Smart Energy Meter & Over And Under Voltage Protection

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Abstract- *The "smart energy meter & over and under voltage protection" is an innovative prepaid energy-monitoring device designed to promote energy conservation and sustainability. By incorporating advanced technology and features, this meter allows for real-time tracking of energy usage, enabling consumers to better understand and manage their electricity consumption.*

With the smart energy meter, users can screen their energy usage, set energy consumption targets, and receive alerts when usage levels exceed predetermined thresholds. By providing this real-time data, consumers are empowered to make up-to-date decisions about their energy usage, helping to reduce waste and lower their overall energy bills.

In addition to promoting energy conservation, the smart energy meter also offers the convenience of prepaid energy billing, allowing users to pay for their electricity in advance and avoid unexpected charges or bill shocks. By preloading credits onto the meter, consumers can easily budget for their energy costs and avoid the stress of accumulating bills.

Overall, the "smart energy meter & over and under voltage protection" is a cost-effective and efficient solution for both consumers and energy providers alike. By encouraging energy conservation and providing convenient prepaid billing options, this device is helping to create a more supportable and environmentally friendly future for all.

Keywords- prepaid energy meter, energy conservation, over & under voltage protection.

I. INTRODUCTION

An electrical meter or an energy meter is a device that measures the amount of electrical energy consumed for residence or business purposes. There are two types of single phase and three-phase meter Domestic Ordinary Power Consumers. Energy consumption is measured byall electrical services using a kilowatt-hour meter with reference to kilowatt-hours (kWh)[1].

Unlike traditional meters, a "smart energy meter & over and under voltage protection" is capable of real-time monitoring and reporting, allowing consumers to better understand and manage their energy consumption.

Not only does a smart energy meter provide detailed data on energy usage, but it also serves as a prepaid energy meter, offering consumers the option to pay for their energy usage in advance. This innovative feature promotes energy Conservation by inspiring users to be more mindful of their energy usage and make additional responsive decisions about when and how they use electricity.

The combination of advanced technology and prepaid functionality makes the smart energy meter an indispensable tool in the quest for sustainable energy practices. By providing consumers with the necessary information and incentives to monitor and control their energy usage, smart energy meters play a vital role in promoting energy conservation and contributing to a more environmentally friendly future.

The voltage protection unit embedded within energy meter assumes a critical role in shielding connected devices from the adverse effects of voltage extremes. Its primary function revolves around promptly discontinuing power transmission when voltage levels exceed or fall below predefined thresholds. In instances of overvoltage, where incoming voltage exceeds safe operational limits, the VPU swiftly intervenes, interrupting power supply to prevent potential damage induced by excessive voltage.

II. METHODOLOGY & OPERATION

According to [2], the Automatic Meter Reading System continuously displays the energy meter and Transmits data via SMS at the request of the service provider. It saves enormous human labor.

The AC supply connected with the energy meter for measuring the consumption of electricity counting of pulse.

Energy meter connected with the Microcontroller through opt coupler 4N35 for counting of pulse and convert analog energy meter to the digital energy meter.

Load connected to meter through voltage sensor and relay so when recharge unit is finished or voltage current increase above or below threshold value the power supply cut off.

LCD display connected with Arduino shows the real time data of energy consumption.

When the amount of recharge get finished in the energy meter, it will send notification to the user mobile phone for the reminder of recharge. In addition, user can make recharge using application.

