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Design of Intelligent Energy Meter

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ABSTRACT

Power is one of the most fundamental necessities of individuals, which is usually utilized for household activities, industries and farming purposes. Protection of the system from the occurrence of various accidents is the most concerning issue as it costs a lot of money to both the government and consumers. In nations like India, these circumstances are on a more regular basis, due to lack of maintenance and carelessness. In order to prevent the occurrence of such accidents we are using an Intelligent Energy Meter (IEM). IEM is an electronic device having a microcontroller interfaced with the energy meter to alert the consumer or the authority from various occurrence of accidents before handedly and also generates bill automatically at the first of every month. This paper presents an intelligent energy meter for a programmed metering. In this energy meter power used and the activation status of several sensors will be shown on the Blynk app simultaneously and conveyed to the consumers. Every accident that are about to happen are sensed and alert message is sent to the user using Wi-fi module. Wi-fi network is utilized for sending notification to the users as it is one of the faster communication technologies with respect to the short distance. The proposed system is far more advantageous than conventional energy meter and empowers remote access of existing energy meter by the energy supplier. In addition, they can screen the meter readings consistently without the individual visiting each house, as the amount of power consumption is notified to the user.

Keywords— Intelligent Energy Meter (IEM), Wi-fi module

I. INTRODUCTION

A smart energy meter, also known as an intelligent energy meter, is an electronic device used to measure and record the consumption of electricity, gas, or water in a household or business. Unlike traditional meters, intelligent energy meters are equipped with advanced features that allow them to communicate with the energy provider, collect and transmit real- time usage data, and interact with other smart devices in a home

or business. Intelligent energy meters offer several benefits to both consumers and energy providers. For consumers, intelligent meters provide more accurate and detailed information about energy usage, allowing them to make informed decisions about their energy consumption and potentially save money on their bills. They can also help consumers to identify areas where energy waste can be reduced, such as by turning off appliances or lights when they are not in use. For energy providers, intelligent meter can help to manage the energy network more efficiently, reduce energy waste, and plan for future energy needs. The real-time data collected by intelligent meters can be used to monitor the network and identify areas where energy demand is high, allowing providers to adjust the supply accordingly. Intelligent energy meters can also help to reduce the carbon footprint of households and businesses by encouraging energy efficiency and reducing energy waste. This can help to address climate change by reducing greenhouse gas emissions. In addition to their energy-saving benefits, intelligent energy meters can also be integrated with other smart devices in a home or business, such as smart thermostats, lighting systems, and security systems. This allows for greater control over energy usage and can help to create a more sustainable and efficient living or working environment. Overall, intelligent energy meters are an important tool in the move towards a more sustainable and efficient energy system. They offer benefits to both consumers and energy providers and have the potential to play a significant role in reducing energy consumption, carbon emissions, and costs associated with energy use.

II. EXISTING SYSTEM

Conventional Energy Meter Set-up

In India, the existing energy meter setup for residential and commercial electricity consumption is typically a basic electromechanical meter, also known as a Ferraris meter. This type of meter consists of a metal disc that rotates at a rate proportional to the amount of electricity flowing through it. More recently, electronic meters have been introduced, which use solid-state components to measure and record electricity usage. These meters are often referred to as smart meters and can communicate usage data remotely to the utility company, eliminating the need for manual meter readings. In India, the electricity distribution companies (DISCOMs) are responsible for installing and maintaining energy meters. The process of getting a meter installed typically involves submitting an application to the DISCOM and paying a fee. The DISCOM then installs the meter and bills the customer based on the recorded usage data. There have been efforts in recent years to modernize the energy metering system in India and move towards smart grid technology. This includes the implementation of advanced metering infrastructure (AMI) that enables two-way communication between the meter and the utility company. This technology has the potential to improve energy efficiency, reduce peak demand, and provide more accurate billing. However, the adoption of smart meters in India has been slow due to various challenges, including the high cost of installation and the need for extensive infrastructure upgrades.

Disadvantages of existing model

One of the main disadvantages of the existing energy meter setup in India is its limited accuracy and reliability. Electromechanical meters, which are the most commonly used type of meter, can lose accuracy over time and may require frequent recalibration to maintain their accuracy. This can result in inaccurate billing and disputes between customers and the utility company. Another disadvantage is the lack of transparency in the billing process. Customers often do not have access to detailed information about their energy usage, making it difficult to track their consumption and identify areas where they could reduce energy usage and costs. There are also concerns about the security and privacy of customer data, particularly with the introduction of smart meters.

