

GSM Based Prepaid Energy Meter Model

Mr. Surya Singh¹, Swayam Kharat², Kunal Kolekar³, Salman Thakur⁴,
Aniket Randale⁵, Sumit Saw⁶

Lecturer, Department of Electronics and Telecommunication Engineering¹
Student, Department of Electronics and Telecommunication Engineering^{2,3,4,5,6}
Bharati Vidyapeeth Institute of Technology, Navi Mumbai, India

Abstract: *The aim of the project is to minimize the queue at the energy meter billing counters and to restrict the usage of energy meter automatically, if the bill is not paid. The project also aims at proposing a system that will reduce the loss of power and revenue due to power thefts and other illegal activities. The work system adopts a totally new concept of "Prepaid Energy Meter". The GSM technology is used so that the consumer would receive messages about the consumption of power (in watts) and if it reaches the minimum amount, it would automatically alert the consumer to recharge.*

Keywords: Arduino, GSM Module, Energy Meter

I. INTRODUCTION

The Electrical metering instrument technology has come a long way from what it was more than 100 years ago. From the original bulky meters with heavy magnets and coils, there have been many innovations that have resulted in size & weight reduction in addition to improvement in features and specifications. Resolution and accuracy of the meter have seen substantial improvements over the years. Introduction of the digital meter in the later part of last century has completely changed the way Electrical parameters are measured. Starting with Voltmeters & Ammeters, the digital meter has conquered the entire spectrum of measuring instruments due to their advantages like ease of reading, better resolution and rugged construction. Of particular significance is the introduction of the Electronic Energy Meter in the mid-eighties. Now a days, the energy consumption and energy distribution has become a big subject for discussion because of huge difference in energy production and consumption. In this regard, energy consumers are facing so many problems due to the frequent power failures; another important reason for power cuts is due to the un-limited energy consumption of rich people. In this aspect, to minimize the power cuts and to distribute the energy equally to all areas, some restriction should have over the power consumption of each and every energy consumer, and according to that the Government should implement a policy, by introducing Autonomous Energy Meters everywhere in domestic sector. Hence, the need has come to think on this line and a solution has to be emerged out.

II. EXISTING METHOD

In this project, we will make a GSM Based Prepaid Electricity Energy Meter using Arduino. Prepaid Electricity Energy Meter is one of the best concepts for the current electricity payment system. In this system, you can recharge the device and update the balance as we do on our mobile phones. • By sending a simple SMS, you can recharge the electricity balance through this system. It can also disconnect the home power supply connection if there is a low or zero balance in the system. And this system will read the energy meter readings and automatically send some updates to the user's mobile phone like low balance alert, cut off alert, resume alert and recharge alert. The Anti-Theft Alert can also be detected when someone tries stealing the meter by opening the lid. So, let us see how we can build this project.

III. PROBLEM STATEMENT

The present power usage reading is made manually by moving to the consumer locations. This requires large number of labour operators and long working hours to accomplish the task. Manual billing is sometimes restricted and delayed by bad weather conditions. The printed billing also has the tendency of getting lost. Over the last few years, Smart (Prepaid) Energy Meter has been proposed as an innovative solution aimed at facilitating affordability and reducing the

cost of utilities. This mechanism, essentially, requires 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. Readings made by human operators are prone to errors. This project addresses the above-mentioned problems. The development of GSM infrastructure in past two decades made meter reading system wireless. The GSM infrastructure, which has national wide coverage, can be used to request and retrieve power consumption notification over individual houses and flats. Apart from making readings using GSM communication, billing system is needed to be made prepaid to avoid unnecessary usage of power.

