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HOME ENERGY CONSUMPTION ALERT ON HANDSET AND MONITORING USINGIOT AND CLOUD

P. Marish Kumar[1]
Associate Professor, Department of EEE
Easwari Engineering College
Ramapuram, Chennai-600089
marishkumar.p@eec.srmrmp.edu.in

K.A.Indu Sailaja[2]
Assistant Professor, Department of EEE
Easwari Engineering College
Ramapuram, Chennai-600089
sailaja.indu@gmail.com

G. Naveen[3]
UG student, Department of
EEEEaswari Engineering College
Ramapuram, Chennai-600089
gopinaveen051@gmail.com

S. Mohammed Saeed[3]
UG student, Department of
EEEEaswari Engineering College
Ramapuram, Chennai-600089
bluesto2002@gmail.com

S. Muthu[3]
UG student, Department of
EEEEaswari Engineering College
Ramapuram, Chennai-600089
muthusarvamm005@gmail.com

Corresponding author mail:gopinaveen051@gmail.com

Abstract— **The proposal's core idea is to employ an Arduino Uno to analyse energy usage intelligently, post data to the cloud that used a Wi-Fi module, and deliver SMS notifications that used a GSM module. People typically lament their energy use when the bill arrives, thus researchers hope to assist them with this effort. Initially, A current sensor is mounted to every load, and the total current of every load is recorded with the help of those current sensors and energy consumption of each load is calculated. The values obtained are delivered to the Arduino for analysis. The Nodemcu, a Wi-Fi module, serves as an interface for delivering data to the cloud so that users can monitor actual information to lower consumption. The component which passes information to the customer's smartphones is called as GSM Module. The programme for the Arduino is developed so that it transmits an alarm notification to the user on certain consumption amount that is programmed onto the Arduino. The user is able to adjust their loads in accordance with their economic stability owing to this. According to their usage, the user may predict how much energy they will require to lessen their load. The user can periodically track the energy use of their loads due to cloud-based Energy consumption tracking. The Energy consumption approach greatly targets persons with limited financial resources, whose goal is to decrease their Energy usage to minimize their electricity costs.**

***Keywords*—Energy consumption, Smart energy systems, power saving, Cloud computing, Internet of things.**

I. INTRODUCTION

An upgraded electricity grid known as a "smart grid" employs modern telecommunication systems to boost its dependability, longevity, and profitability. The capacity of components inside a smart grid to interact among themselves in real - time basis is one of the most salient benefits. Energy providers, for instance, would virtually and promptly gather user usage data with the use of smart metres, a fundamental component of the smart grid, and redistribute assets to meet user demand. It may produce the ideal power consumption while preventing loss. Smart metres provide benefits, but they can have drawbacks. Cyber-attacks could happen to smart metres that employ the most recent connectivity techniques. The counters are scattered, and the attacker can directly access the communication protocol. The risk of eavesdropping, interrupting, or manipulating with observations performed by evaluation tools exists. In order to safeguard confidentiality and the accuracy of measurement, safety precautions are vital. A lot of the metres are often dispersed around areas that are flooded with power, although a few metres are farther out and more challenging to reach. According to this research, up to 50% of a smart metre network's overall running costs can be attributed to just 1% of difficult-to-reach metres. Thus, you can cut expenses by as much as to 50% by fixing just 1% of issues this manner. In Order to address those mentioned problems, this study suggests a safe advanced metering programme that depends on LoRa technique, a brand-new wireless transmission network created to support lengthy transmission.Itsecures data in transit with symmetric encryption algorithm. We create key management methods to securely and reliably change the encryption keys utilized to secure transmitted information in order to safeguard long-term authentication methods. The system should be put into use, studies should be run, and its effectiveness should be assessed. In conclusion, we provide the number of things:

- We are setting the standard for LoRa-based smart metre technology that offers end-to-end security protocols.
- Put the design into practise and run assessment studies to show that it is useful for actual smart grid applications.
- To make it easier to apply the design to different energy/utility sectors, we present metre architecture modifications that compensate for the battery constraints of many other metres. B. Meters for gas and water.

