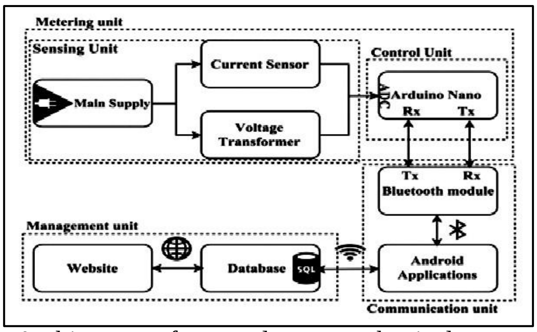

Fig.1. Architecture of smart electro-mechanical energy meters

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Customers are unable to maintain track of their energy use, mostly due to the fact that they are post-paid meters, unless on a monthly basis. Smart meters, discussed in figure 1 on the other hand, may be used to manage power use when they are programmed with household appliances. Furthermore, smart meters are less prone to human mistakes. Electronic measuring devices, known as smart meters, are used by electric utility companies to relay information about their consumers and the operation of their electric networks [2]. It comprises only a metering unit and a communication interface that connects the metering device to the utility's computer system.

The communication interface module is attached to the micro-controller and is responsible for transmitting and receiving information between the utility and the metering device placed in the home. This article describes the design and execution of a fully integrated smart energy-efficient metering system, which is both smart and energy-efficient. Smart metering systems with minimal power usage are provided by the design [3]. One end of the suggested design is implemented at the consumer level for IoT operation, while the other end is implemented at the service provider level for managing customers' data via an implemented website and customized database, respectively. Android apps are also meant to be more user-friendly on the client's end, making them more appealing to potential customers.

II. CONVENTIONAL SYSTEM

When it comes to developing nations, electromechanical meter reading devices are present in the homes and businesses of customers (both residential and commercial), and information is gathered monthly by using human resources. Price is a huge reason for the same. Consequently, such a meter has many drawbacks, including the following: A meter reader person is necessary to read the meter of each user in order to determine power usage. Meter reading fluctuations and inaccuracies are more common when electromechanical meters are used. When harsh weather circumstances arise and meters to be read are not readily accessible to the reading team, a calculated bill is employed, which is troublesome for both the consumer and the provider. Present-day advances in wireless smart technology have resulted in the widespread usage of wireless technology in AMR systems and a variety of other applications in industrialized nations, but it is also being employed in poor countries.

System in Use Until Now In order to calculate the amount of energy consumed in joules, energy meters continually measure the instantaneous voltage (volts) and current (amperes) to produce kilowatt-hours.

The electromechanical induction meter and the electronic meter are the two most common types of electricity meters used today. An electromechanical induction meter is one in which the total number of rotations of an aluminium disc is directly proportional to the amount of energy used [4].

Digital displays on LCD or LED screens indicate the amount of energy spent, as well as the amount of power factor and reactive power utilized. Electronic meters are also capable of transmitting the amount of energy consumed to distant locations through a communication network. Apart from measuring the amount of energy used, electronic meters may also record information about the load and the power supply, such as the instantaneous and maximum rates of utilization demanded by the load, voltages, power factor, and reactive power consumed, among other things. It is very dependent on the meter reader. When taking a manual meter reading, it is impossible to prevent making a mistake. When it comes to energy use, there is never any crosschecking or rechecking of human readers. Using software tools, it is possible to alter the readout of an energy meter while taking photographs of it [5].An increase in the number of meter reading staff results in additional expenditures for the organization in terms of recruiting them and their travel charges, which are prohibitively costly.Wherever the energy meter is situated within the home, it is possible that the reading will not be checked owing to the lock. It is not possible for the user to get information on his regular energy consumption. It is possible that the client will not get his or her energy bill at the normal interval of time before the due date.

III.PROPOSED SYSTEM

The concept is being offered in order to decrease the amount of human intervention required for the collection of the monthly reading and to reduce the number of technical difficulties associated with the billing process. The customer receives information from the electrical board section on the amount of the bill, how to make a payment, and the specifics of the pre-planned power outage [6].

