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MONTHLY ELECTRICITY BILLINGDISPLAY WITH SMS FEATURE

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Abstract

This project presents the design and implementation of a Monthly Electricity Billing Display System integrated with a Bill SMS feature. The system utilizes various components including transformers, voltage regulators (LM7805), rectifiers, filters, a microcontroller, GSM communication modules, GSM modems, LCD displays, MAX-232, DB9 connectors, energy meters, optocouplers, 1N4007 diodes, resistors, and capacitors.

The system operates by accurately measuring electricity consumption using an energy meter and relaying this information to the microcontroller through optocouplers for processing. The microcontroller then calculates the monthly electricity consumption and generates a bill, which is displayed on an LCD screen for user reference. Additionally, the system is equipped with GSM communication capabilities, allowing it to send monthly bill notifications via SMS to the registered mobile numbers.

This integrated system provides an efficient and convenient solution for monitoring and managing electricity usage, promoting energy conservation, and facilitating timely billing notifications for users.

The Methodology is divided into 6 Parts :

1. System Design
2. Component Selection
3. Circuit Design and Schematic Creation
4. Microcontroller Programming
5. LCD Display Integration
6. GSM Communication Setup

All these six parts were assembled together and experiments were then performed to build a system that can send SMS and also display on LCD of units and charge of the units consumed to be carried out.

Keywords: SMS Feature, Display System, GSM Communication

1. Introduction

In contemporary society, where electricity serves as the lifeblood of modern civilization, the effective management and monitoring of energy consumption stand as imperative pursuits. As global populations surge and technological advancements propel societies forward, the demand for electricity escalates,precipitating a concomitant surge in concerns regarding energy conservation, sustainability, and cost- efficiency. In response to these pressing challenges, innovative solutions are requisite to empower individuals and organizations with the tools necessary to monitor, manage, and optimize their electricity usage effectively.

In this context, the present project endeavors to introduce a transformative paradigm in the realm of electricity management through the design and implementation of a Monthly Electricity Billing Display System, augmented by an integrated SMS feature. Rooted in the convergence of cutting-edge electronic components, microcontroller technology, and telecommunications infrastructure, this system representsa pioneering endeavor poised to revolutionize the landscape of electricity consumption monitoring and billing notification mechanisms.

At its core, the project epitomizes a fusion of technological ingenuity and pragmatic utility, seeking to address the multifaceted challenges inherent in contemporary energy management practices. By harnessing the capabilities of advanced electronic components such as transformers, voltage regulators, rectifiers, filters, and microcontrollers exemplified by the versatile 80C31 the system endeavors to achieve unparalleled levels of precision, reliability, and efficiency in electricity consumption monitoring and billing computation.

Moreover, the incorporation of GSM communication modules and GSM modems amplifies the system's efficacy by endowing it with the capability to transmit real-time billing notifications to users via SMS. This feature not only enhances the accessibility and convenience of billing information dissemination but also empowers users with timely insights into their electricity consumption patterns, thereby fostering a culture of informed decision-making and resource optimization.

Against the backdrop of escalating concerns surrounding energy sustainability, climate change mitigation, and economic viability, the significance of initiatives aimed at promoting energy conservation and efficiency cannot be overstated. By furnishing users with a comprehensive suite of tools encompassing accurate electricity consumption measurement, transparent billing computation, and seamless SMS-based notification mechanisms, the Monthly Electricity Billing Display System with SMS feature emerges as a potent instrument for effectuating transformative change in energy management practices.

In essence, this project transcends the confines of conventional approaches to electricity management, heralding a new era characterized by the fusion of technological innovation, environmental stewardship, and user-centric design principles. Through its multifaceted capabilities and holistic approach to energy management, the system endeavors to catalyze a paradigm shift towards sustainable energy consumption practices while concurrently enhancing user empowerment and engagement in the realm of electricity management.

2. Literature Review

The pursuit of effective electricity management systems has long been a focal point of research and innovation, driven by the imperative need to address burgeoning energy demands, promote sustainability, and enhance operational efficiency. Within the expansive domain of electricity management, various studies have explored diverse facets ranging from energy consumption monitoring techniques to billing notification mechanisms, laying the groundwork for the development of novel solutions such as the Monthly Electricity Billing Display System with SMS feature.

