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Smart Prepaid Meter using GSM

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Abstract: *With the growing demand for energy efficiency and transparent billing systems, prepaid energy meters provide an effective solution. This project focuses on developing a Prepaid Energy Meter Using GSM and Arduino, which allows consumers to monitor and manage electricity consumption in a prepaid manner. The system automatically deducts energy charges based on usage and notifies users via GSM communication.*

The system is equipped with advanced features such as auto cut-off, which disconnects power supply when the prepaid balance runs out, and power theft tracking, which detects and tracks instances of power theft. The system is built using cutting-edge technologies such as microcontrollers, wireless communication modules, and sensors, which enable real-time monitoring and control of electricity usage.

Traditional energy meters follow a postpaid system where consumers use electricity and pay the bill at the end of a billing cycle. This often leads to disputes, delays in payments, and energy wastage. A prepaid energy meter eliminates these issues by allowing users to purchase electricity in advance, similar to a prepaid mobile recharge system.

Keywords: Arduino; Energy Meter

I. INTRODUCTION

Traditional energy meters follow a postpaid system where consumers use electricity and pay the bill at the end of a billing cycle. This often leads to disputes, delays in payments, and energy wastage. A prepaid energy meter eliminates these issues by allowing users to purchase electricity in advance, similar to a prepaid mobile recharge system. This project integrates an Arduino microcontroller, an energy meter, and a GSM module to create an efficient, user-friendly, and transparent energy billing system.

Electric energy consumed by any appliance is measured by a device known as an electric energy meter. For a long, the journey of energy meter has started. An electric meter or energy meter is a device that measures the count in units of how much electrical energy is consumed. The most common unit of measurement on the electricity measurement is that the kilowatt-hour [kWh], which is adequate to the quantity of energy employed by a load of 1 kilowatt-hour over one hour. Energy meter systems are designed in such a manner to ease or to meet your specific requirements. Usage of energy meter not only beneficial for power supply companies but also to the common man who can count the accurate amount of unit consumed and pay the amount for it respectively. The use of electric meter was started late 19th century and it became increasingly important that an electric energy meter, similar to the then-existing gas meters, was required to keep users cope up with ongoing technologies and to make accurate billing system for customers instead of charging the same amount from users every month.

II. LITERATURE REVIEW

Pre-paid energy meter Reading and Distribution Control Using GSM Networks, mainly focused on the measurement of power from the customer side that has been consumed by them. An embedded system which can be attached to the existing digital meter at consumer side and establish communication between consumer and service provider through GSM is designed. Design embedded with Arduino and GSM technology which is an advancement over the conventional energy reading system which enables the consumers to have a control over their electricity usage is

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proposed.A prepaid energy meter to control electricity theft was proposed. In this a smart energy meter with GSM module is installed at consumer side and a server ismaintained at service provider side. In, various solutions for prepaid energy in smart metering is addressed. In this century, one source of energy that is being uncontrollably consumed by the population is electric energy and if some measures are not taken at the initial stage, then this source of energy will be exhausted soon enough. Some people use it intentionally while some are unaware that their share of electric energy is being used by another person without their knowledge. To stop this over usage of electric energy this new technology is being developed which will reduce the amount of usage of electricity with high percentage. This technology will allow the user to set the amount of electric energy they want to consume by doing the prior payment for it which means the user will do pre-payment for electricity and according to the amount person paid they will get limited units of electricity to consumers and once the limited units are consumed power will be cut, this will not only reduce the burden from a population of paying high amount while it will also reduce the load from power supply companies as well.

III. AIM OF PROJECT

Smart Prepaid Energy meter using Arduino and GSM can provide the solution to problems discussed. his project helps in not only automating but also for controlled managing of the energy consumed, which results in efficient usage of power. GSM modem is helpful for the message alerts and notifications needed for these purposes. The different components used are controlled by ATmega 328P microcontroller.

