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Monthly Electricity Billing Display With SMS Feature

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Abstract: This paper presents the design and implementation of a Monthly Electricity Billing Display System integrated with SMS features. The system provides real-time usage information to consumers and sends periodic billing updates via SMS. This not only enhances transparency but also enables users to monitor and manage their electricity consumption efficiently. The increasing demand for energy-efficient and user-friendly solutions in the power sector has led to the development of smart billing systems. This project presents a Monthly Electricity Billing Display System with SMS Feature, designed to automate and simplify the process of energy monitoring and billing. The system continuously monitors the electricity consumption using a digital energy meter and displays the consumed units and billing amount on an LCD screen. A microcontroller processes the data and sends the billing information to the consumer's mobile phone via a GSM module. This real-time SMS alert system enhances billing transparency, reduces manual effort, and helps users stay informed about their energy usage. The proposed system not only improves efficiency for utility providers but also promotes energy awareness and timely bill payments among consumers. It is a step toward smart energy management in line with modern digital infrastructure.

Keywords: Sola—electricity billing, SMS feature, real-time display, embedded systems, energy metering

I. INTRODUCTION

The evolution of smart metering technology has made it possible to provide acccurate and real-time billing systems. This paper discusses a microcontroller-based system that calculates electricity consumption and sends the bill to the user's mobile via SMS. In today's digital age, effective energy management is essential for both consumers and utility providers. Traditional methods of electricity billing often result in delays, inaccuracies, and lack of consumer awareness. To overcome these issues, a system that displays monthly electricity usage along with an SMS notification feature is highly beneficial. This technology enables real-time monitoring of energy consumption and ensures timely delivery of billing information directly to the user's mobile phone. It not only enhances transparency and accuracy but also encourages energy-saving habits by keeping users informed about their usage patterns.

This system plays a key role in promoting digital solutions in the power sector and supports the vision of smart and sustainable energy management Electricity is one of the most essential resources in modern life, and its efficient management is crucial. Traditionally, electricity billing is done manually, which can be time-consuming, prone to human errors, and inconvenient for consumers. To address these challenges, the Monthly Electricity Billing Display System with SMS Feature offers a smart solution by automating the billing process and enhancing user awareness.

This system continuously monitors electricity usage and displays the consumed units along with the billing amount on digital screen. Additionally, it sends monthly usage and billing information to the consumer's mobile phone via SMS using a GSM module. This not only reduces the dependency on manual meter reading but also helps consumers track their energy usage in real time, encouraging timely payments and responsible energy consumption. By combining digital display and mobile communication technologies, this system contributes to the development of smart homes, smart grids, and the broader vision of a Digital India

