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Smart Energy Meter using IoT

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Abstract: *In recent times, internet of thing based applications are more efficient to provide solution regarding the real time problems. The labor involved in gathering energy utility meter readings. The Internet of Things (IoT) provides an efficient and cost-effective way to wirelessly send energy consumer information as well as monitor power use. In this paper we are presenting smart energy monitoring system. the main objective of our project is reduced manual efforts for measuring electricity by Internet and make the electrical appliance intelligence and provide consolation toconsumer and also get reduction in electric bill.*

Keywords: Current Sensor, Android Application (Rain Maker , Blynk) , , ESP 32 dev Wi-Fi Module

I. INTRODUCTION

In the present situation the demand for electricity is increasing day by day its may be in the sector of agriculture hospital industries or household so it becomes more tricky to manage electrical usage

A large portion of global electric energy consumptionis attributed to households, with the majority of this consumption being attributed to household appliancessuch as weather heaters, clothes washers and dryers, dishwashers, refrigerators, freezers, electric stoves, lights, and so on, which account for a significant portion of energy bills. The amount of energy consumed by each element is greatly affected by the time of use and how long it is connected to the power grid.

The control and reduction of losses, focused on the end user, are issues with energy distribution and consumption. This allows for the creation of an internal study of both consumption and control, which then resultsin the effective optimization of energy resources.

To conserve proper electricity uses and reduce electricity bill is also big challenge for each middle class family. To tackle this challenging situation, we are introducing our project IOT based smart energy monitoring and controlling system.

The Internet of things (IOT) is a network of interconnected computing devices, mechanical and digital machinery, items, animals, or people that have a unique identification and can transfer data over a network without needing human to human or human to computer contact.

Four key goals guide the design of a smart energymeter that uses a Wi-Fi technology. They are as follows:

- To monitor the consumption of appliances
- To make the household appliances intelligent
- Cut down on energy waste.
- To reduce electricity

The system is built around an Arduino microcontroller board to get proper use of the system people should know about the rainmaker and black software the complete information of energy bitter is uploaded to blink cloud where the consumer is able to monitor electric meter or bold the world and by using the rainmaker all appliances able to operate via Google remote or an Android phone.

II. LITERATURE SURVEY

[1] In this work, an energy control system forresidential usage was created by combining a wireless smart socket, a home gateway, a userinterface, and the Internet of Things (IoT). Toconnect with the home gateway, the smart socket contains an embedded Zigbee communication module. The connected gadget will be measured by the smart socket. parameters and send to home gateway. The control message will be sent to the associated sockets by the home gateway

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through a distant cloud server. This system has four different control modes: peak time control, energy control, automated control, and user control. The implementation findings reveal that some household appliances consumed 43.4% less energy in one week.

[2] This study discussed the energy control systemused in the residence. A functional example of a "IOT Based Smart Energy Meter" has beenattempted. For ease, the propagation model is utilized to compute the household's energy use and even create the energy unit readout. As a consequence, it lowers energy waste and promotes

[3] To identify different IoT system traits and characteristics, current literature reviews were examined. This survey study covers a GPRS- based IoT-based data collecting system and energy management system. This Energy Management System project's central idea is the Internet of Things. In this work, related technologies such as smart meters, GPRS Gateway, GPRS communication network, web- based software, databases, and others are utilized. Using the GPRS Gateway,.NET Framework, and MySQL database, the IoT architecture is developed.

[4] Via an android application, users may accessall of the cloud's data that has been saved. By logging into the appropriate accounts, users can obtain information about their registered accounts.As a security measure, the user must provide their user id and password in order to log in.

[5] The user may check the quantity of used units, received pulses, total cost, and Wi-Fi network dataafter logging in. Users are guided through the application's use through a help file. Pre-paid consumers establish an initial balance of money that has been recharged. After 80% of therecharged money is paid, the programautomatically calculates the amount of spent units and alerts the users.

[6] "Smart energy meter surveillance using IoT" is a proposed emerging field related to IoT. Electronics and IT have undergone a transformation thanks to and IoT-based gadgets. The main goal of this initiative is to raise knowledge about energy usage and the effective use of home appliances to reduce energy consumption. The current power billing system hasmany flaws.

[7] With the aid of IoT and GSM technologies, this suggested smart meter is utilized to automaticallydetect energy use and automatically compute the cost. This work estimates the bill made up of hardware and software components based on the energy consumption units measured from the user's location. The controller sends the bill to the relevauser following the calculating procedure. The Wi-Fi module will simultaneously update the bill on the user's website. since it requires manual labor.Using IoT, this system will provide information on meter readings and power cuts when use exceeds the designated limit. With the aid of a GSM module, the Arduino esp8266 microcontroller is programmed to accomplish the goals.