IV. LITERATURE SURVEY

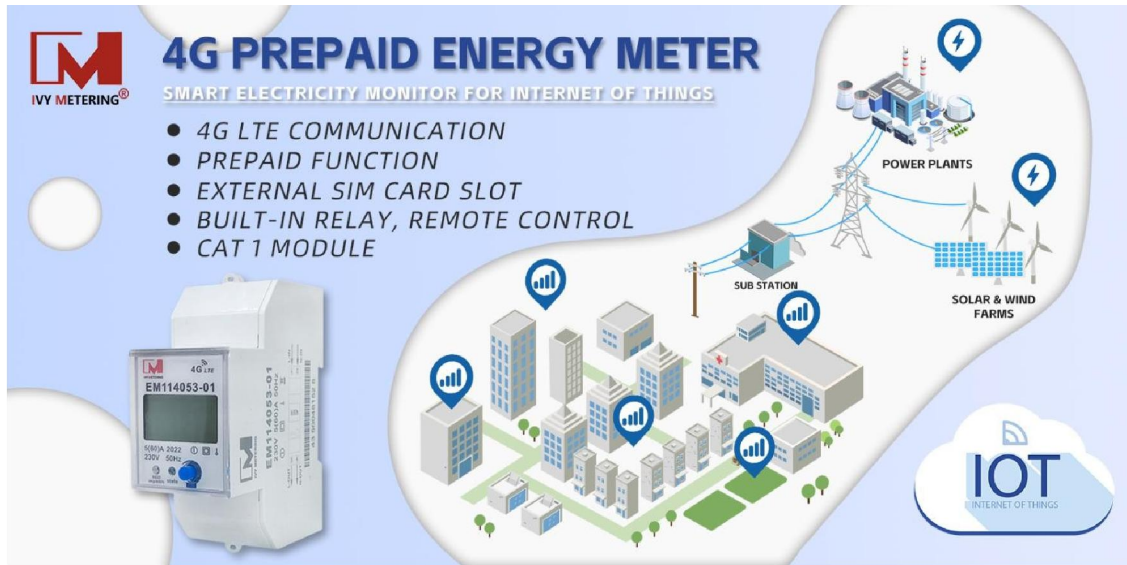
In 2017 Nazmat Toyinet.al. told that energy fuels the growth and development of any country, and as such effective monitoring, measurement, billing and access control is imperative. They presented a device that uses the evolving Internet of Things (IoT) technology in the design and implementation of an Internet based prepaid energy meter often referred to as smart meters. The energy measurement and billing system is automated. The system employs the ATmega328p and ESP8266 to operate a dual core microprocessor unit with one core dedicated to energy sensing and measurements, while the other handles the network connectivity, storage, computations and overall system performance. They used the HTML5 technology to develop a highly interactive mobile and web frontend Graphic User Interface (GUI) application that allows for consumers to have access to monitor and control their consumption pattern while the utility companies can monitor and control customers and their billing systems.

The major advantage of the designed system is its ability to upgrade the existing energy meters into prepaid energy meters with the attachment of prepaid modules which eliminates the need to entirely replace the energy meter. They ensured that the proposed prepaid energy meter will be very useful for the power utilities in developing countries with large population who use traditional energy meters because upgrading the existing energy meters is more economical than replacing them fully with a prepaid energy meter.

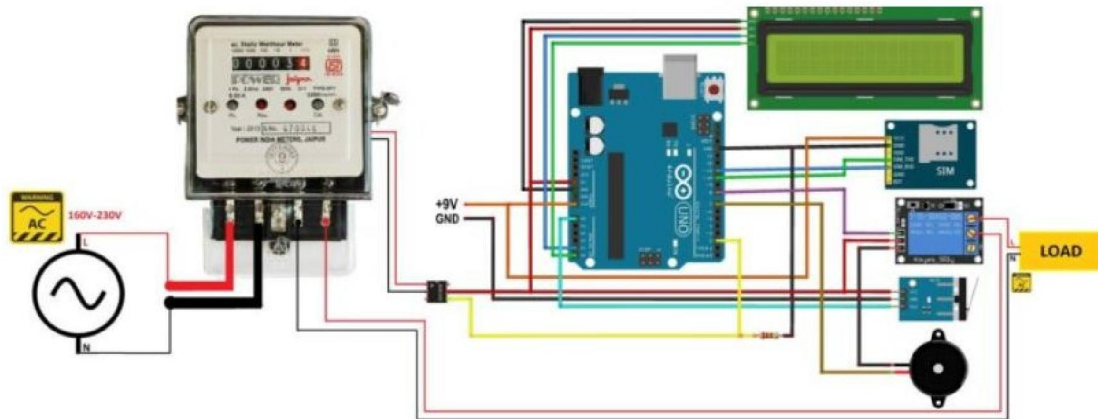
V. SCOPE OF PROJECT

A scheme of Electricity billing system called "PREPAID ENERGY METER " can facilitate in improved cash flow management in energy utilities and can reduce problem associated with billing consumer living in isolated area and reduces deployment of manpower for taking meter readings. Every consumer can recharge RFID tag assigned and recharge its meter at various ranges (i.e. Rs 50, Rs 100, Rs 200 etc.).In our project and implementation we have given the name for RFID tag card smartcard. Consumer can check its balance in LCD attached with the module and be prepare for the next recharge in advance.

The concept of "Prepaid electricity meter" gives the smooth and better flow of capital processing and administration of energy utilities. It can reduce the hurdles which are associated with users living in the areas in which the access of billing and electricity is a problem. It can reduce a large amount of time and manpower for taking and noting down readings. Every consumer using the "Prepaid electricity meter" can recharge to any amount such as Rs 15, Rs 25, Rs 30. As it recharges the account of user all over the Asia so it also reduce the cost of transportation .Adding a mini printer to the "prepaid electricity meter" produces the printed bill which the user can keep for the record .If a software is added to the "Prepaid electricity meter" by which a balance can be seen on request then a consumer's power cut can be prevented.