Since there is currently no sophisticated equipment available for reading power bills in residences, measurements are taken manually if nobody is present and the reading from the prior month is logged. Because of this, the utility bills are not properly managed, and this situation calls for humanitarian demand. There are several issues that need to be addressed because of the growing practice. The increase in energy output must initially be made to accommodate the initial increase in demand. In addition to this aspect, increased demand can result in a gird accumulation. Since everybody consumes a great deal of power, we are unable to manage the amount that can be supplied to houses and businesses using this way.

Power theft surveillance currently uses a poor system that is unreliable. While reading the energy metres, the capacity theft is discovered by comparing the capacity obtained at the transformer and the capacity acquired at the endpoint. There are no countermeasures implemented. Wireless technology is employed in the present study to track electric meter theft. The quantity of electricity provided to a home or business facility is estimated by an electric metre. Electric metre manipulation and safety have been a top issue for governments all around the world as a result of rising power bills and rising power thievery. The current techniques for identifying and eliminating energy and power stealing are useless and inefficient, which results in lost income as well as destruction to both private and public assets.

In this, we demonstrate a cutting-edge advanced metering technology that monitors and regulates power. Every device's sensor can be used to check the power. This strategy works better and conserves energy.

An announcement will be issued and the power source would be turned off for a while if the person uses additional electricity. In order to get a high energy permission, the user visits her EB office. To ascertain the quantity of power used in the residence, electrical sensors are installed to evaluate the EB meter's existing status. With wireless communication, electricity prices could be collected and checked in a manner that does not require labour in households and businesses, thus preventing energy losses and obtaining electricity consumption. When a power outage happens, the platform also communicates an explanation (such as predictive maintenance, bill payment challenges, etc.) via Text messaging.

To alert clients of large power usage, these suggested methods incorporate IOT technologies. This procedure is carried out as needed. In other words, it activates whenever an user's and their EB's smartphone deliver a Text message after getting one from a trusted server. Current, voltage, and short circuit sensors are subsequently employed to manage power thievery. This decrease thievery and physical work. There are many benefits to wireless network systems when GSM is used in the system. Coding is employed in these devices to provide appropriate voltage and power levels. There is no significant power usage whenever the current and voltage levels are below a particular threshold. This results in no alerting text being received, and the LED being switched off as well.

An alert message and an LED display are both activated whenever the power factor surpass a predetermined threshold. It costs less than other electric meters that use a great deal of energy and don't have a fully automated metre measuring component. Additionally, a payment notification must be delivered.

The rest of the paper is formulated as detailed literature survey in section II, followed by the system selection, tool management and required drivers and details on section III. The section IV holds the methodology and results and discussions are made in Section V. Further the conclusion and future enhancement is given.

II. BACKGROUND STUDY

In order to further enhance power effectiveness and reduce cost savings for the entire network, the stages are organised employing geometrical structured model-predictive management [1]. The network may supply additional functions and react to numerous grid queries by communicating with the energy grid on a superior stage. Simultaneously, drive patterns for bottom level trains are switched to maintain deadlines and on-route limits while achieving the cheapest price of control systems. A thorough actual research situation created with a railroad administrator and a train manufacturer serves as a basis for validating the produced methodology. The findings are shown, and they demonstrate massive savings in costs and energy usage caused by the concurrent management of various trains employing the same power unit.

A dispersed control system with an event-triggered message delivery strategy avoiding Zeno behaviour is developed with the goal of easing data transmission constraints while ensuring the effectiveness of the method. Strict calculation method is used to confirm the suggested techniques' divergence and sustainability [2]. Experiments involving simulation software are done to confirm the viability of the suggested approach. The findings indicate that despite the fact that randomized disruptions interact with the phases of the HESS, the suggested technique can still accomplish the state of the charge (SoC), state of temperature (SOT), and stateof energy (SoE) balance of HESS, proportionate power exchange, and power monitoring strategies.