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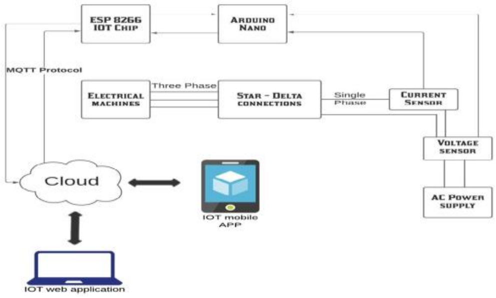

Fig. 2. Architecture of IoT based energy metering system for industries

If a consumer does not pay his or her bill on time, the user is notified by IoT via a text message or email. If the client continues to fail to pay the bill, an alarm message will be delivered, and then the power connection to the remote server will be automatically removed, according to the specified consideration [7]. It gives information about power outages in advance, as well as information on daily energy use [8]. It sends out an alarm if the energy usage surpasses a certain threshold. It also has the capability of terminating the power supply by the transmission of a message when the inhabitants are no longer present in order to reduce energy waste.

- In apartment buildings, the energy meter is located a long distance away from the inhabitants [9]. An LCD display is installed in each residential dwelling in the apartment complex to alert residents of power outages, daily energy usage, billing information, and an alarm for the critical limit indication, among other things.
- Electrical power has become indispensable as a result of technological advancements and the widespread use of electricity in all aspects of modern society. We are developing smart meters by using IoT [10].
- The data of the users is stored and delivered to the users' database using the mobile application, where the database is constantly updated by the data from each meter and then it may be altered through the utility website's user management interface.
- It is possible to purchase consumption plans and make online payments using the Android application that was developed [11]. Comparing the power consumption of the suggested design meter to the worldwide market design, reduced it by 16 percent.
- In order to charge for electricity, the power computed from the current sensor and the voltage sensor is converted to kilowatts and delivered to the billing company.
- This voltage detecting circuit is used to get direct current (DC) motion from an alternating current (AC) system for contributiontoa microcontroller. Current Sensor: The current is sensed by means of a current transformer, and it is corrected at the first operation amp stage and enhanced at the second operation amp stage of the operation.
- Control and Management Unit: This unit contains a microcontroller that is linked to the sensors and is responsible for reading the sensors and doing computations [12]. Furthermore, the data will be sent to the IoT chip.
- Once the samples have been gathered, they will be subjected to a series of mathematical procedures involving a set of discrete-time signals, which will allow for the calculation of power, energy, and power factor. Pushing data from the microcontroller to the database, and then buying that data back into the project with the IoT chip Nod MCU [13].
- Communication Unit: The communication unit is responsible for pushing data from the microcontroller to the database.

The below-mentioned images contain the device in action. The Node MCU is connected to the internet which periodically sends live data to the Database in GCP for Processing [14]. The Arduino Nano connected with other voltage sensors allows us to get real-time data about the current flow and know the status of the board. Below are a few images enclosed that depict and help us in analyzing how the setup works in a real-time environment.

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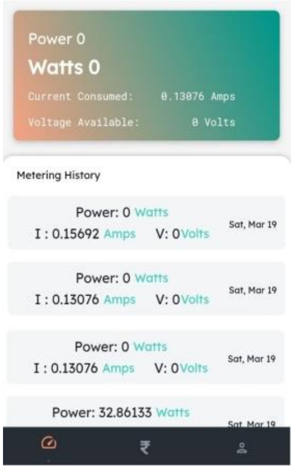

Fig.3.Android App with the Power Readings and other metrics

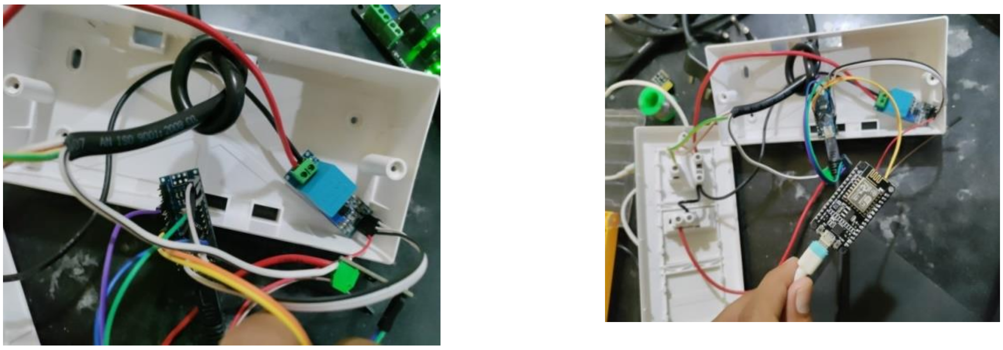

Fig.4.Node MCU Connected to the Internet using WiFi

IV. CONCLUSION

As a result, we were able to effectively create and demonstrate a device to monitor energy use utilizing Internet of Things technology in this study. Integration of Data to GCP (Google Cloud Platform) played an important role in the flexibility of data and allows us to use the sensor data for long term analytics. Further study on the creation of an advanced dashboard along with local interconnected devices could be developed.

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