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IoT Based Smart Load Management

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Abstract: This research paper is about creating ways to use smart home devices for managing energy. The paper talks about home devices used in homes and small offices. It looks at things like managing sensors, pricing and controlling energy use. The paper also talks about home devices and how they can work together no matter who made them. This includes things like meters and smart energy products. By making these standards the paper wants to make it easier for smart home devices to work together. This will make managing energy use better and more reliable, in smart homes. The paper is trying to make smart home devices work well together smart home devices can help manage energy use in a better way and smart home devices can be more efficient.

Keywords: *IoT; Smart Load Management; NodeMCU; MQTT; Energy Monitoring; Smart Grid.*

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I. INTRODUCTION

The IoT-Based Smart Load Management system is a way to control and monitor how much energy we use. It uses Internet of Things technology to do this. The main goal of the IoT-Based Smart Load Management system is to make energy use more efficient lower the cost of electricity make the system more reliable and keep everything running safely.

The IoT-Based Smart Load Management system uses a network of sensors, controllers and devices to see how energy is being used. It can then figure out how to manage energy use in the way possible. This helps to stop energy from being wasted and makes sure that we use what we need.

The IoT-Based Smart Load Management system also. Analyzes data in real time. This helps us make decisions about energy use.

In factories and other industrial places the IoT-Based Smart Load Management system works well. It uses Internet of Things technology, new sensing devices and data analysis to keep an eye on energy use all the time.

If the IoT-Based Smart Load Management system sees that something is not right with the way energy is being used it will send a message to the people in charge.

The IoT-Based Smart Load Management system is a way to manage energy use. It can help us use energy in a way and make the world a more sustainable and reliable place. The IoT-Based Smart Load Management system is good, for the future because it helps us save energy and use it efficiently.

➢ *Block Diagram*

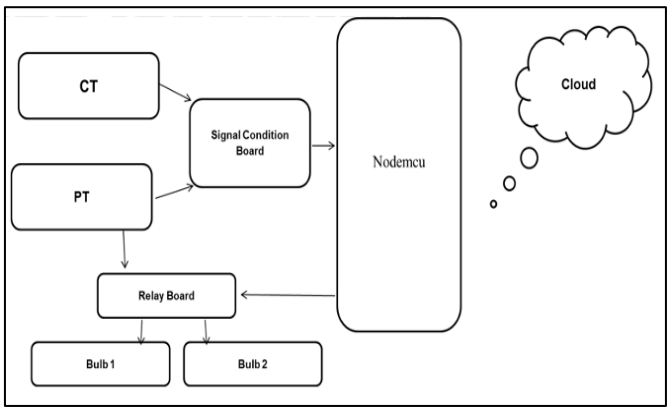

Fig 1 Block Diagram of IoT Based Smart Load Management

➢ *Existing System*

The existing smart load management system mainly depends on manual operations, where users are required to regularly monitor and manage their electricity consumption on their own. This traditional method is often inefficient and can easily result in human mistakes, which negatively affects

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proper energy management and utilization. In addition, the absence of automated monitoring and analytical features prevents users from identifying unusual power consumption patterns or receiving useful suggestions for improving energy efficiency. Due to these limitations, users face difficulties in achieving better energy savings and making accurate decisions related to power usage. Therefore, there is a strong need for a more intelligent and automated smart load management system that can effectively monitor, control, and optimize energy consumption while reducing human effort, minimizing errors, and providing meaningful insights for improved energy management and efficiency.

➢ *Disadvantages:*

- The system is employed with a wired connection.
- The reason for using wired communication is to replace existing wired systems.
- Implementing a wired system requires careful planning and construction work to ensure efficiency and a clean design.
- The use of a wired connection introduces hardware complexity into the system

➢ *Proposed System*

The proposed smart load management system is a solution that uses the internet to keep an eye on how much power's being used. It is especially useful in places like factories. This system uses a lot of sensors that are connected to each other and looks at the data to see how much energy is being used. The smart load management system can always watch how much energy is being used and find any changes or things that are not normal. When the smart load management system finds something that's not right it tells the person in charge so they can fix the problem before it gets worse.