III. PROPOSED SYSTEM

A smart energy monitoring system is a crucial tool for minimizing energy expenses and regulating energy use. Here are some components that might be included in a smart energy monitoring system proposal:

1. Sensors: The sensors that measure energy usage are the initial component of the smart energy monitoring system. These sensors might be placed throughout the electrical network, including at the main power supply, specific circuits, and appliances. The sensors would send data to a central hub for processing.
2. Central hub: The central hub would gather sensor data and analyze it in real time to give insights into energy use trends. The hub would employ machine learning algorithms to discover energy consumption trends that might be utilized to optimize energy usage and lower expenses.
3. Dashboard: A user-friendly dashboard that shows energy use statistics in an easy-to-understand manner should be included in the system. Users should be able to monitor historical and real-time statistics, establish energy consumption targets, and receive notifications when usage exceeds pre-defined restrictions.
4. Mobile app: A mobile app that allows users to monitor their energy use while on the go might be developed. The program may send real-time alerts and messages to users, allowing them to take action to cut energy use and expenditures.
5. Integration with smart devices: To allow users to regulate energy use remotely, the system might be linked with smart devices such as thermostats, lighting, and appliances. Users may also set up automation rules to switch off devices automatically when they were not in use, reducing energy waste.

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6. Energy analytics: Advanced analytics tools should be included in the system to give insights into energy usage patterns, highlighting potential for energy savings and cost reduction. The system should also be able to make recommendations for improving energy efficiency, such as switching to more efficient appliances or altering lighting systems.

Overall, a smart energy monitoring system might assist individuals and organizations in optimizing energy consumption, lowering expenses, and contributing to a more sustainable future.

IV. METHODOLOGY

Methodology that can be used for the development of a smart energy monitoring & controlling system:

1. Requirement analysis: During this phase, the needs for the smart energy monitoring system are determined, including the system's unique capabilities and features. Identifying user needs, business requirements, and technological requirements is part of this step.
2. System design: The system architecture and design are created based on the requirements stated in the first step. The selection of appropriate sensors, communication protocols, and data storage and analysis methods is part of the system design.
3. Development of a prototype: A prototype of the smart energy monitoring system is created to assess the system's viability and the accuracy of the data acquired by the sensors. The prototype can be produced using off-the-shelf hardware and software or with custom-made gear and software.
4. Sensor deployment: The sensors are placed in the field at this step, and data collecting begins. To assess energy use, the sensors are deployed at strategic spots across the electrical network.
5. Data acquisition and storage: Sensor data is delivered to a central data repository for storage and analysis. The data is saved in a format appropriate for analysis, and the system maintains the data's confidentiality and privacy.
6. Data analysis: The data acquired from the sensors is evaluated in this step to discover energy usage patterns, trends, and abnormalities. Machine learning algorithms, statistical analysis, and other methodologies can be used to conduct the analysis.
7. Reporting and visualization: Based on the data analysis, the system creates reports and visualizations. The reports and visualizations give insights into energy use trends, allowing users to make educated energy decisions.
8. Integration with other systems: The smart energy monitoring system may be coupled with other systems, such as building automation systems, to enable energy consumption automation based on predefined rules and schedules.
9. Testing and validation: The system is tested and verified to ensure that it fits the criteria stated in phase one. Unit testing, integration testing, system testing, and acceptance testing are all examples of testing.
10. Deployment and maintenance: The system is deployed for usage once it has been tested and certified. The system is maintained and supported to ensure that it continues to perform properly and efficiently.

V. BLOCK DIAGRAM

An robotization system is a combination of detectors, regulators, and selectors designed to negotiate a function with minimum or no mortal commerce. This content is covered by the interdisciplinary field of engineering known as" mechatronics," which combines mechanical, electrical, and electronic systems. In this system four channels are available for operation This channels are accessible with physical remote, via a mobile operation and via a google also

Wi-Fi module:

WI-FI modules (wireless fidelity), also known as WLAN modules (wireless local area network), are electrical components that allow a wireless internet connection in a number of goods.