These meters collect and transmit data about a customer's energy usage, which could be vulnerable to hacking or other forms of cyber-attacks. In addition, the installation of energy meters in India has been uneven, with many areas still lacking reliable electricity supply and basic infrastructure. This makes it difficult to accurately measure and bill for electricity usage in these areas. Overall, while the existing energy meter setup in India has served as a basic means of measuring and billing for electricity usage, there are significant challenges that need to be addressed in order to ensure accuracy, transparency, and security in the energy billing process.

Proposed System

System Design

The design is built to reduce the effort needed and improve the working capability of the energy meter, with advanced features like automated bill generation and notification to power consumption. The proposed system has a microcontroller, Arduino Uno. The Arduino UNO is the microcontroller associated with the energy meter, whose primary function is to count the number of LED blinks, and the frequency of LED blinks totally rely on the amount of power consumed by the consumer. A small mathematical calculation is involved in converting the number of LED blinks to the number of power units consumed. Once this code is burned to the Arduino UNO microcontroller, the counting takes place. The more frequent the LED blinks, the more power is consumed by the consumed and vice versa. The Arduino UNO is a microcontroller board based on the Atmega328P. It has 14 digital input/output pins, 6 analog inputs, a 16 Mhz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. The 14 digital pins can be used as either inputs or outputs, and they can be programmed to read digital signals or control various external components like LEDs, motors, and sensors. The 6 analog inputs allow the board to read values from analog sensors like temperature sensors or light sensors. The board is powered via the USB connection or an external power source connected to the power jack. The Atmega328P microcontroller on the board is programmed using the Arduino Software (IDE), which is a simple and easy-to-use development environment that allows to write, upload and debug the code. Overall, the Arduino UNO board is a versatile and powerful microcontroller board that is widely used in a variety of applications, including industrial automation systems. The hardware of the project consists of Arduino module for connectivity and Blynk app is used to monitor the power consumption in phone and generates automatic billing, makes it precise and has increased accuracy in predicting and determining the power to be consumed and a notification alert is sent to the user using Blynk app. This paper has several simulations results the intelligent energy meter attached to it. Hence, the proposed system design proves to be automated and more efficient than the existing system design.

Name of the component	Function
Arduino Microcontroller	It acts an intelligent device in which several sensors are interfaced to prevent the occurrence of accidents.
PIR Sensor	It switches on the power system only when a motion is detected.
Flame Sensor	It alerts the consumer when a flame is detected.
Gas Sensor	It switches of the power supply when a gas leak is detected.
Buzzer	It is used as an indication device and is associated with flame sensor.
LDR Sensor	It counts the number of LED blinks to determine the power consumption of the user.
Relay Module	It acts as a switching device when the sensors are activated.
Blynk App	It is the communication app supported by Arduino and Wi-fi Module.
System Server	It refers to the electricity board of respective region.

Components Required

Table. 1 Components and its function

Several other supporting components such as capacitors, resistors, IC regulators are also used in implementation of this model.