The smart load management system does more than just watch and send alerts. It also gives users ideas on how to use energy. This helps people make choices and use methods that save energy. The smart load management system helps people save money on their electricity bills and use energy in a way.

The smart load management system is very smart. Can watch what is going on in real time. It helps places work better and use energy in a way that's good, for the earth. The smart load management system also gives people warnings when something is wrong. Suggests ways to use power in a better way. This helps the smart load management system manage energy in a way.

➢ *Advantages:*

- Energy Efficiency is improved
- Lower Energy Costs
- Increased Reliability
- Increased Safety

➢ *Hardware Components*

- Nodemcu
- CT (Current Transformer)
- PT(Potential Transformer)
- Relay Board
- Bulbs(2)

➢ *Software Requirement:*

- Arduino IDE
- Embedded-C
- IoT

II. LITERATURE SURVEY

"A Survey on Smart Metering and Smart Grid Communication Sustainable Energy Reviews"

I read this study that mainly focuses on smart communication systems and smart metering techniques used in modern smart grids.

It explains that monitoring and control operations are widely used in industries for energy management.

The development of grids is largely influenced by the growing energy demands of consumers and service providers.

The paper provides an overview of grid concepts and discusses communication technologies that support smart grid operations and energy distribution systems.

"Hybrid Nanogrids Development to Improve Residential Reliability and Resiliency Supply: Testing and Implementation Tropical Renewable Energy Center, Universitas Indonesia"

This paper talks about a concept called "Dual Power Nanogrids" that improves residential power supply reliability and stability.

This concept became important during COVID-19 when daily activities shifted to homes.

The proposed system separates power supply into DC and AC voltage sections, where AC power is delivered through a 230 VAC inverter to support motor-based loads.

The study highlights how hybrid nanogrid systems improve energy reliability and efficiency in applications with smart metering.

"A Survey on Smart Grid Technologies and Applications Journal of King Saud University. Computer and Information Sciences"

This survey paper discusses grid technologies and applications.

A smart grid is described as a digital electricity network that supports two-way power flow, automatic fault recovery, flexibility, resilience and sustainable energy management with smart metering.

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The paper explains metering technologies, communication systems, cloud computing integration and practical applications of smart grids in modern power systems and energy management solutions.

"Grid-Tied Distributed Generation Systems to Sustain the Smart Grid Transformation: Tariff Analysis and Generation Sharing Frontiers in Energy Research. Electrical Applications"

This research paper presents a model developed by ENEL, a large electricity utility company in Chile.

The model focuses on energy management and electric power control for a building with 60 apartments and smart metering.

It is part of ENEL's Smart Grid Transformation initiative and green energy program.

The system includes grid-connected distributed generation technologies like microgrids, power generation and energy storage systems installed in Santiago, Chile.

The paper shows how smart grid technologies support energy management and improve electricity distribution efficiency, in residential environments with smart grids.

III. HARDWARE MODULE

➢ *Nodemcu:*

The ESP32s module is a good device that does not cost a lot of money and it is very flexible. It is mainly used to give internet to devices in projects. The ESP32s module can work in two ways: it can be like a point that other devices connect to or it can connect to a network that already exists. This module can. Receive data from the internet, which makes it very useful for smart devices and IoT systems. It also works with something called API, which's like a way to get information from the internet. One of the things about the ESP32s module is that it works with the Arduino IDE, which makes it easy for people who are just starting out to program and make things. Even though this version of the module does not have a lot of pins you can always add more. Use a different module like the ESP-12 or ESP-32 if you need more pins for your project. Overall the ESP32s module is a choice for people who want to make IoT devices that connect to the internet.

