IoT-Based Energy Meter Analysis Using Real-Time Data Monitoring

1st Ishwarya Varadarajan
Department of Computer Science and Engineering,
Sri Sairam Engineering College,
ishwaryasubha@gmail.com

3rd Thanuja Babu
Department of Computer Science and Engineering,
Sri Sairam Engineering College,
tanujaaa1326@gmail.com

2nd Priyadharshini M
Department of Computer Science and Engineering,
Sri Sairam Engineering College,
priyadharshinidevi20@gmail.com

4th P.Nivedhitha
Department of Computer Science and Engineering,
Sri Sairam Engineering College,
nivedhithap96@gmail.com

2022 1st International Conference on Computational Science and Technology (ICCST) | 978-1-6654-7655-3/22/$31.00 ©2022 IEEE | DOI: 10.1109/ICCST55948.2022.10040444

***Abstract*—We cannot function without electricity in our daily life. After declining by 4.5% in 2020, global energy consumption grew by 5% in 2021. The majority of countries had increases in their energy consumption, including +5.2% in China, +4.5% in India, and +4.7% in the EU. Energy monitoring is a highly important chore that eventually gets out of control. The meter reading must be known by the consumer because it will be used to determine how much will be charged for the withdrawal. By examining the readings from the energy meters and transmitting the analysis to the concerned consumer online, this project automates the framework. This project system utilized trackers to collect and protect data on energy consumption. It also included a microcontroller with an energy meter.**

Each appliance in the home has an energy meter that the tracker secures. Using the GSM module, data is used to communicate the consumed units and amount charges through the online portal so that the client can view the energy consumption. Customers can firmly monitor their daily energy consumption thanks to this.

Keywords—Wireless Communication; IoT, smart Industry, energy management, Power system; Smart energy consumption.

I. INTRODUCTION

Energy management is the process of monitoring and adjusting energy use so that a facility can use less energy. Energy management in commercial settings entails taking measures to lower electrical energy consumption expenses without sacrificing work quality. Ensuring optimum energy practices in industries will result in significant cost savings, increased productivity, and a safe working environment. The major goal is to develop a new and clever way using IoT that might aid in lowering energy consumption and emissions, hence altering carbon footprints, and providing highly efficient Smart houses that give owners power usage statistics. Therefore, an attempt has been made to offer a trustworthy and human-friendly application for electrical equipment that is simple to use and keeps an eye on. Prices decrease as less fuel or electricity is consumed by the general public. This lowers the cost of maintaining and repairing vehicles, computers, air conditioners, and kitchen appliances.

Utility companies won't need to construct as many power plants if the public uses less electricity. These facilities frequently detract from the aesthetics of the area, make a lot of noise, and put the safety of neighboring residents at risk. There is less pollution in the world as a result of these environmental developments.

II. HISTORY OF IoT

While employed for Procter &Gamble in 1999, computer scientist Kevin Ashton developed the idea for the Internet of Things. However, John Romkey, a researcher, created a toaster that could be turned on and off via the internet in 1990, before anyone had heard of the Internet of Things. The first Internet refrigerator plan was put up by LG in 2000. In several mainstream periodicals, the phrase "IoT" was frequently used. The First EuropIoT IoT Conference was held in Zurich in 2008 after it was approved by the EU. Actually, the Internet of Things was founded between 2008 and 2009. The idea then gradually expanded to become the largest system in the world.These days, it is employed in every industry, including construction of smart homes and cities, transportation, healthcare, pollution control, and agriculture. It is also coupled with other technologies like artificial intelligence, deep learning, and machine learning. As a result, IoT applications are growing every day, creating the Smart World.

III. PROPOSED SYSTEM

A. IoT-based energy management technology

The limitations of fossil fuels have led to an increasing interest in renewable energy. However, reliability, power quality, and stability issues are raised by the grid's integration of renewable energy sources. This project suggests an architecture for RES (renewable energy system), a small-range power system made up of resources and storage systems, related to the internet of things (IoT). The four layers of the suggested architecture are application, communication network, data syncretization, and acquisition layers.

The energy meters used to collect data from smart plugs are then transmitted for syncretization; after analysis through a web application, users will receive a form of data that has been synthesized