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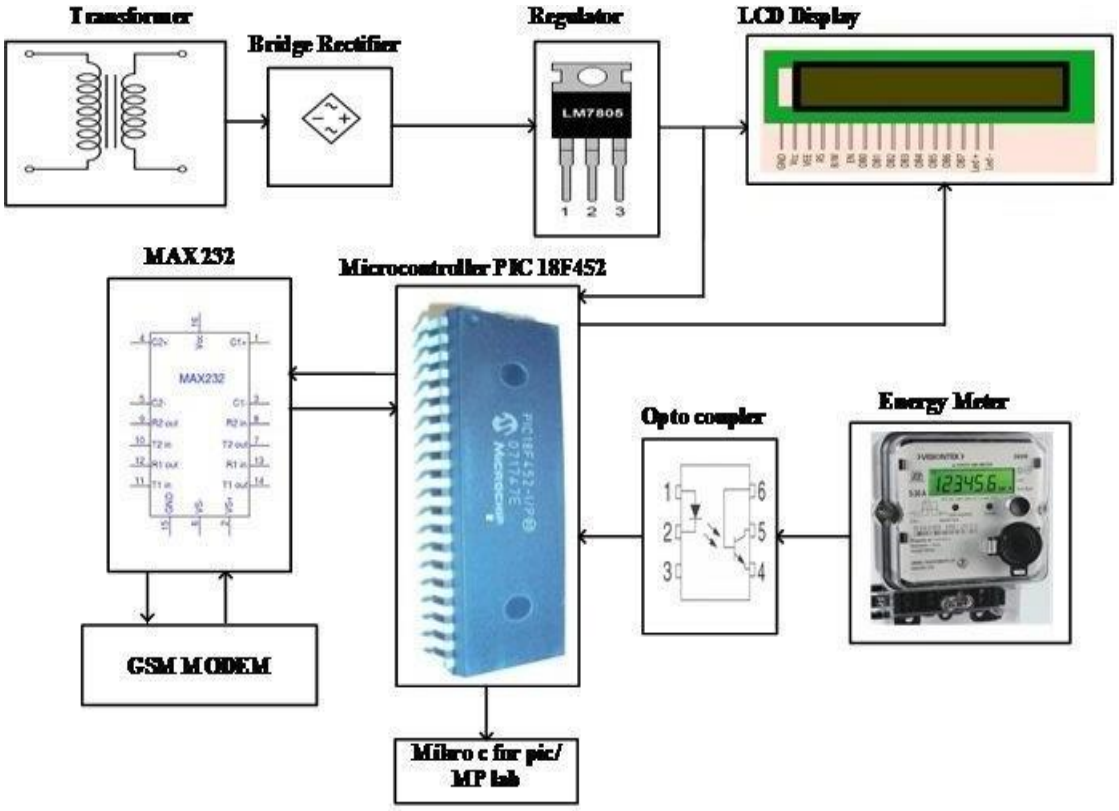

1.1 **Architecture**

The architecture of this system is designed to continuously monitor electricity consumption, process the data, and communicate it to the user via display and SMS. It consists of the following key components working together: The architecture of this system integrates hardware and communication modules to monitor, process, and communicate electricity consumption data. Each component in the architecture plays a critical role in ensuring accurate and real-time billing along with SMS alerts.

1. Structural Framework (Trunk and Branches)

The trunk represents the central unit responsible for managing the system's operations.
Microcontroller The heart of the system that controls all other components. It processes data from the energy meter, sends it to the display, and communicates with the GSM module.

Branches – Subsystems and Functional Extensions

1. Energy Monitoring Branch
- Digital Energy Meter
- Current and Voltage Sensors
- Function: Measures energy consumption and sends signals to the MCU.

2. Display Branch
- LCD/LED Display
- Function: Shows real-time data like units consumed and bill amount.

3. Communication Branch
- GSM Module (e.g., SIM800/SIM900)
- Function: Sends SMS alerts to the user's mobile phone.

4. Power Supply Branch
- Voltage Regulator
- AC to DC Converter

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2. Photovoltaic Nano leaves

As energy demands increase and sustainability becomes critical, combining innovative solar harvesting technologies with smart billing systems offers an efficient, eco-friendly solution. One such integration is using Photovoltaic Nano leaves to generate power and coupling it with a monthly billing display system with SMS notifications to manage and monitor usage.

- Photovoltaic Nano leaves as the energy generation source.
- A smart energy meter that tracks energy usage.
- A microcontroller to process data.
- An LCD display to show monthly billing information.
- A gsm module to send usage/bill updates via SMS.

- **Importance of Monthly Electricity Billing display with SMS Feature**

The monthly electricity billing display with SMS feature enhances consumer convenience and energy awareness. It provides real-time updates on electricity usage and billing, helping users monitor and control consumption. The SMS alerts ensure timely bill notifications, payment reminders, and overuse warnings, even without internet access. This system reduces billing errors, supports transparency, minimizes manual meter reading, and promotes digital and paperless communication. Overall, it contributes to efficient energy management and aligns with modern smart grid initiatives.