➢ *Current Transformer:*

A Current Transformer or CT is a device that is used to measure how much electric current is flowing through a power system. It is used in a lot of applications like protection systems, metering, control operations and monitoring electrical systems. You can find CTs in substations, distribution systems and industrial equipment. They help give accurate measurements of the current so that relays and energy meters can work properly. Some important things to consider when it comes to Current Transformers are how accurate they are how burden they can handle and what happens when there is a lot of current flowing through them. These devices are designed to work efficiently even when there is a problem with the system and they follow the rules that the industry has set for reliability and performance.

➢ *Potential Transformer:*

Potential Transformers or PTs are devices that are used to reduce voltages to lower voltages that can be measured. They are mainly used in substations, power distribution systems and industrial electrical networks where it's important to measure the voltage accurately. PTs help give voltage readings for protection relays monitoring devices and energy meters. These devices are designed to work with voltage ratings and accuracy levels so they can work well under different conditions. They also follow the safety and performance rules that the industry has set, which helps make sure that electrical systems are monitored and protected effectively.

➢ *Relay:*

A relay is a device that is used to switch circuits on and off. It works by using a field to move a part called the armature, which opens or closes the contacts. Small relays usually have one contact while bigger relays have contacts. Inside the relay there is a coil and an iron core that work together to control the flow of current in the circuit. When current flows through the coil it creates a field that changes the position of the armature and controls the circuit. Relays are used in a lot of electrical systems, like protection systems, automation systems and switching systems because they provide a reliable and efficient way to control the circuit. The ESP32s module can work with relays to make devices that can control and monitor electrical systems.

IV. SOFTWARE MODULE

➢ *Arduino Software (IDE);*

- The Arduino IDE is a software platform where you write, compile and upload code to Arduino boards.
- It has an interface with a code editor, message console, toolbar and menu options.
- Earlier versions saved files with a.pde extension. Now they use the.ino format.
- The IDE works with Arduino and Genuino boards.
- You can easily select the board and communication port you need.
- It is easy for beginners to use and supports programming in C and C++.
- There are examples and libraries to help with Arduino development.

➢ *Sketchbook:*

- The Arduino IDE uses a sketchbook to store your Arduino programs or sketches.
- When you open the IDE for the time it creates a sketchbook folder in your Documents directory.
- You can find your saved sketches in the Sketchbook option in the File menu. By using the Open button on the toolbar.
- If you want you can change where your sketchbook is located through the Preferences settings.
- This helps you keep your projects organized.

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➢ *Uploading:*

- To upload a sketch to the Arduino board you need to connect the board to your computer with a USB cable.
- Then open the sketch in the Arduino IDE. Click the Upload button or select Upload from the Sketch menu.
- The IDE compiles the program. Sends it to the board.
- New Arduino boards reset automatically when uploading, but older boards might need a reset.
- When its done the IDE shows an "Upload message.
- If theres a problem during compilation or connection it shows an error message.

➢ *Embedded C:*

- Embedded C is a programming language used for developing embedded systems and microcontroller-based applications.
- It helps developers directly access and control hardware parts making it good for low-level programming tasks.
- Embedded C allows for code execution and optimized memory usage, which is important for systems with limited resources.
- The language is flexible for implementing operations and customized functionalities in embedded devices.
- Embedded C is widely used in industries like automation, automotive, electronics and IoT system development because its efficient and reliable.

➢ *ThingSpeak:*

- ThingSpeak is an IoT cloud platform for collecting, storing and analyzing sensor data.
- It works with devices like Arduino, Raspberry Pi and other IoT systems to send data to the cloud.
- The platform has features like public channels, REST API, MQTT communication and MATLAB integration for advanced analytics and visualization.
- ThingSpeak lets users monitor sensor data in time and supports collaboration through its global user community.
- Its data analysis and cloud connectivity features make it useful, for IoT-based applications and smart monitoring systems.