Schematic diagram



WORKING

A GSM-based energy meter measures electrical energy consumption using sensors and a microcontroller to track parameters like voltage and current. Once the data is collected and processed to calculate total energy usage, the meter utilizes a GSM module to send this information via SMS to a predefined mobile number. This allows users to monitor their energy consumption remotely and receive alerts for low credit or abnormal usage. By enabling real-time communication, GSM-based energy meters enhance energy management, streamline billing processes, and improve user convenience.

HARDWARE COMPONENTS DESCRIPTION

Arduino:

Arduino is an open-source electronics platform that combines user-friendly hardware and software, making it accessible for beginners and professionals alike. At its core is a microcontroller, typically from the ATmega series, mounted on a circuit board that features input/output pins, power connectors, and interfaces for connecting various sensors and actuators. Arduino boards, such as the popular Arduino Uno and Mega, come with a simplified programming environment based on a variant of C/C++, enabling users to write and upload code easily. The platform supports a wide range of applications, from home automation and robotics to interactive art and educational projects,

allowing users to interface with numerous components like motors, lights, and sensors. Arduino's open source nature fosters a vibrant community, providing extensive documentation, forums, and libraries that facilitate collaboration and innovation. This versatility and ease of use make Arduino a leading choice for anyone looking to explore the world of electronics and programming.

GSM Module:

A GSM module is a vital component used in embedded systems for enabling mobile communication. It facilitates the integration of GSM (Global System for Mobile Communications) technology into various electronic projects, allowing devices to send and receive SMS, make voice calls, and access mobile data. Commonly used modules, such as the SIM800 and SIM900, are compact and feature built-in antennas, making them suitable for a wide range of applications, from remote monitoring and automation to IoT projects. The GSM module communicates with microcontrollers via serial communication (UART), enabling easy integration with platforms like Arduino and Raspberry Pi.

16 x 2 LCD Display:

A 16x2 LCD (Liquid Crystal Display) is a popular display module used in various electronic projects, particularly in conjunction with microcontrollers like Arduino. The term "16x2" indicates that the display has 16 columns and 2 rows, allowing it to show up to 32 characters at a time. These LCDs are typically based on the HD44780 controller, which facilitates easy interfacing through a standard set of commands. They can display alphanumeric characters, special symbols, and even custom characters, making them versatile for user interfaces. The display operates in either 4-bit or 8-bit mode, enabling flexibility in pin usage, which is crucial for projects with limited I/O pins. Backlit options enhance visibility in low-light conditions, while the contrast can be adjusted for better readability.

Bread Board :

A breadboard is a crucial tool used in electronics prototyping and circuit design, allowing users to build and test circuits without the need for soldering. Typically made of plastic with a grid of holes, a breadboard features a series of interconnected metal clips beneath the surface that facilitate easy connections between electronic components. It usually includes two horizontal rows of power rails on the top and bottom, which are used to distribute power (usually 5V or 12V) across the board.

Single Channel Relay:

A single-channel relay is an electromechanical switch used to control high voltage devices with low-voltage signals. It consists of a coil, an armature, and a set of contacts. When an electric current flows through the coil, it generates a magnetic field that moves the armature, either closing or opening the contacts, thereby controlling the flow of electricity to the connected load. Single-channel relays are commonly utilized in automation and control systems, enabling microcontrollers, like Arduino, to operate appliances, lights, and motors that require higher voltage or current than the control circuit can handle. They are often found in home automation systems, smart appliances, and industrial applications, allowing users to switch devices on and off remotely or automatically based on specific conditions. Typically available in various forms, including mechanical and solid-state, single-channel relays can be easily integrated into circuits and provide isolation between the control and load sides, enhancing safety and reliability in electronic designs.

Energy Meter:

An energy meter is a device that measures the amount of electrical energy consumed by a residence, business, or electrical device over time, typically expressed in kilowatt-hours (kWh). These meters are crucial for billing purposes, allowing utility companies to track energy usage and charge customers accordingly. Traditional electromechanical energy meters use a rotating disc and calibrated gears to calculate consumption, while modern smart meters employ digital technology to provide real-time data, enable two-way communication, and facilitate remote monitoring. Smart meters can also record data on energy consumption patterns, allowing consumers to manage their usage more effectively and utilities to optimize grid performance. In addition to standard measurement, many energy meters

include features such as load profiling, which analyzes usage trends, and integration with home automation systems for better energy management

VI. CONCLUSION

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 number of units and then use the electricity until the unit exhausted. If the available units are exhausted, then the notification message send to the consumer's registered number and electricity supply is cut -off by a relay. This reduces the human labour and at the same time increases the efficiency in calculation of bills for used electricity. Prepaid Energy Meter will bring a solution of creating awareness on unnecessary wastage of power and will tend to reduce wastage of power. This paper will reduce the burden of energy providing by establishing the connection easily and no theft of power will take place.

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