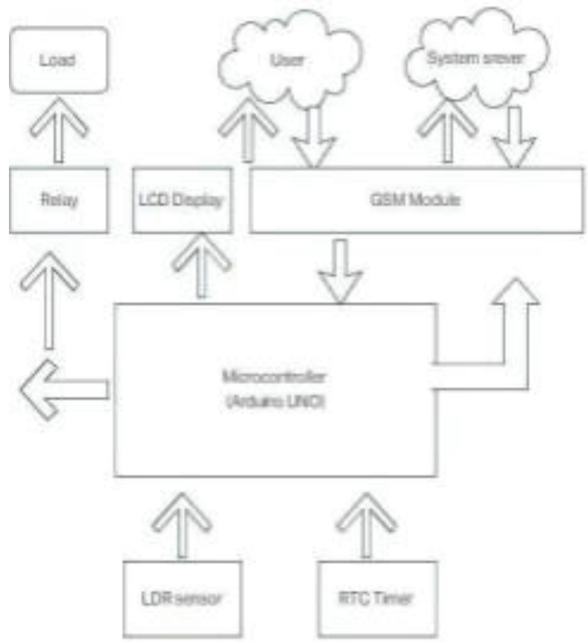


Fig1.Block Diagram of Complete System

The major goal of this project is to demonstrate how much electricity a household uses on a daily basis, to help the consumer understand this usage with unmistakable facts, and to encourage them to use less electricity. Customers will receive an additional warning alarm for excessive electricity use. Each appliance's KWH reading will be sent to the central server on an hourly basis along with a smart energy identification number. A central system manages all of the appliances, and it collects data from smart plugs. Data is delivered to the server through the smart plug built into the office setting.

The smart plug data is uploaded to the main database or data visualization platform through a specially configured router that serves as a gateway. The web application that offers the live stream retrieves this data. Here, the user can use their login to track their energy consumption. Additionally, the user can configure an alert system to notify them when their energy consumption surpasses a predetermined threshold. Additionally, customers can access the information they need about a certain equipment and use it remotely. Data from all appliances are gathered on the server. Accurate real-time monitoring of RES is crucial for producing reliable findings; customers can view the most recent data online.

IV. METHODOLOGY

Fig. 1, or the architectural design of smart meters, is an addition to the basic technique of this project.

By using a web portal on a computer or mobile device, the hardware and software interface are linked to assess the daily electricity usage of consumers. On a 16X2 LCD, the smart meter may display information such as voltage and power consumption. The LCD receives data from the microcontroller, including consumption time and KWH parameters.

A. Functional diagram

A flow chart is one method for displaying a functional diagram. The diagram displays a general structure of the system. There are many different elements used in the functional diagram, such as join, fork, etc. By employing the CLA generator, we can cut down on the number of logic operations. The gates count for the look-ahead adder is dramatically decreased from 32 to 28 as a result. The CLA design, however, calls for a minimum size, latency, and compared to the recently announced, less power is lost to CSLA. Because of the minimal output of carry delay, adder performs effectively in the arithmetic unit. The results of the synthesis show that the recommended adder gives about 20% more ADP compared to standard adder design.

B. System design and implementation

Speech is an important input for machine-man communication. Hence,Google help and web-based applications can be utilized for controlling the home appliances in order to make smart homes more user-friendly. The advantage of using many modes is that Google Assistant performs poorer in noisy environments. Therefore, in such a case, web-based apps can help with system appliance control. The proposed paradigm is therefore designed to provide greater flexibility and to fortify the system. The overall design of the smart home automation system is depicted in Figure 1. A controller unit (Main Switching of the House Circuit), which connects both the 24-hour available, can be utilized to build a smart house, as shown in Figure 1.Wi-Fi system. The primary controller is set up to automatically join any available networks and be connected to an auto power backup in order to avoid losing the Wi-Fi connection. In order to enable the conversion of semi-devices (in this case, the outdated home appliance system) into smart appliances, the subunits are also connected to the main controller. A user can therefore access and operate their smart home through an Internet of Things (IoT) site that relies on Adafruit and other softwares like IFTTT to keep the communication channel open and uses Google Assistant and web-based services.

C. System Requirements

- NodeMcu (ESP8266).
- IFTTT
- Adafruit.
- Arduino IDE.

An open-source firmware called NodeMcu (ESP8266) gives developers the freedom to create IoT-based applications. NodeMcu has grown in popularity as a result of its affordable price and Wi-Fi capabilities. It also offers Nodejs, which uses Lua script and takes less computing time to complete the work. Making it the first choice for IoT applications and making the device work significantly faster. IFTTT("If This Then That,") is an interface that offers a web-based service that connects a gadget with a mobile app. By employing conditional statements, it will be much simpler for the device to operate in accordance with the mobile application. A library that supports the MQTT is called Adafruit (Message Queue Telemetry Transport). As a MQTT broker, it functions.

A protocol service that enables the sending and receiving of feed data is the foundation of MQTT. MQTT has the benefit of offering a faster pace of data transmission and requiring less data bytes for communication. The connections between the devices and the server requires 80 bytes to establish, and the 25 bytes from the server to the device. The code is assembled using the Arduino IDE programme.