In this project we used ESP 32 WIFI module for home automation circuit and energy monitoring circuit which provides all data and information on the web page (RAINMAKER , BLYNK)

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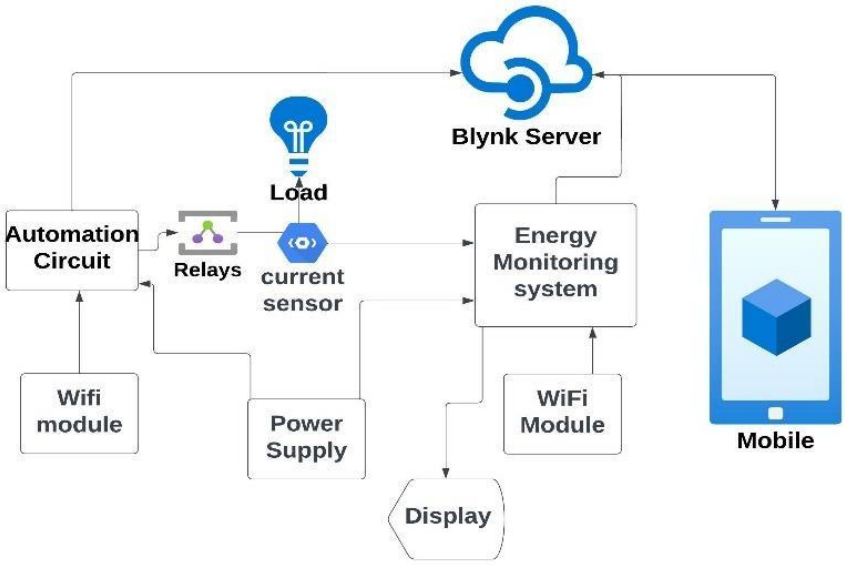

Fig 5.1 Block Diagram of the Embedded SystemAutomation Circuit:

Relay:
Relays are electrically driven switches that open and close circuits by receiving electrical signals from other sources. By turning the switch on and off, they receive an electrical signal and transmit it to other pieces of equipment.
This relays are directly operated by automation circuit which is used to control the flow of AC supply to a load as per signals

Current Sensor:
A current detector is a device that detects current and converts it into an easy- to- measure affair voltage commensurable to the current flowing through the channel being measured. The current sensor is connected load and provides data like Voltage and Current value along with power consumption and total kWh units to a Energy monitoring device

Energy Monitoring system:
Energy monitoring systems provide users with information about their consumption habits, allowing them to regulate their energy use effectively and save as much money as possible.
In this system all data provided by current sensor is processed and uploaded to cloud (BLYNK)

Cloud :
The cloud is not a physical object, but rather a massive network of distant servers located all over the world that are linked together and intended to function as a unified ecosystem. These servers are intended to store and manage data, execute programs, or provide content or services such as streaming films, online mail, office productivity tools, or social media.
For this project we are using cloud (RAIMNMAKER & BLYNK)

Display :
The simple display is provided in the system to see all information of the system physically . Voltage and Current value, power consumption and total kWh units like data can be displayed simultaneously