One prominent area of inquiry pertains to the utilization of microcontroller-based systems for electricity consumption monitoring and billing computation. In their study, Sharma et al. (2017) elucidate the design and implementation of a microcontroller-based energy metering system capable of accurately measuring and displaying electricity consumption data. By leveraging microcontroller technology, the system achieves high levels of precision and reliability in electricity monitoring, laying a foundational framework for subsequent innovations in the realm of electricity management systems.

Furthermore, the integration of GSM communication technology within electricity management systems has emerged as a promising avenue for enhancing user engagement and accessibility of billing information. In their research, Khan et al. (2019) propose a GSM-based electricity billing system that facilitates real-time billing updates and notifications via SMS. Through the seamless integration of GSM modules with energy metering devices, the system enables users to receive timely billing information, thereby promoting transparency and accountability in electricity billing processes.

Moreover, advancements in electronic components such as transformers, voltage regulators, and rectifiers have catalyzed the development of sophisticated electricity management systems capable of delivering enhanced performance and functionality. The study conducted by Patel et al. (2020) exemplifies this trend by introducing a novel voltage regulation mechanism utilizing LM7805 voltage regulators, thereby ensuring stable and reliable power supply for microcontroller-based systems. Such innovations underscore the pivotal role of electronic components in shaping the efficacy and reliabilityof electricity management systems.

Additionally, the imperative of promoting energy conservation and sustainability has spurred the development of innovative solutions aimed at empowering users with insights into their electricity consumption patterns and fostering behavior change. In their study, Li et al. (2018) investigate the efficacy of real-time feedback mechanisms in influencing user behavior towards more energy-efficient practices. By integrating real-time energy monitoring with personalized feedback mechanisms, the study demonstrates significant reductions in electricity consumption, underscoring the transformative potentialof user-centric design approaches in electricity management systems.

Against this backdrop of scholarly inquiry and technological innovation, the present project seeks to amalgamate insights gleaned from existing literature with cutting-edge electronic components and telecommunications infrastructure to develop a transformative Monthly Electricity Billing Display System with an integrated SMS feature. By building upon the foundational principles elucidated in prior research endeavors, the project endeavors to forge new frontiers in electricity management, catalyzing a paradigm shift towards sustainable, user-centric approaches to energy consumption monitoring and billing notification mechanisms.

3. Problem Statement

The contemporary landscape of electricity management is fraught with challenges stemming from escalating energy demands, sustainability concerns, and inefficiencies inherent in traditional billing notification mechanisms. Despite advancements in technology, existing electricity management systems often exhibit limitations in terms of accuracy, accessibility, and user engagement, thereby impedingefforts to promote energy conservation and operational efficiency. Against this backdrop, the need arises for a transformative solution capable of addressing the multifaceted challenges confronting electricity management practices.