In the context of two kinds of unpredictability, this research proposes a power management paradigm for aquifer thermal energy storage (ATES) networks that link building climate comfort (BCC) systems to a grid. In accordance with the time of year, ATES may serve as a heating element (hot well) or sink (cool well) [6]. As a private ambiguity source, we categorize every building's unsure heat power usage, and as a public ambiguity source, we categorize every neighbour's unknown shared pool of resources (ATES). To forecast the heat energy deficit in a collection of interrelated BCC devices as well as connections among its regional ATES, we build a huge probabilistic mixed nonlinear framework.

Home energy management systems (HEMSs) aid in the control of energy requirements in order to achieve maximum power use and widespread production of sustainable energy while having to give up the convenience of people. HEMSs function in accordance with a number of factors, such as electricity bills, climate extremes, production levels, and increased satisfaction [10]. With the decrease in energy use within homes and companies using smart grids, they have a growing pervasive part in power conservation. With regard to key principles, setups, and technology architecture, this article gives an extensive survey of the HEMS research. In doing so, it also offers an overview of HEMS technology developments and current internet technology for demand response systems.

The most recent details concerning various energy management mechanisms at the household, integrator, and system level is provided in this research [9]. As every system's key components—objective functions, restrictions, evolutionary computation, communication protocols, and the influence of EVs—are taken into account, the pros and downsides of every one can be looked at and contrasted. Layered power management's difficulties and restrictions are discussed. In order to strengthen the multi-level system for managing energy, various future areas of study are recommended. Various existing articles are considered here to create a strong knowledge base on proposed design [10]-[16].

III.SYSTEM DESIGN

A. GSM model

Fig 1. GSM modem

.Cellular modems use GSM technology. Global System for Mobile Communications is signified by this acronym (GSM). Bell Labs created the GSM concept in 1970. It is a commonly utilised mobile transmission technique on a global scale. Functioning within 850,900, 1800, and 1900 Megahertz frequency bands, GSM is indeed an accessible digital mobile platform utilized for the delivery of cellular data as well as voice. Through the implementation of Time Division Multiple Access (TDMA) technology, the GSM network was established as a digital device for transmission. Data is compressed and automatized by GSM before being sent through a channel with two distinct user data feeds, all having its own time frame. Data speeds of 64 kbps to 120 Mbps can be delivered via digital systems.

B. Current sensors

Fig 2. Current sensor

A device known as a current sensor monitors electric current (AC or DC) flowing through the wire and creates a signal proportional to the measured power. The signal that is produced may be an analogue output of voltage, current, or indeed digital signals. The observed power can then be displayed in an ammeter, saved for later study in a data gathering device, or used for management purposes.

The output signal and measured current can be:

- Analog output, which produces the waveform of the current that is sensed;
- The Bipolar output, which replicates the current sensed's waveform.
- AUnipolar output, which is directly proportional to the measured current's average or RMS value.
- Direct current input
- A Unipolar with a Unipolar output that mimics the wave pattern of the measured current

C. ARDUINO UNO

Arduino UNO µcontroller board builton ATmega328P.It consists 14 digital input and output pins, 6 inputs for Analog signal,USB connector, power connector and a reset button. It has all the things that needs the support for the µcontroller. It can be just connected it to your laptop oryour personal

computer with a USB cable or power it with an AC-DC adapter or battery and you're ready to go. It is a DIY UNO that allow us to start work without worrying too much about doing anything wrong,In the worst case you can

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replace the chip for a few rupees and get to start your work again.

D. *ESP32*

ESP32 is a low-cost system on chip (SOC) package comprised on inbuilt wireless communication module provided with dual core variations. The module connects with wireless components such as Bluetooth, Wifi soc like ESP8266 etc. The ESP module also called as Node MCU module. The connectivity is established and ports are able to communicate with the dynamic user id or SSID with relevant passwords.

Fig 4. ESP32 Module

Fig 4. Shows the ESP32 module or represented as Node MCU. The wireless network is established through Node MCU connected via USB 2.0.The ESP32 is also difficult to access and use. You need to solder wires to its pins with the appropriate analog voltages to perform the simplest tasks, like turning it on or sending keystrokes to the "computer" on the chip. You also need to program it in low-level machine instructions that the chip hardware can interpret. This level of integration is not a problem for using the ESP8266 as an on-board controller chip in mass-produced electronics.