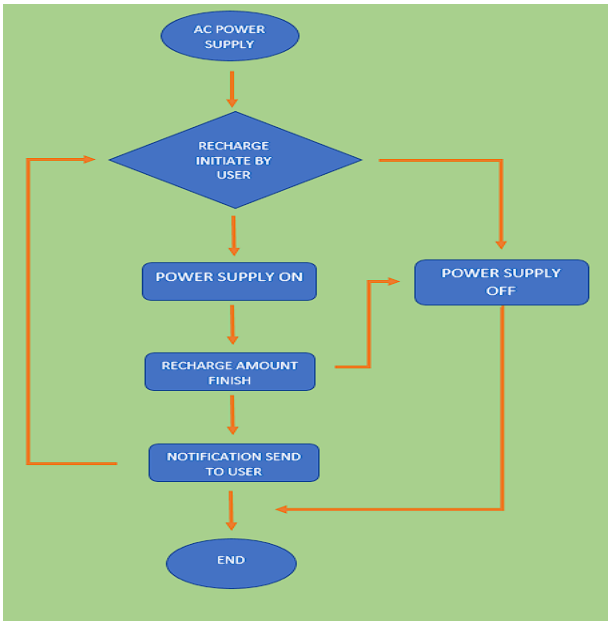

Fig. Flow diagram of prepaid energy meter

Basic unit of power is watts. One thousand watts is one kilowatt. If we use one kilowatt in one hour, it considered as one unit of energy consumed.

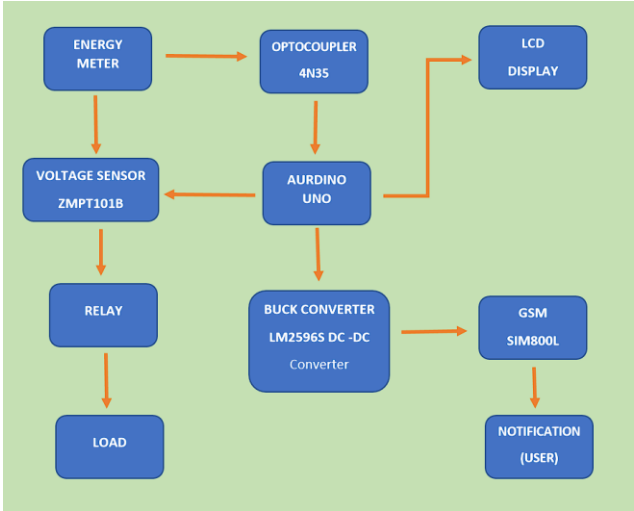

Fig 2.1. Block diagram

Voltage protection unit:

In recent years greater demand have placed on the transmission network, with this increase in demand or transmission line hence it is the responsibility of the power suppliers to supply safe and economical electrical power to customers with an existing transmission efficiency[3].

Voltage stability is the ability of a power system to maintain stable acceptable voltages at all system &devices under normal operating conditions and after being subject to a disturbance [4].

In recent years, it noticed that several voltage variability has been Responsible for major network downfalls in New York, India, Florida, French, Northern Belgium, Swedish, Japanese, Mississippi, Srilanka, North America, Pakistan and Tokyo etc. [5].

In this voltage protection unit, we use a voltage sensor to find and continually monitoring the voltage of grid. If the voltage cross above or below the threshold value the power, supply automatically, cut off and reduces the risk of any damage to electrical devices.

A. COMPONENTS USED:

1) Analog energy Meter:

An energy meter, also known as an electricity meter, is a device used to measure the electrical energy consumption by an electric load. It provides accurate readings of the amount of energy consumed in kilowatt-hours (kWh). Energy meters are essential for billing purposes, monitoring usage, and managing electrical distribution systems. The energy is the total power spent and used by the load at a particular interval

of time. It is use in domestic and industrial AC circuit for measuring the power consumption. The meter is less expensive and accurate.

2) Opt coupler 4N35:

The 4N35 optocoupler utilized in electronic circuits for applications such as providing electrical isolation between input and output circuits, signal conditioning, voltage level shifting, noise immunity enhancement, and control of switches or relays. Its ability to transmit signals across an isolation barrier makes it valuable in systems requiring protection against voltage spikes, noise, or ground loops, while also facilitating safe interfacing between circuits with different voltage levels. Additionally, it finds use in feedback and control loops, enhancing stability and safety in systems like power supplies, motor controls, and industrial automation.

