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Design and Implementation of smart energy grade using IOT

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ABSTRACT :

The quick rise in power name and the growing need for effective strength distribution have led to the development of smart strength grids. This project involves designing and building a Smart Energy Grid that uses the Internet of Things (IoT) to improve the monitoring, management, and automation of electricity use. The suggested tool combines smart meters, sensors, and IoT-enabled controllers to gather information in real time about power usage, voltage levels, and how well the grid is working. This data is sent to a major cloud platform where it is processed and analyzed to help with decision-making.The system lets application companies keep an eye on grid parameters from afar, find problems, prepare for overload situations, and make the best use of energy distribution. A user-friendly interface lets customers track how they use their devices, which leads to longer attention spans and less energy use. The grid also makes it easier for people to talk to each other and mix renewable energy sources like solar or wind into the power supply network.The IoT-based Smart Energy Grid wants to make electrical systems more reliable, efficient, and environmentally friendly by allowing real-time analytics, automatic responses to changes, and stepped-up name-for-facet control. The implementation shows how IoT can change traditional energy grids and help make the future smarter and greener.

Key Words: Smart Energy Grid, Internet of Things (IoT), Energy Monitoring,Smart Metering, Load Management, Real-time Data, Remote Control.

INTRODUCTION

The traditional strength grid infrastructure is becoming less and less able to meet the growing demand for strength, make sure that strength is distributed evenly, and make room for renewable strength resources. Problems like losing strength, not being able to track things in real time, and not being able to talk to people enough show that a complicated answer is needed. In this case, the Smart Energy Grid is a modernized version of the old strength grid that includes virtual verbal exchange and smart manage structures.

The Internet of Things (IoT) is a key part of turning the old grid into a smart, computerized, and self-regulating device. IoT lets you get, analyze, and control power resources from a distance by connecting smart meters, sensors, actuators, and controllers to a central community. These changes make it easier to balance loads, find faults, do predictive maintenance, and connect decentralized renewable power systems like solar and wind.

Also, using cloud platforms and cell apps lets customers and alertness providers access energy data anytime, anywhere. This openness encourages saving energy and helps with call-for-aspect management plans.

The purpose of this paper is to plan and implement a Smart Energy Grid that is cost-effective and can grow as needed. IoT technologies will be used to improve the performance, reliability, and sustainability of power distribution systems. The device shows how modern technology can help meet the growing demand for energy with a limited grid

Objectives

The primary objectives of this research are:

- Create a smart power grid system based on the Internet of Things (IoT) that lets you track and control power use and distribution in real time.
- To make a smart metering tool that accurately tracks power use and sends the data to a central server or cloud platform.
- To make it possible for sensors, smart meters, and control devices to talk to each other over Wi-Fi using IoT protocols like MQTT, Wi-Fi, or Zigbee.
- To let clients and application businesses access and control power data from anywhere using mobile or web apps.
- To find and report problems, overloads, and power theft in the grid to make the electricity machine more reliable and safe.
- To make it easier to connect renewable energy sources like solar panels to the smart grid and manage the flow of energy effectively.
- To sell strength conservation and demand-aspect control by giving customers information about how they use energy in real time.
- To make sure that the device can be used in homes, businesses, and industries without any problems and at a reasonable cost.

PROPOSED BLOCK DIAGRAM

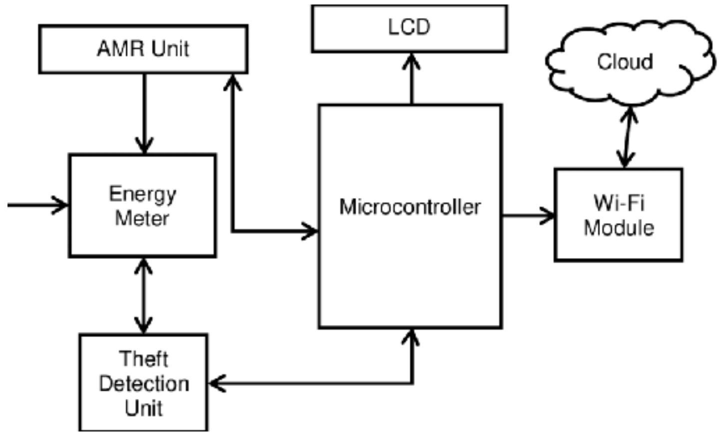

Figure.1 Proposed block diagram

The block diagram of the smart electricity grid shows how IoT works with many interconnected modules that work together to intelligently monitor, manage, and control the flow of electricity. The device's main processing unit is a microcontroller or microprocessor, which is located in the middle of the device. It is also known as NodeMCU or Raspberry Pi. It is connected to smart strength meters that measure how much power is being used in real time from homes, businesses, or software grids. These smart meters have modern and voltage sensors (like CT and PT sensors) that send data to the microcontroller all the time.The IoT module (Wi-Fi or GSM) is also connected to the microcontroller. This lets you talk to a cloud server or IoT platform wirelessly, like ThingSpeak, Blynk, or AWS IoT. This lets people who are not in the office, like application groups or clients, get real-time information through mobile apps or web dashboards. A relay module is safe to use to control the flow of electricity, such as when you need to disconnect a load because it's being used too much or because of a fault. A local LCD/LED display shows real-time electricity use and signals.