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VI. SETUP AND OUTPUT

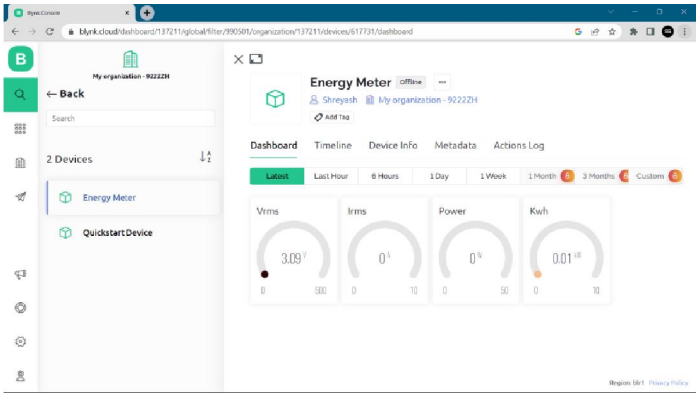

Fig:6.1 Desktop Setup Of Blynk

Fig:6.2 Mobile Setup Of Blynk

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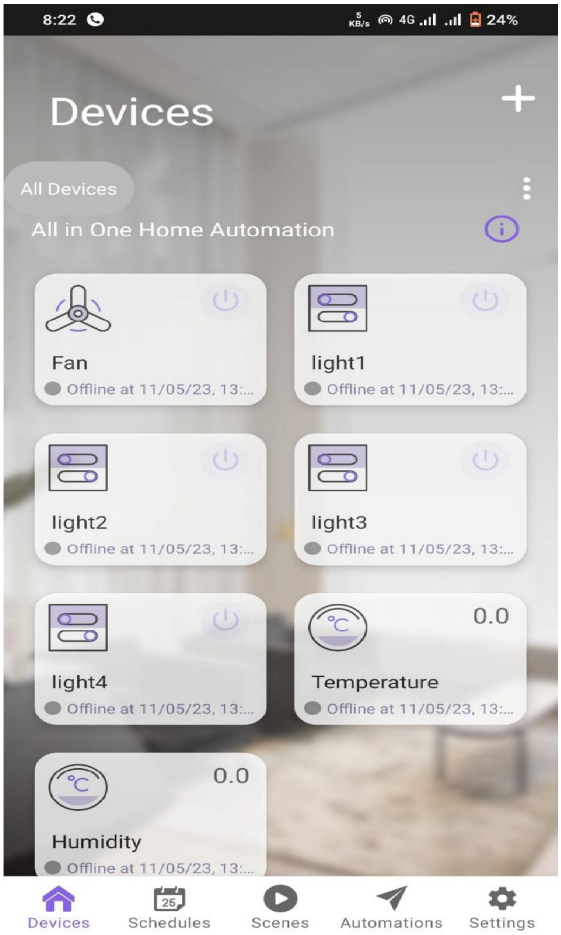

Fig: 6.3Mobile Setup Of ESP Rainmaker For Automation

Actual Circuit :

Fig: 6.4 Actual Circuit Developed

VII. RESULT AND APPLICATION

7.1 Result

1. Reduced energy consumption: A smart energy monitoring system may assist users discover places where energy is being wasted and take actions to minimize their energy consumption by offering real-time insights into energy consumption trends. Over time, this can result in considerable cost savings.

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2. Increased energy efficiency: A smart energy monitoring system may help customers manage their energy usage by discovering the most energy-efficient settings for their gadgets and appliances, in addition to decreasing total energy consumption.
3. Raised awareness: By giving real-time statistics on energy consumption, a smart energy monitoring system may help consumers become more conscious of their energy consumption and its environmental effect.
4. Better decision-making: Users may make better educated decisions about when and how to consume energy if they have access to precise energy usage data. They can, for example, adjust their consumption to off-peak hours when electricity costs are cheaper.
5. Predictive maintenance: A smart energy monitoring system may discover possible faults with appliances and gadgets before they become big problems by analyzing energy usage trends. This can save users money on maintenance and downtime.

7.2 Application

- Grid frequency management
- Event correlation (network and substation level)
- Control center computers and terminal units (SCADA)
- Lightning strike monitoring
- Scheduled load shedding
- Quality of supply metering
- Energy metering (time of use tariffs)

VIII. ADVANTAGES

1. Cost savings: By monitoring real-time energy use, customers may discover regions of excessive energy consumption and take actions to decrease energy waste, resulting in lower energy bills and cost savings.
2. Greater energy efficiency: Smart energy monitoring systems may assist customers in optimizing their energy use by discovering the most energy-efficient settings for their gadgets and appliances. This can cut energy use while also extending the life of equipment.
3. Environmental advantages: Smart energy monitoring systems can assist decrease greenhouse gas emissions and alleviate the effects of climate change by lowering energy use.
4. Predictive maintenance: Smart energy monitoring systems may discover potential faults with appliances and gadgets before they become serious problems by analyzing energy usage trends. This can save users money on maintenance and downtime.
5. Remote monitoring: Smart energy monitoring systems may be accessible from anywhere with an internet connection, allowing users to monitor energy use and regulate appliances and gadgets.

IX. CONCLUSION

Using electric energy meters for consumption control is an important factor for both electric companies and their customers. As new information and communication technologies evolve, it can be easier to measure consumption of electric energy. Electric companies and their customers must measure the amount of electricity they consume. Electric energy meters can be used to measure consumption. With the evolution of information and communication technology, measurement has become more precise.

Electric utilities and their customers use electric energy meters to measure the consumption of electricity. With the development of new communication technologies, consumption measurement will become even more important. Both electric companies and their customers are interested in measuring their electric energy consumption. Electric energy meters are a useful tool for monitoring consumption and regulating it. Over time, and with the development of new information and communication technology, electric energy meters are becoming more common. Both electric companies

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and their customers benefit from the ability to measure the consumption of electric energy. With advancements in information and communication technology, electric companies and their customers have been able to control consumption of electric energy. As new information and communication technologies have evolved, it becomes increasingly important to measure electric energy consumption. By using electric energy meters, you can monitor and control your energy consumption

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