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SMART ENERGY METERING SYSTEM USING IoT

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Abstract : Efficient energy utilization plays a very vital role for the development of smart grid in power system. So, proper monitoring and controlling of energy consumption is a chief priority of the smart grid. The existing energy meter system has many problems associated to it and one of the key problem is there is no full duplex communication. To solve this problem, a smart energy meter is proposed based on Internet of Things (IoT). The proposed smart energy meter controls and calculates the energy consumption using ESP 8266 12E, a Wi-Fi module and uploads it to the cloud from where the consumer or producer can view the reading. Therefore, energy analyzation by the consumer becomes much easier and controllable. This system also helps in detecting power theft. Thus, this smart meter helps in home automation using IoT and enabling wireless communication which is a great step towards Digital India.

The objective of this project is to monitor the consumed energy and calculate the fare and using the RFID R/W card as prepaid card for paying the amount to EB substation. Normal exiting energy meter are Analog. This type of Energy meter needs the EB Employer for directly come to home to calculate the Amount for unit of Energy consumed by the consumer. Some time the EB Employer may enter the wrong consumed unit value. So it cause calculated amount for Energy unit may be higher or lower so it affects both EB and Consumer. This project avoids this type problem. It is the digital Energy meter so there is no reason for error occurs and there is no need for EB officer to come directly for take the reading.

INTRODUCTION

In the previous decade, energy saving has been one of the basic issues in planning electronic apparatuses or gadgets. The Future is moving towards the energy administration which require changes from energy usage and energy supply. For the energy administration of household customers the smart meter is need of great importance. The smart meters are an embedded system which is implemented with microcontroller. The main purpose of the microcontroller is to simplify the system design and provide flexibility.

Up to present, many energy monitoring and control methods have been proposed. An emerging technology brought about rapid advances in modern wireless telecommunication is Internet of Things (IoT). IoT is defined as a kind of network which is not only can connect the objects, can be fully automatic, can collect, transmit and process information intelligently but also can realize the scientific management at anytime and anywhere through a variety of sensing devices and the Internet.

The basic characteristics of IoT are networked, instrumented, automated and intelligent. The smart grid plays a great role in our present society. Tens of millions of the people's daily life will be degraded dramatically because of the unstable and unreliable power grid . Smart meter is a reliable status real time monitoring, automatic collection of information, user interaction and power control device . It provides a two way flow of information between consumers and suppliers providing better controllability and efficiency . It provides real time consumption information providing energy consumption control . Whenever the maximum load demand of customers crosses its peak value, the supply of electricity for the customers will be disconnected with the help of smart energy meter . In ideal environment with

normal work load condition, the life span of the smart meter is about 5 to 6 years . But in reality smart energy meter suffers environmental issues and decreases its life span with abnormal consumption of energy.

OBJECTIVES

Real-time Monitoring Enable consumers to monitor their energy consumption in real-time through a web or mobile application. This helps users to understand their energy usage patterns and make informed decisions to optimize consumption. Remote Access and Control Allow users to remotely access and control their energy meter via the internet. This feature enables consumers to manage their energy consumption even when they are not physically present at the location.

RESEARCH METHODOLOGY

[1] Birendrakumar Sahani, Tejashree Ravi, Akibjaved Tamboli, Ranjeet Pisal International Research Journal of Engineering and Technology (IRJET) 4 (04), 96-102, 2017.We can see a person standing in front of our house from electricity board, whose duty is to read the energy meter and handover the bills to the owner of that house every month. This is nothing but meter reading. According to that reading we have pay the bills. The main drawback of this system is that person has go area by area and he has hey Google hey surface read the meter of every house and handover the bills. Many time errors like extra bill amount, or notification from electric board even though the bills are paid are common errors. To overcome this drawback we have come up with an idea which will eliminate the third party between the consumer and service provider, even the errors will be overcome.

[2] Dr Shreedhar A Joshi, Srijay Kolvekar, Y Rahul Raj, SS Singh Bonfring International Journal of Research in Communication Engineering 6 (Special Issue), 89-91, 2016 .Smart meter is a next generation meter which is highly efficient and user friendly, which provides a great way to save and control the usage of energy. The smart meter is wirelessly connected to users by the means of IoT. This means user can easily have control on the meter as per his needs. The advantage of smart meter is it can be used by utilities to communicate information to bill customers and operating their electric system. Earlier the system utilized one way communication to collect meter data and were referred as AMR.

[3] Bibek Kanti Barman, Shiv Nath Yadav, Shivam Kumar, Sadhan Gope 2018 2nd international conference on power, energy and environment: towards smart technology (ICEPE), 1-5, 2018.Efficient energy utilization plays a very vital role for the development of smart grid in power system. So, proper monitoring and controlling of energy consumption is a chief priority of the smart grid. The existing energy meter system has many problems associated to it and one of the key problem is there is no full duplex communication. To solve this problem, a smart energy meter is proposed based on Internet of Things (loT). The proposed smart energy meter controls and calculates the energy consumption using ESP 8266 12E, a Wi-Fi module and uploads it to the cloud from where the consumer or producer can view the reading.

[4] Danielly B Avancini, Joel JPC Rodrigues, Ricardo AL Rabêlo, Ashok Kumar Das, Sergey Kozlov, Petar Solic International Journal of Energy Research 45 , 189-202, 2021. The significant increase in energy consumption by the growth of the population or by the use of new equipment has brought big challenges to the energy security as well as the environment. There is a need that consumers can track their daily use and understand consumption standards for better organizing themselves to obtain financial and energetic efficiency. With the improvement of smart networks technology for better energy supply, a smart meter is not just a simple measurement gadget anymore, but it has additional functions including smart equipment control, bidirectional communication that allows integration of users and networks, and other functionalities.