IV. METHODOLOGY OF THE PROJECT

The block diagram of the proposed system is shown in Fig 2. 1. It consists of Arduino UNO, GSM module, relay, energy meter, 16x2 LCD, mobile (to send recharge SMS). The pre-paid energy meter works as, the user first will send recharge SMS via mobile which will be received by sim card placed in GSM module, as soon as recharge completes, a message will be sent to Arduino UNO which will process the message and will be passed on to LCD screen (which will show recharge completion message) and also to relay which is connected to Arduino and energy meter both. A relay that acts as a barrier to the supply of energy will then allow passing power through it to the load. Once the amount given as recharge about to become zero relays will again stop the supply of power and a message will be displayed on the LCD screen to recharge again for further use of electricity. Circuit connections for this Pre-paid energy meter are shown in the Fig 2, we have used an Arduino UNO for processing all the things used in the project. A liquid display is connected for displaying the status of Units and remaining balance.

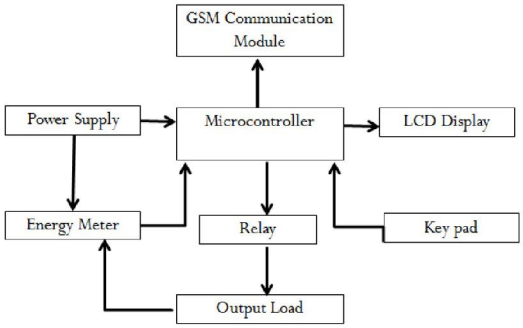

Fig. 2.1 Block Diagram

Components & Details:

Arduino Mega Board Model:

Arduino is an open-source computer hardware, open-source software and microcontroller-based device building kit and interactive objects that can sense and control physical devices. arduino designs and manufactures software, software and software.

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The project is focused on the design of the microcontrollers. The board contains a combination of digital and analog input/output (I/O) pins, which can connect to specific expansion boards (termed shields).

GSM Modem:

Specifications

Frequency Bands: Typically quad-band (850/900/1800/1900 MHz) for global coverage.
Interfaces:
Serial (RS-232): For communication with a microcontroller or computer.
SIM Card Holder: For inserting the SIM card.
Antenna Connector: (e.g., SMA) for connecting the GSM antenna.
Audio Interface: For voice communication.
Data Transfer: Supports GPRS (General Packet Radio Service) for data transfer.

Energy Meter:

Energy meter specifications vary based on type (single-phase, three-phase, smart, etc.) and application (residential, industrial) but generally include accuracy class, current and voltage ratings, frequency, power consumption, environmental conditions, and communication capabilities.

General Specifications:

Frequency: The standard operating frequency, usually 50 Hz in many regions.
Power Consumption: The amount ofpower the meter itself consumes, measured in Watts (W) or Volt-Amperes (VA).
Environmental Conditions: Specifications for operating temperature, humidity, altitude, and other environmental factors.

BUZZER:

A buzzer or beeper is an audio signal device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. If embedded system is misplaced from dashboard, the IR sensor becomes active. The signal is sent to microcontroller to ring the buzzer. It is connected to the pin no 28 of microcontroller.

Advantages: -

- Eliminates manual meter reading and reduces operational costs.
- Prevents electricity theft by ensuring prepaid consumption.
- Reduces disputes over incorrect billing.
- Encourages energy conservation by allowing users to track consumption.
- User-friendly interface with real-time updates and SMS alerts.
- It is real time operating system.
- It is accurate.
- The system is programmable.

V. APPLICATIONS

- In educational organization.
- In hospital pump system.
- Home purpose.
- Electricity department.
- In industries.
- Domestic purpose use.

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VI. CONCLUSION

The Prepaid Energy Meter Using GSM and Arduino provides an effective and transparent solution for electricity billing. By allowing users to pay in advance and monitor consumption in real time, the system promotes responsible energy usage. The GSM-based notification system ensures timely alerts and prevents unexpected power disconnection. This technology can significantly improve energy management and reduce electricity theft in residential and commercial sectors. The design of Smart Energy meter using GSM technology can make the users to pay for the electricity before its consumption. In this way, consumers hold credit and then use the electricity until the credit is exhausted. If the available credit is exhausted then the electricity supply is cut-off by a relay. This reduces human labour and at the same time increases the efficiency in calculation of bills for used electricity. Smart energy meters will bring a solution of creating awareness on unnecessary wastage of power and will tend to reduce wastage of power. This module will reduce the burden of energy providing by establishing the connection easily and no theft of power will take place. This paper work exposes the purpose of energy monitoring and controlling by implementing prepaid system. It is hoped that this work helps the consumers for better energy management and its utility in the distribution system for economic liability of the Electrical Boards.

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