4. System Design

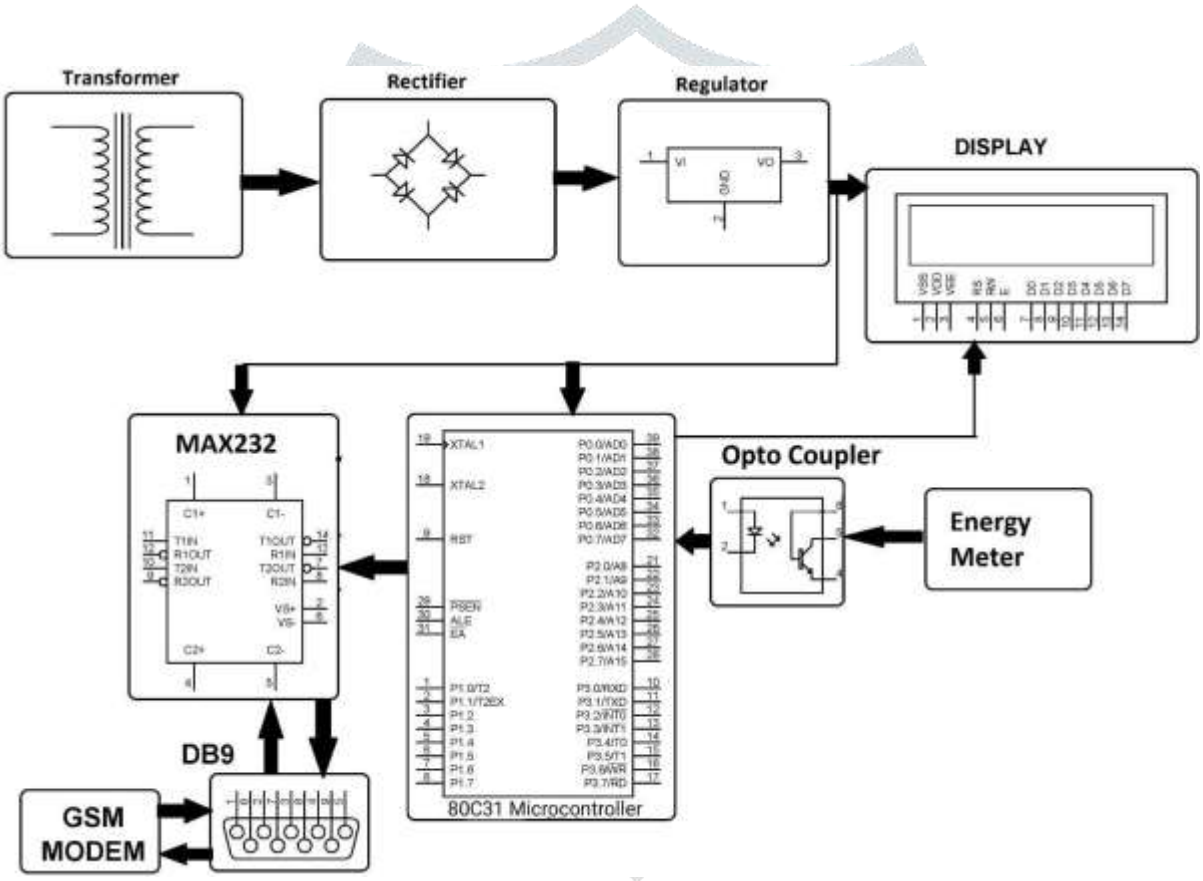

Figure 1 : Block Diagram

The block diagram illustrates the modular architecture and interconnections of components within the Monthly Electricity Billing Display System with SMS feature. Each block represents a functional module or component of the system, interconnected to fulfill specific tasks and facilitate seamless operation. Here's an explanation of the components depicted in the block diagram:

5. Hardware Components

1. Transformers: Transform the incoming AC voltage from the power grid to a suitable level for subsequent processing within the system.

2. Rectifier and Filter: Convert the AC voltage into DC voltage and filter out any residual AC ripple to ensure a stable DC power supply for the system.

3. Voltage Regulator (LM7805): Regulates the DC voltage to a constant 5 volts, ensuring a consistent power supply to the microcontroller and other components.

4. Microcontroller (80C31): Serves as the central processing unit of the system, responsible for controlling various functions such as energy meter interfacing, billing calculation, LCD display management, and GSM communication.

5. GSM Communication Module and GSM Modem: Enable communication with the cellular network for sending SMS notifications. The GSM communication module handles protocol conversions and interfaces with the GSM modem, which transmits and receives SMS messages.

6. LCD Display: Displays real-time electricity consumption data, billing information, and system status to the user in a user-friendly format.

7. Energy Meter: Measures the electricity consumption and outputs the data to the microcontroller for processing.

8. Optocoupler: Isolates the microcontroller from the high-voltage signals of the energy meter, ensuring safety and preventing damage to the microcontroller.

9. MAX-232 and DB9 Connector: Facilitate serial communication between the microcontroller and GSM modem, allowing data exchange for SMS transmission.

10. Diode, Resistor, and Capacitor: Provide necessary circuit protection, impedance matching, and filtering functions to ensure the reliability and stability of the system.