IV. METHODOLOGY

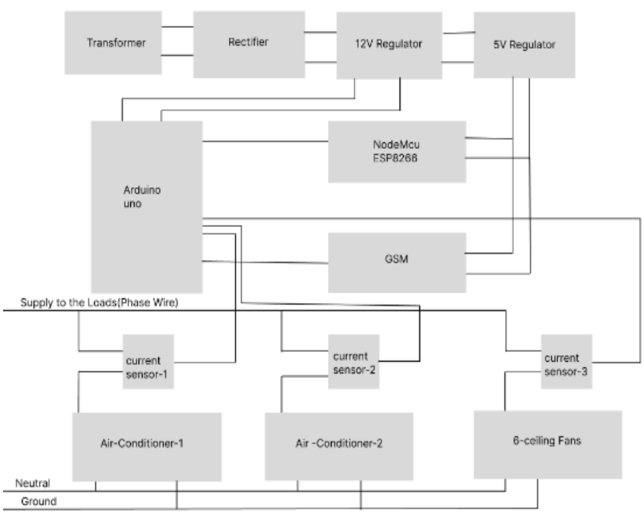

Fig 3. System architecture

Implementation summary

- The novel system is focused on developing a smart energy management system and measurement protocol.
- Current sensor is utilized here to measure the incoming range of current flow. Smart embedded microcontrollers are utilized here to dynamically manage the energy parameters.
- The Arduino UNO hardware is utilized here for the purpose of integrating the external components to the system as well as communicating with the Internet of things platform.
- The management of energy in the home premise and industries are important task in current scenario.
- The role of embedded system implementations in smart energy management system are highly demandable.
- The proposed model connected and tested with three loads connected parallel in which the measurements are validated.
- Each current sensor measures the current consumption of each load and sends those data to the Arduino uno
- Those values are processed in the Arduino uno and those data are used to calculate the individual load's energy consumption.
- Each load's energy consumption is calculated by taking the current values per minute for 60 minutes.
- The average values of the 60 minutes are used to calculate the energy consumption of the individualloads that are connected.
- The average values of all the current sensors are then added to get the total energy consumption value.
- The average values of 60 minutes are taken to calculate accurate value of the exact runtimeof the each load.
- The processed data are then sent as string value to the NodeMCUand then it converts them to double to pass them into the cloud.
- The data that has passed to the cloud enables the user to see the current and energy values of the loads.
- The Arduino sends the information to GSM Module
  So that it can be used to alerts the user as a message.
- The information is transferred through GSM module on high consumption rate detected by the monitoring system.
- Further the presented model is enhanced as the green environment management with advanced sensors.
- This model allows the user for the efficient use of

the electrical utility and the resources and further reduces the financial and electricity losses.

V. RESULTS AND DISCUSSIONS

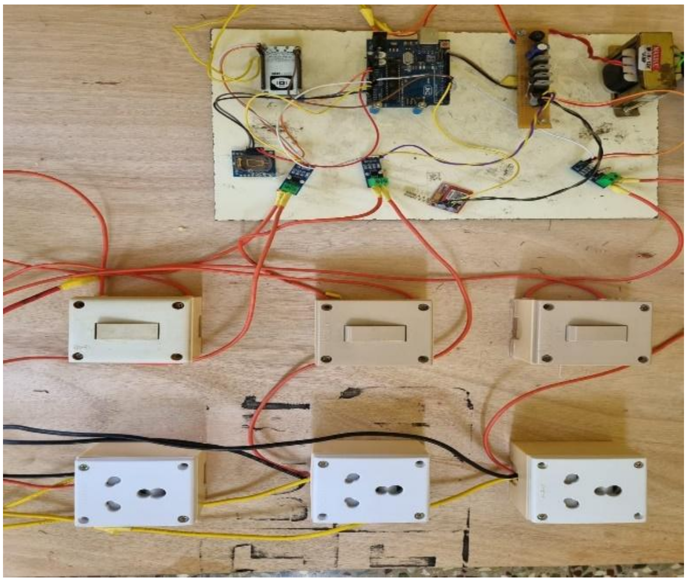

Fig 5. Integrated Smart energy system

Fig 5 shows the integrated Smart energy system using embedded devices utilized for dynamic updations.

