Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 12, December : 2024

PREPAID ENERGY METER USING SMARTCARD TECHNOLOGY

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ABSTRACT

Prepaid energy systems utilizing smart card technology offer an efficient and modern approach to energy management. This system involves the use of a smart card to load a predetermined amount of credit, allowing consumers to pay for electricity in advance. The technology integrates seamlessly with smart meters, which deduct the consumed energy from the available credit on the smart card in real-time. This innovative solution addresses several challenges associated with traditional postpaid energy billing systems. It eliminates the need for manual meter readings, reduces billing disputes, and minimizes the risk of unpaid bills, making it particularly suitable for residential and small business applications. Consumers benefit from greater control over their energy usage, as they can monitor their consumption and budget more effectively. Additionally, energy providers experience improved revenue assurance and reduced administrative costs. The system also supports energy conservation initiatives by promoting conscious energy usage. Advanced features such as alerts for low balance and the ability to recharge remotely further enhance user convenience. Prepaid energy solutions using smart card technology represent a significant step toward sustainable energy management, fostering transparency, efficiency, and accessibility in the energy sector. This technology is gaining global traction, particularly in areas with irregular electricity supply or where traditional billing systems are logistically challenging. Future developments may incorporate renewable energy credits and integrate with IoT-based platforms for even smarter energy management. The development of a prepaid energy meter utilizing smartcard technology offers a novel approach to energy management and consumption.

Keywords: Internet of Things, sensors, Ardunio uno.

1. INTRODUCTION

The rapid advancements in technology have transformed how utilities, including electricity, are consumed and managed. Prepaid energy systems, powered by smart card technology, are a modern approach that allows consumers to pay for electricity in advance and use it according to their credit balance. This system involves the integration of smart meters and reloadable smart cards, ensuring a seamless and efficient way to manage energy consumption. Unlike traditional postpaid billing systems, where consumers are billed after usage, prepaid systems provide a "pay-as-you-go" model. Consumers load credit onto their smart cards, which are linked to smart meters. As electricity is consumed, the smart meter deducts the corresponding cost from the available credit in real time. This approach eliminates billing delays, minimizes disputes over inaccurate

readings, and reduces the risk of unpaid bills. Prepaid energy systems empower users to take greater control of their energy usage, enabling them to track their consumption patterns and budget effectively. For utility providers, the technology ensures better revenue collection, reduces administrative burdens, and curtails electricity theft. Furthermore, this system is particularly advantageous in regions with inconsistent electricity access or where traditional billing infrastructures are lacking. By fostering a culture of accountability and encouraging efficient energy use, prepaid energy systems using smart card technology pave the way for sustainable energy management and enhance the overall experience for consumers and providers alike. Prepaid energy meter systems have emerged as an effective solution to these challenges. By requiring consumers to pay for their electricity in advance, these systems ensure that consumption is directly linked to available credit, it promt the better financial discipline and reducing the risk of unpaid bills.

This project explores the development of a prepaid energy meter using smartcard technology, and aiming to provide a secure, efficient, and a user-friendly process for managing electricity usage. Smartcard are secure, temper-resistant, and capable of storing data reliably, making them an ideal medium for storing prepaid credits. This project aims to create a prepaid energy metering system that not only addresses the shortcoming of billing methods but also promotes sustainable and responsible energy usage. The Energy extremity is one of the major problems that the world faces moment. The energy extremity can be reduced to a certain extent by duly covering our energy consumption and avoiding energy destruction. The main end of the design is to design a RFID grounded reimbursed energy meter. RFID grounded reimbursed electricity is a unique and new conception which saves lot of time and power for electricity department. stoner can recharge the card whenever the power is required.

2. LITERATURE REVIEW:

Sharma and Rana proposed this energy metering system that uses smart card technology for prepaid electricity billing. Their research focused on the simplicity and security of approach, noting that the prepaid system integrated with smart cards allows for accurate billing and better customer service. The integration of Prepaid Energy Meters with Smart Card Technology has gained significant attention in recent years due to its potential to revolutionize energy consumption management. These systems offer a transparent, efficient, and reliable way for consumers and utilities to manage electricity usage and payments. The literature surrounding this technology explores its development, benefits, challenges, and various applications across different regions. The smart card can store consumer information, prepaid balance, and consumption details, allowing for real-time updates and easy recharging of credit.

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3. BLOCK DIAGRAM:

The block diagram of our prototype as shown below

Fig 1: Block Diagram

COMPONENTS:

3.1 ARDUINO UNO:

- Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connector on, a power jack, an ICSP header and a reset button.

- Arduino boards, combined with sensors, actuators, and wireless connectivity, allow homeowners to control various aspects of their living spaces with ease.

Fig 2: Arduino uno

3.2 LCD:

An LCD (Liquid Crystal Display) functions by utilizing liquid crystals to control light transmission. A backlight illuminates the display, and its light passes through a polarizing filter, restricting light waves to a specific vibration direction. Liquid crystals, sandwiched between glass plates, align to allow light passage when no voltage is applied. A second polarizing filter, perpendicular to the first, normally blocks light. However, when an electric field is applied to specific liquid crystal areas, it twists them, altering light polarization. This twisted light can now pass through the second filter. By controlling voltage application, light intensity is modulated, creating the image on the screen. A color filter layer, composed of red, green, and blue sub-pixels, filters white light to produce color displays.