1. Real-Time Billing Information

Allows consumers to monitor monthly usage and billing at regular intervals. Helps avoid bill shock by providing timely updates on consumption and cost.

2. Transparency and Accuracy

Reduces billing errors by providing clear and automated readings. SMS feature ensures users are notified instantly, improving billing transparency.

3. Consumer Awareness and Energy Saving

Helps users track their energy usage habits and adjust consumption patterns. Encourages energy conservation by making users more aware of their consumption.

4. Cost-Effective Communication

SMS is a low-cost, widely accessible method to inform consumers. Even users without smartphones or internet access can receive updates.

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5. Timely Reminders and Alerts
Sends alerts for due dates, high usage, or billing anomalies. Reduces the chances of missed payments or late fees.

6. Efficient Complaint Handling
Customers can verify their usage and compare with the billed amount. Helps in dispute resolution and reduces complaints related to overbilling.

7. Reduces Manual Meter Reading
Smart display with automatic SMS feature eliminates the need for manual readings. Saves time, labor, and costs for the utility provider.

- **Applications & Use Cases Smart Homes**

1. Monitor monthly consumption and receive SMS alerts for energy use and billing.
a. Ideal for rooftop solar installations in residential buildings.
2. Smart Buildings & Offices
a. Helps track and reduce energy costs.
b. Automated energy billing for individual offices or floors.
c. Real-time display ensures transparent energy use in shared workspaces.
3. Remote and Rural Electrification
4. Suitable for off-grid areas where traditional power lines are unavailable.
a. SMS feature is valuable in rural areas with limited internet access.
5. Keeps track of energy usage and cost via SMS, avoiding unexpected expenses.
6. Health Clinics in Remote Areas
a. Ensures power availability for critical devices.

- **Challenges & Limitations**

1. Network Connectivity Issues
In remote or rural areas, unstable mobile networks can delay or prevent SMS delivery. Poor internet or signal quality affects real-time billing updates and notifications.

2. Data Privacy & Security Concerns
Storing and transmitting billing data over mobile networks may expose user information to potential breaches or misuse. Requires strong encryption and secure servers.

3. System Integration
Integrating with existing electricity meters or legacy infrastructure can be technically complex and expensive. Compatibility issues may arise with different meter models.

4. Cost of Implementation
Upgrading meters and adding GSM modules or smart interfaces increases initial setup costs. Maintenance and SMS charges may also add to operational expenses.

5. Power Dependency
In areas with frequent power outages, the display system may not function unless it has backup power (e.g., battery or solar).

- **Future Scope**

Prepaid Energy Billing
- Implementation of prepaid energy systems where users can recharge energy credits and monitor balance through SMS or mobile apps.

3. Mobile App and IoT Connectivity
- Future systems may include a dedicated mobile app, Wi-Fi or Bluetooth modules for accessing usage and billing data in graphical form.

4. Solar and Renewable Energy Integration
- Can be integrated with solar panels or photovoltaic nanoleaves to track both generation and consumption for net metering.

5. Voice and Multilingual SMS Alerts

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- SMS alerts can be expanded to regional languages or even voice call notifications for better accessibility, especially in rural areas.

6. Cloud Data Storage and Analytics

- Data can be sent to cloud servers for long-term storage, trend analysis, and predictive maintenance using AI/ML.

II. CONCLUSION

This system provides a simple, cost-effective, and user-friendly solution for electricity billing with the added benefit of SMS communication. It can be further enhanced with IoT integration and remote serve based data logging. The integration of photovoltaic nanoleaves with a monthly electricity billing display system and SMS feature presents a smart, eco-friendly, and efficient solution for modern energy needs. Photovoltaic nano leaves offer clean, sustainable power generation with high efficiency, while the smart billing system ensures real-time monitoring, transparency, and user awareness. The addition of SMS alerts enhances communication, making it easier for users to track their energy usage and billing without depending on manual readings or internet connectivity.

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