PROBLEM DEFINITION

As we have already mentioned, digital energy meters provide several benefits, but there is always room for improvement or change in order to make products easier for both consumers and suppliers to use. Life on Earth would not be conceivable without the vital development of electricity. Therefore, metering. The amount of electricity used is necessary. Following are some problems observed in those energy meters. which should be A large staff is needed in order to accomplish duties like bill payment and meter reading, which both demand a huge workforce. Meter reading and other associated tasks, such paying bills, are handled by a sizable crew.

OVERVIEW OF THE PROJECT

The primary goal is to develop a system that accurately monitors and manages energy consumption in real-time, providing users with insights into their energy usage patterns and enabling efficient energy management.The project involves deploying IoT-enabled energy meters equipped with sensors to measure electricity consumption. These meters are connected to a central hub or gateway device, which collects and processes the data. The system includes backend software infrastructure hosted on cloud platforms or local servers. This software manages data transmission, storage, analysis, and visualization.

ARDUINO MICROCONTROLLER (HARDWARE)

In this, we will learn about ESP32, a dual core MCU from Esp ressif Systems with integrated Wi-Fi and Bluetooth. If you worked with ESP8266, then ESP32 is a significant upgrade with a lot more features. This Getting Started with ESP32 guide is for complete beginners, with or without prior experience in IoT or ESP8266. ESP32 is a low-cost System on Chip (SoC) Microcontroller from Espressif Systems, the developers of the famous ESP8266 SoC. It is a successor to ESP8266 SoC and comes in both single-core and dual-core variations of the Tensilica's 32-bit Xtensa LX6 Microprocessor with integrated Wi-Fi and Bluetooth.

RELAY

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

ENERGY METER

An electricity meter, electric meter, electrical meter, energy meter, or kilowatt-hour meter is a device that measures the amount of electric energy consumed by a residence, a business, or an electrically powered device. In electric meter or energy meter is a device that measures the amount of electrical energy consumed by a residence, business, or an electrically powered device. Electric meters are typically calibrated in billing units, the most common one being the kilowatt hour. Periodic readings of electric meters establish billing cycles and energy used during a cycle. In settings when energy savings during certain periods are desired, meters may measure demand, the maximum use of power in some interval. In some areas, the electric rates are higher during certain times of day, to encourage reduction in use.

New: Creates a new instance of the editor, with the bare minimum structure of a sketch already in place.
Open: Allows to load a sketch file browsing through the computer drives and folders.
Open-Recent: Provides a short list of the most recent sketches, ready to be opened.
Sketchbook: Shows the current sketches within the sketchbook folder structure by clicking on any name opens the corresponding sketch in a new editor instance.
Examples: Any example provided by the Arduino Software (IDE) or library shows up in this menu item. All the examples are structured in a tree that allows easy access by topic or library.
Close: Closes the instance of the Arduino Software from which it is clicked.
Save as: Saves the sketch with the current name. If the file hasn't been named before a name will be provided in a Save as window.
Save: Allows to save the current sketch with a different name.
Page-Setup: It shows the Page Setup window for printing.
Print: Sends the current sketch to the printer according to the settings defined in Page Setup.
Preferences: Opens the Preferences window where some settings of the IDE may be customized as the language of the IDE interface.
Quit: Closes all IDE windows. The same sketches open when Quit was chosen will be automatically reopened the next time you start the IDE.
Undo/Redo: Goes back of one or more steps you did while editing when you go back you may go forward with Redo.
Cut: Removes the selected text from the editor and places it into the clipboard.

Copy: Duplicates the selected text in the editor and places it into the clipboard.

Copy-Forum: Copies the code of your sketch to the clipboard in a form suitable for posting to the forum, complete with syntax colour.

Copy-as-HTML: Copies the code of your sketch to the clipboard as HTML, suitable for embedding in web pages.

Paste: Puts the contents of the clipboard at the cursor position, in the editor.

Select-all: Selects and highlights the whole content of the editor.

Comment/Uncomment: Puts or removes the comment marker at the beginning of each selected line.

Increase/Decrease-Indent: Adds or subtracts a space at the beginning of each selected line, moving the text one space on the right or eliminating a space at the beginning.

Find: Opens the Find and Replace window where you can specify text to search inside the current sketch according to several options.

Find-Next: Highlights the next occurrence if any of the string specified as the search item in the Find window, relative to the cursor position.

Find-Previous: Highlights the previous occurrence if any of the string specified as the search item in the find window relative to the cursor position.

CONCLUSION

This project provides wireless meter reading system that can monitor and analyze the data at every interval providing accurate results with less error. Some of the advantages of this smart system are: -Energy conservation. Lots of time and power saving from power department. Automatic control of energy meter. To make consumer keeps the track of energy meter. Power theft detection. Some of the disadvantages are Sometime the system takes time to upload the data depending on the Internet Speed and Module baud rate. The IoT concept can also be implemented in various working environment such as home automation, automatic water level detector and traffic control system etc. Implementing a smart energy meter using IoT technology offers numerous advantages for both consumers and utilities. By providing real-time monitoring of energy consumption, remote access, and control, as well as automatic billing functionalities, smart energy meters empower users to make informed decisions about their energy usage.

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