V. RESULT

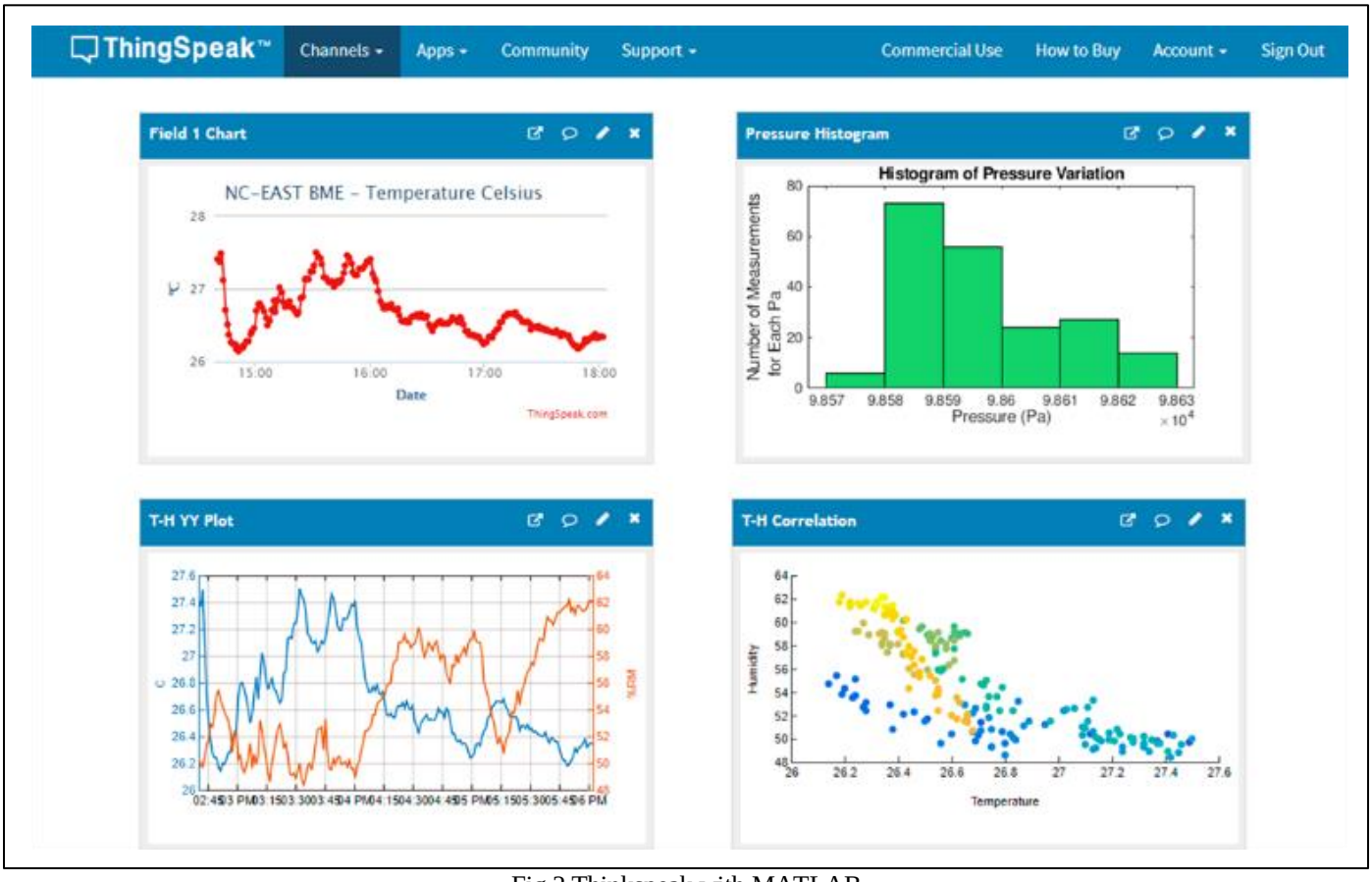

Fig 2 Thinkspeak with MATLAB

➢ *MQTT (Message Queuing Telemetry Transport)*

MQTT is a lightweight communication protocol widely used in Internet of Things (IoT) applications. It is specially designed for devices with limited memory, processing power, and network bandwidth. MQTT works on a publish-subscribe model, where devices publish messages on specific topics and

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other devices subscribe to receive those messages. An MQTT broker acts as the central server that manages communication between publishers and subscribers. Topics are organized in a hierarchical structure, allowing efficient data sharing between connected devices. MQTT also supports different Quality of Service (QoS) levels to ensure reliable message delivery based on application requirements. Due to its low bandwidth usage, scalability, and real-time communication capabilities, MQTT is commonly used in smart homes, industrial automation, and IoT-based monitoring systems. Its simple and efficient design makes it one of the most preferred protocols for IoT communication..