The machine may also have renewable energy sources, like solar panels, that are connected through energy converters, as well as a battery management system (BMS) that stores and provides power when needed. The standard system uses IoT technology to automatically control smart loads, improve energy efficiency, monitor things from afar, bill people dynamically, and find faults.

Methodology

To make a smart electricity grid work, the first step is to figure out the problems with traditional power systems, such as having to track things by hand, having to wait for bills to come in, wasting power, and not being able to access it from far away. A device based on the Internet of Things (IoT) is suggested to get around those worrying situations. It is carefully decided what hardware extras are needed, such as a NodeMCU or ESP32 microcontroller, current and voltage sensors (CT and PT), a relay module, and a Wi-Fi or GSM communication unit. It comes with a smart strength meter that keeps an eye on how much power it uses all the time. The sensors send information to the microcontroller, which then sends it to an IoT cloud platform like ThingSpeak or Blynk over the internet. This allows for real-time remote tracking and control from a phone or laptop. The device is set up to find problems like overvoltage, overload, or too much power use and then take action, such as alerting the customer or cutting off the power through relays. Writing embedded code with Arduino IDE or a similar tool to handle data collection, cloud communication, and load control logic is part of the software side. The whole machine is then tested in different situations to make sure it works correctly, accurately, and quickly. After testing, the device is put to use in a real-world setting, like a home or business, to show how well it can use strength. This smart grid, which is connected to the Internet of Things (IoT), makes sure that power is used in the best way possible and that loads are controlled. It also provides a scalable solution for cutting-edge power dreams.

RESULTS AND DISCUSSION

The smart power grid was successfully put into place, and the tool worked well in a variety of test situations. The smart strength meter measured voltage, current, and power use in real time and sent the data to the cloud platform (ThingSpeak/Blynk) with no significant delay. Users have been able to see how much power they are using from afar through their smartphones or internet dashboards, which has led to more awareness and better control over how they use power. In cases of overload, the relay module worked well by disconnecting the load, which stopped damage to the power supply or waste of power. Alerts and notifications have been sent out right away when strange situations, like overvoltage or too much intake, were found. The device also supported load control by allowing users to prioritize important devices and disconnect unimportant ones at the same time when needed. The results showed that there was less wasteful use of power, which means that real-time tracking and automation make energy use much more efficient. Data logs collected from the cloud platform showed that the tool was balanced by showing that it was consistent and reliable over long periods of time. Overall, the suggested IoT-based smart power grid system turned out to be a cost-effective, reliable, and scalable solution that could be used for home automation, business electricity management, and smart city applications.

Discussion

The IoT-based smart electricity grid is getting better, which shows how great it is to combine digital technology with traditional electricity systems. Real-time statistics collection and cloud-based tracking give consumers and application companies useful information about how people use electricity, which helps them make better decisions and save energy. One of the most important benefits found was the ability to remotely monitor and control electric loads. This is especially useful for dealing with high demand and cutting down on wasted energy use. The relay-based load control system worked as it should, keeping appliances safe and preventing overloads or faults in the future. Also, the device's response time for sending data to the cloud and getting control commands was very short, showing how well the chosen microcontroller and communication modules worked. The implementation also showed how important it is to calibrate sensors and deal with mistakes in order to make sure accurate measurements. During testing, issues like community interruptions, sensor noise, and strength fluctuations were dealt with, which suggests that improvements are needed in the future, such as battery backup and AI-based load prediction. The project showed that adding IoT to energy grids can turn them into smart, automatic, and energy-efficient systems. This will help move us toward smart homes, smart industries, and sustainable cities

CONCLUSION

In conclusion, the design and use of an IoT-based smart electricity grid have shown that it is possible to change traditional energy management systems by allowing real-time tracking, control from a distance, and sensible load control. The tool effectively measured and sent strength records using sensors and microcontrollers. The combination with IoT systems made it easy for customers to access intake data through mobile and web apps. The electricity system became more reliable and safe because it could automatically respond to overloads and other unusual situations, as well as disconnect loads and show signs. The project not only makes energy use more efficient and cuts down on waste, but it also sets the stage for smart grid applications that can be used in homes, businesses, and cities. This device can make a big difference in the development of sustainable and smart energy solutions for the future if it gets better with things like integrating renewable energy, predictive analytics, and AI-based control.

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