3) ZMPT101B Voltage sensor:

The ZMPT101B voltage sensor is a commonly used module in electronic circuits for measuring AC voltage levels. It operates based on the standard of electromagnetic induction and is capable of accurately detecting AC voltages in the range of 0 to 250V. The sensor provides a proportional analog output voltage signal that corresponds to the detected input voltage. It is widely employed in various applications such as smart energy meters, power monitoring systems, and voltage measurement modules due to its compact size, high accuracy, and ease of integration. Additionally, the ZMPT101B sensor often utilized in conjunction with microcontrollers or analog-to-digital converters (ADCs) to facilitate voltage monitoring and control in electronic systems.

4) Buck converter:

It is a device, which convert a higher voltage level of direct current (DC), and steps it down to a lower voltage level. This is useful in various electronic applications where we need to power devices that operate at different voltage levels than the power source available. Let GSM SIM 800 require 4.4 volt to operate but Arduino provide power supply of 5 volt DC that can damage GSM module, so Buck converter it from 5 volt DC to 4.4-volt DC power.

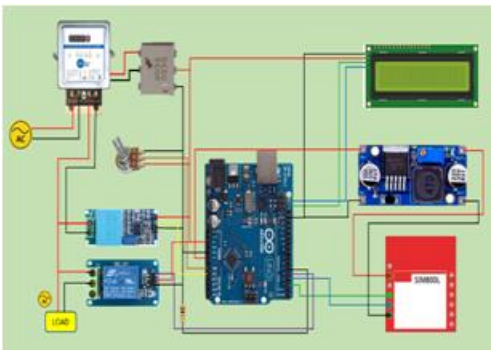

Fig. 3.1 circuit diagram

B. APPLICATION

1) Household usage:

A “smart energy meter & over and under voltage protection” serves a dual purpose beyond energy conservation by also ensuring the safety of home appliances against over and under voltage conditions. By continuously observing voltage levels in real-time, these meters act as vigilant guardians, swiftly detecting any fluctuations or anomalies in the power supply. In instances of overvoltage, where voltage exceeds safe limits, the meter triggers protective measures to prevent potential damage to connected appliances. Conversely, during under voltage situations, where voltage falls below operational thresholds, the meter takes preemptive action to safeguard appliances from operating erratically or sustaining harm. Through its proactive approach to voltage management, the smart energy meter not only promotes energy efficiency but also enhances the safety and longevity of home appliances, ensuring a secure and reliable household environment.

2) Industrial / Commercial usage:

In industrial settings, the reliable operation of equipment and machinery is paramount for maintaining productivity and preventing costly downtime. However, the occurrence of overvoltage poses a significant risk to these assets, often resulting in damage or failure that can halt production processes. Smart energy meters play a vital role in safeguarding industrial machinery from the adverse effects of overvoltage and under voltage conditions. By continuously monitoring voltage levels with precision and accuracy, these meters swiftly detect changes from normal operating parameters. In the event of overvoltage, the smart energy meter intervenes proactively, implementing protective measures to prevent damage to critical equipment. Similarly, during under voltage situations, the meter takes decisive action to ensure that machinery operates within safe and optimal ranges. By providing this essential layer of protection, smart

energy meters not only safeguard industrial assets but also contribute to maintaining uninterrupted operations and preserving overall productivity in industrial environments.

III. CONCLUSION & FUTURE SCOPE

Arduino is an innovative form of power determination that uses as a controller and is more useful because programming is very simple. . It is free source tech. This approach ensures that domestic energy use is reliable, safe and up-to - date quickly. This program enables consumers to control and track their use. Energy usage information helps users to control their energy use according to their need and save both money and power for the future , and we have interfaced Arduino with Energy Meter (analog) via Optocoupler to a GSM module to send notification about their recharge and electricity bills to the customer via SMS user can also make recharge with GSM system. This system can help user to make recharge quickly and does not require any type of smart phone. User can make recharge from any place it also provides the domestic power consumption accurately, safely, and with a relatively fast update rate, thus helping the user optimize and reduce their power usage. In this project, the data communication is through a mobile network, which is done by GSM system with respect to time. This design convert analogue data of electromagnetic energy meter to digital data. IOT can be used in the place of GSM module for real time information. If it implements in real world, then it can help us to reuse the analogue meter. [6].

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