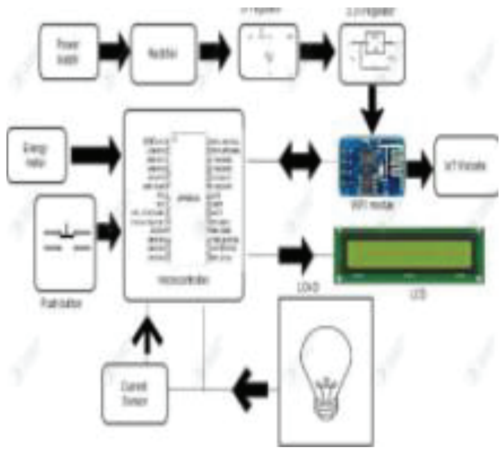


Fig.2. Architecture of the system

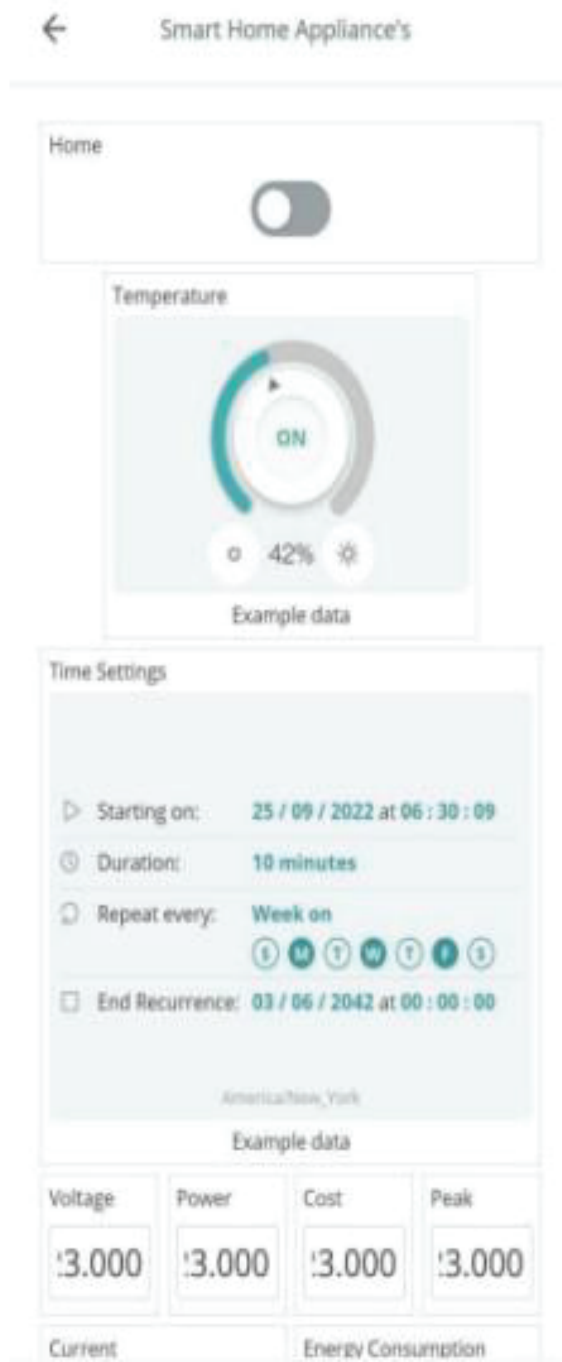
VI. CONCLUSION AND FUTURE SCOPE

By installing the aforementioned energy monitoring system, the building's occupants were actively participating in EMS, and as a result, the buyer is conscious of their energy usage. In this work, the system for conserving energy was implemented using strategies: scheduling and a chat-bot system. The monitoring of a consumer's energy use has been turned into an interactive web dashboard. The efficiency of this energy-saving solution has been calculated through analysis. The results are reported. By installing this system, quantity of energy utilized was greatly rewarded. An energy consumption prediction model based on time series data has been used. The recommended course of action is very scalable and flexible.

For many IoT enthusiasts, this platform stands out since the data may be used extensively to build a linked ecosystem. This approach can be employed in large organizations where a variety of energy monitoring techniques are available and multiple devices need to be turned on and off at once. Numerous methods are used for analysing of incoming data to lower energy use. IoT ideas can be to run live, parallel calculations across several aggregators at once. By putting this technology in place, a significant quantity of energy was saved. These findings are talked about. Energy consumption numbers have been predicted using a time-series based model. The suggested solution is very scalable and adaptable to different situations. This makes it unique as a platform for different IoT since the data can be widely exploited to create a linked environment. When several energy monitoring systems are available and several devices need to be turned on and off simultaneously, this strategy might be used in large enterprises. Numerous methods can be used for the analysis of incoming data to lower energy use. We can employ IoT concepts to simultaneously execute live, parallel calculations across a number of aggregators.

VII. RESULTS

After a successful connection, users can use an IFTTT statement command to access their smart home gadget. It will be available to Adafruit so they can link the Google Assistant to the NodeMCU, the brains of smart home automation. The home appliance must be connected to the central controller unit, relay sets are employed. A rechargeable battery is also used.



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