Flowchart of the Intelligent Energy Meter

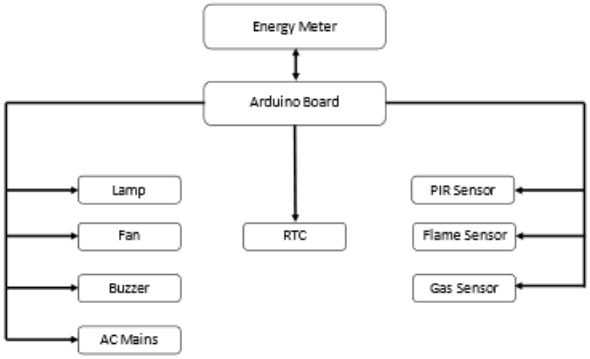


Fig.1 Flow Chart

Block Diagram of the Intelligent Energy Meter

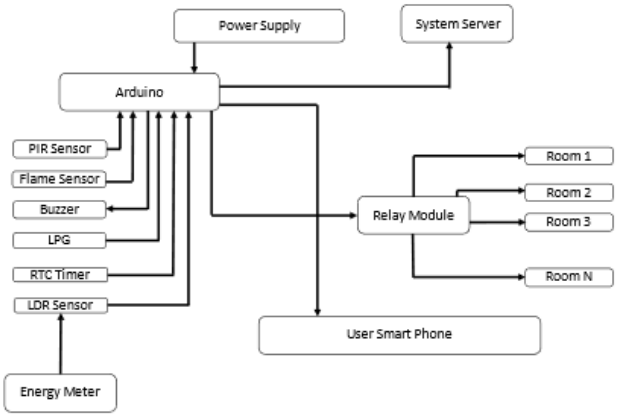


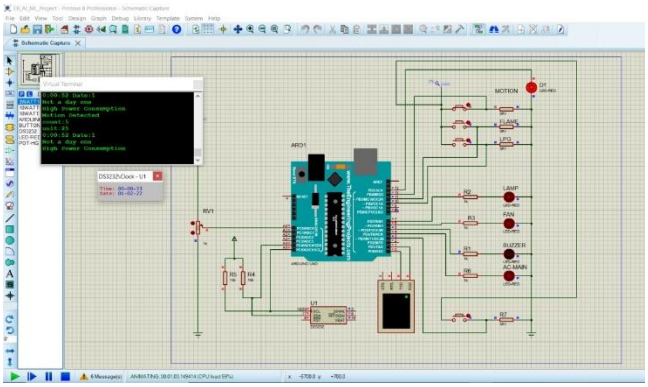
Fig.2 Block Diagram

Simulation Results

The following are the simulation results obtained under various cases:

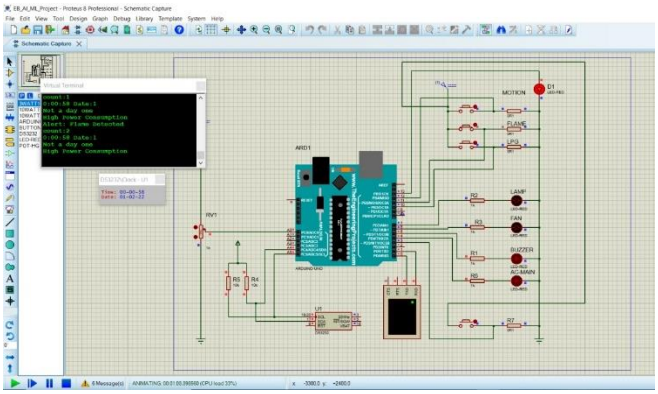
Case 1: Motion Sensor

When the motion sensor is activated, the Arduino shows that there is a motion detection and it turns on the light and fan in the house. By doing so, the power is consumed only in the presence of motion and when in need. Therefore, the
power wastage is reduced.



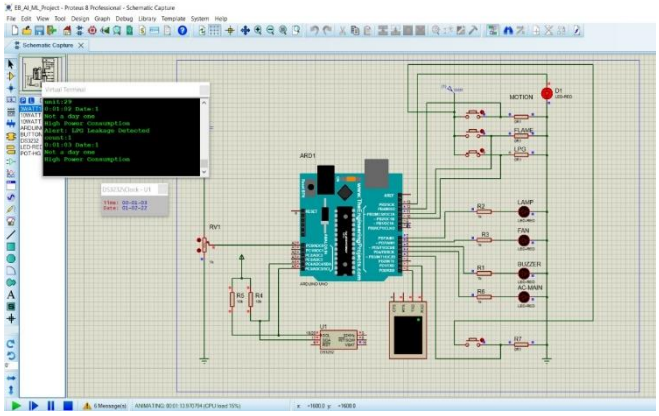
Case 2: Flame Sensor

When the flame sensor is activated, an alert message (Buzzer) stating Flame Detected is sent to the user. Thereby, warning the using to put off the fire immediately or evacuate the place at the earliest. This ensures the safety of the consumer.



Case 3: LPG Sensor

When LPG Sensor is activated, the ac-mains is turned off and it prevents the house from the occurrence of any accidents that could possibly occur from this gas leak.



III. Conclusion

In conclusion, intelligent energy meters offer a range of advantages over conventional energy meters. By providing real- time energy consumption data, intelligent meters enable consumers to identify areas where they can reduce energy usage and save money on bills. Intelligent meters also help to improve energy efficiency, reduce carbon emissions, and contribute to a more sustainable future. In addition, intelligent meters enable energy providers to offer more responsive and personalized customer service, improving overall satisfaction. With their advanced technology and real-time data capabilities, intelligent energy meters are a valuable tool for managing energy usage and promoting a cleaner, more sustainable energy future. As more households and businesses adopt intelligent energy meters, the benefits of this technology are likely to continue growing, making it an important part of the global effort to combat climate change and promote a more sustainable future.

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