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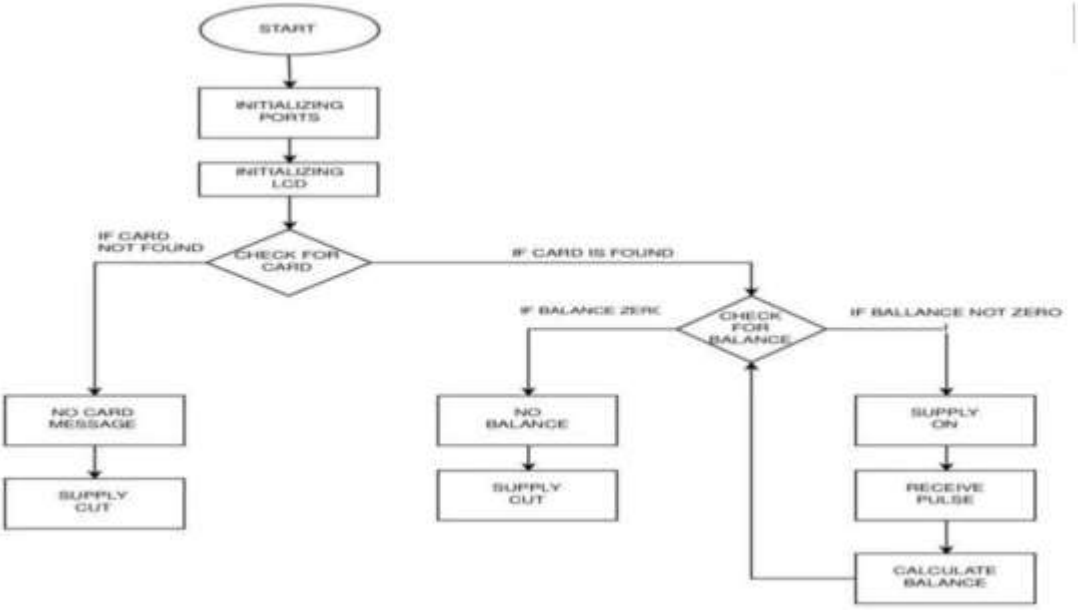
Fig 3: LCD

3.3.IR SENSOR:

• An IR sensor is a sensor that can take values using IR rays. This is done by reflec ng IR rays. It includes two IR LEDs. One IR LED emits IR rays while the other IR LEDs receive IR rays.

Fig 4: IR Sensor

4. DESIGN FLOW:



5. WORKING:

1. *Prepaid Smart Meter*

A prepaid smart meter is installed at the consumer's premises. It tracks electricity usage and deducts the

corresponding cost from a prepaid balance.

2. *Smart Card System*

- Consumers are issued a smart card or token.

- The card is recharged with a specific amount at kiosks, online portals, or utility offices.

3. *Balance Loading*

The smart card is inserted or tapped on the meter, transferring the recharge amount. The meter updates its internal balance.

4. *Energy Consumption*

As electricity is consumed, the smart meter deducts the cost from the prepaid balance. The meter also displays real-time consumption and remaining balance.

5. *Low Balance Alert*

The meter provides warnings through an LCD, LED indicator, or alarm when the balance is low, prompting the user to recharge.

6. *Automatic Cut-Off*

When the prepaid balance is exhausted, the meter cuts off the power supply until recharged.

7. *Advanced Monitoring*

Smart meters with two-way communication allow remote monitoring by utility providers and online recharge options for consumers.

6. RESULT

After implementing the prepaid energy using smart card technology by using above listed components, It has the potential to revolutionize the energy sector by offering greater control, efficiency, and transparency for both consumers and energy providers**.**

1. *Cost Control*: Consumers can better manage their energy expenses by paying in advance, preventing surprise bills.

2. *Efficiency*: Prepaid meters help track real-time energy usage, encouraging consumers to be more conscious of their consumption.

3. *Reduced Delinquency*: Utility providers benefit from fewer payment delays or defaults since consumers pay upfront.

4. *Convenience*: Consumers can recharge their balance at various locations or online, offering flexible payment options.

5. *Energy Conservation*: The system promotes energy-saving behavior, as users are more aware of their consumption levels.

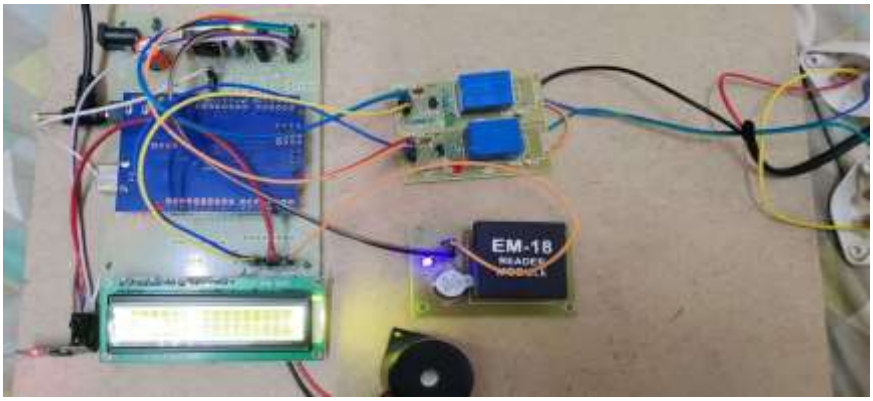


Fig: represents the results of iot based prepaid energy system

CONCLUSION

Helps consumers to contribute towards energy conservation. Recovery from the Government and apartment blocks will get easy. Prepaid energy meter minimizes Electricity in a cost-efficient manner. The users are not bound to pay an excessive amount of money, users can pay accordingly.

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