➢ *Broker:*

The MQTT broker is the main component of the MQTT communication system and works as an intermediary between connected clients. It receives messages from publishing devices and forwards them to subscribers based on their subscribed topics. The broker manages message filtering, routing, and communication between multiple connected devices. It supports large-scale IoT systems by handling many simultaneous client connections efficiently. MQTT brokers also provide features such as message storage, security, authentication, and Quality of Service (QoS) management to ensure reliable communication. By enabling smooth and secure data exchange between devices, the broker plays an important role in building scalable, stable, and efficient IoT applications.

➢ *Advantages:*

- Efficient data transmission and quick implementation due to MQTT's lightweight nature.
- Low network usage thanks to minimized data packets, optimizing bandwidth utilization.
- Efficient distribution of data through MQTT's publish/subscribe model, ensuring selective delivery to subscribed clients.
- Successful implementation of remote sensing and control applications.
- Fast and efficient message delivery, enabling real-time communication between devices.
- Usage of small amounts of power, making it suitable for energy-constrained devices.
- Reduction of network bandwidth, enhancing overall system performance and scalability.

VI. CONCLUSION

- This project shows that the smart device management system using IoT can monitor and control energy use in time.
- It helps people use power when they don't need it and makes energy use more efficient.
- The system can find energy use patterns and tell the user right away if something might be wrong.
- It gives users information and tips on how to manage energy better.
- Using IoT technology lets users keep an eye on energy use all the time and access the data from far away.
- This system makes things more reliable and efficient. It supports using energy in a way that is good for the environment in homes and factories.
- In the end this smart system, for managing energy use is a reliable and smart way to monitor and control energy use today.

REFERENCES

[1]. ZigBee Alliance, “ZigBee Specification,” Version 1.1.
[2]. ZigBee Alliance, “Smart Energy Profile Specification,” Version 1.0.
[3]. IEEE, “IEEE Std. 802.15.4-2003: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks,” IEEE Press, New York, 2003.
[4]. V. Singhvi et al., “Intelligent Light Control Using Sensor Networks.”
[5]. M.-S. Pan, L.-W. Yeh, Y.-A. Chen, Y.-H. Lin, and Y.-C. Tseng, “Design and Implementation of AWSN-Based Intelligent Light Control System,” ICDCSW ’08.
[6]. L. Gelazanskas and K. A. A. Gamage, “Demand Side Management in Smart Grid,” Sustainable Cities and Society.
[7]. S. Nithin, N. Radhika, and V. Vanitha, “Smart Grid Test Bed Based on GSM.”
[8]. A. Mahmood, N. Javaid, and S. Razzaq, “A Review of Wireless Communications for Smart Grid,” Renewable and Sustainable Energy Reviews.
[9]. M. Kuzlu, M. Pipattanasomporn, and S. Rahman, “Review of Communication Technologies for Smart Homes/Building Applications.”
[10]. K. Sharma and L. M. Saini, “Power-Line Communications for Smart Grid: Progress, Challenges, Opportunities and Status,” Renewable and Sustainable Energy Reviews.
[11]. R. Somakumar, P. Kasinathan, and G. Monicka, “Optimization of Emission Cost and Economic Analysis for Microgrid by Considering a Metaheuristic Algorithm-Assisted Dispatch Model,” International Journal of Numerical Modelling: Electronic Networks, Devices and Fields.
[12]. G. Monicka, Apurva, Nishant, and Piorebello, “Design and Development of a Smart Electric Trike with Detachable Handle for Differently Abled,” Materials Today: Proceedings.