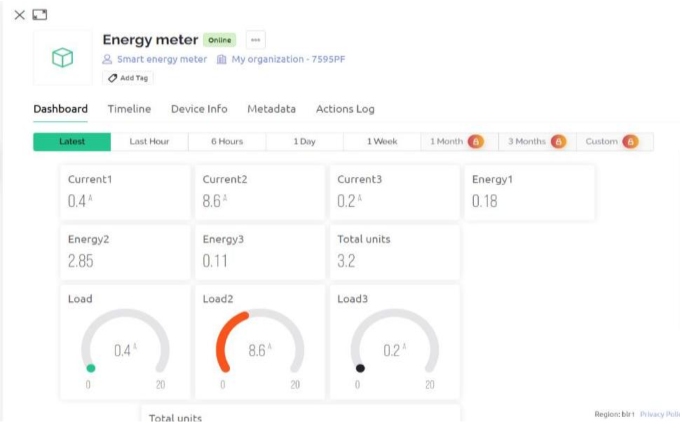

Fig 6. Output on the website

Fig 6 shows the output shown in the blynk website.

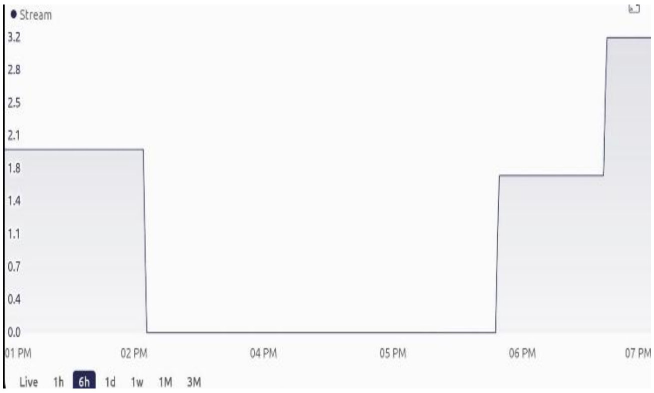

Fig 7. Output graph of the total units calculated and shown in the Blynk cloud.

The prime challenges faced by the proposed smart energy management system is that the variation in current levels, forbidden fluctuation in the supply need to be analyzed in future. The presented approach is enhanced by utilizing the recorded values of energy consumption of different loads to artificial intelligence analysis for control and update as well as predictive maintenance. The system is further explored by inducing more advanced microcontrollers and digitally controlled devices for better performance.

VI. CONCLUSION

Power theft surveillance currently uses a poor system that is unreliable. While reading the energy meters, the capacity theft is discovered by comparing the capacity obtained at the transformer and the capacity acquired at the endpoint. In the presented work, a safe advanced metering network built around Internet of Things technology is presented and put into practice as a cost-effective and reliable advanced metering option. The suggested infrastructure is also intended to function with an effective management method that incorporates self-verification and future key confidentiality to preserve long-term privacy by modifying keys on a regular basis. The assessment showed that the suggested solution is workable in practical applications.

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Dr. P. Marish Kumar
He was born in Rajapalayam, Tamil Nādu in 1981.He received the B. E Degree in Electrical and Electronics Engineering from the Madurai Kamarajar University, Tamil Nadu, India, in 2003, and the M.Tech degree in the specialization of Power Electronics and Drives from S.R.M University, Chennai, Tamil Nādu in 2005 and a PhD in Electrical Engineering from Anna University, Chennai , Tamil Nādu,India, in 2020. He has more than 18+ years of Experience in Teaching. At present,he holds the post of Associate Professor in Department of Electrical and Electronics Engineering, Easwari Engineering college, Chennai, India. His research area includes photovoltaic systems, Renewable Energy systems, Control systems, and Power converters. He has authored the books titled "Power Electronics" and "Electric circuits and Electron Devices". He has published more than 29 journal articles and holds 4 patents.