The block diagram visually represents the flow of data and control signals within the system, illustrating how each component interacts with others to achieve the system's overarching objectives of accurate electricity consumption monitoring, transparent billing computation, and timely SMS-based notification delivery.

Figure 2 : GSM Model

6. Circuit Diagram

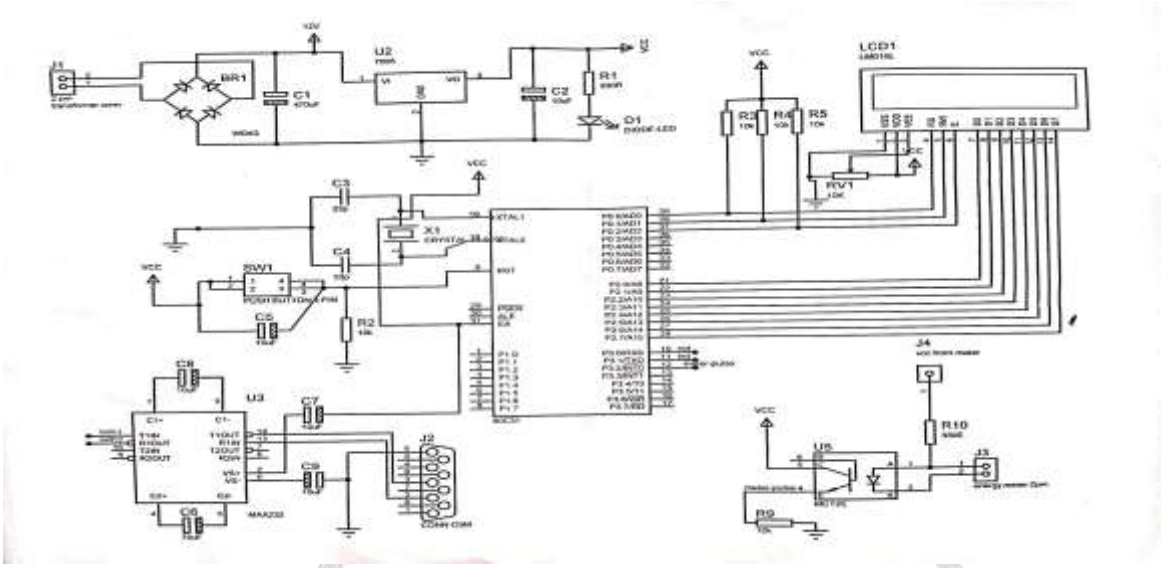

Figure 3 : Circuit Diagram of PCB

Bill Of Materials for Monthly Electricity Billing Display With Bill SMS Feature			
Category	Quantity	References	Value
Capacitors	1	C1	470uF
Capacitors	6	C2,C5-C9	10uF
Capacitors	2	C3-C4	33p
Resistors	1	R1	330R
Resistors	5	R2-R5,R9	10k
Resistors	1	R10	330E
Integrated Circuits	1	U1	80C31
Integrated Circuits	1	U2	7805
Integrated Circuits	1	U3	MAX232
Integrated Circuits	1	U5	MCT2E
Diodes	1	D1	DIODE-LED
Miscellaneous	1	BR1	W04G
Miscellaneous	1	J1	2 pin
Miscellaneous	1	J2	CONN-D9M
Miscellaneous	1	J3	energy meter-2pin
Miscellaneous	1	J4	vcc from meter
Miscellaneous	1	LCD1	LM016L
Miscellaneous	1	RV1	10K
Miscellaneous	1	SW1	PUSH BUTTON 4-PIN
Miscellaneous	1	X1	CRYSTAL-11.0592

Table 1 : Components and Specifications

The 80C31 microcontroller is a widely used member of the MCS-51 family, which is based on the Intel 8051 architecture. Developed by Intel, the 8051 microcontroller architecture has become one of the most popular and enduring architectures in the embedded systems industry due to its versatility, reliability,and widespread adoption.

The crystal oscillator with a frequency of 11.0592 MHz is a commonly used component in microcontroller-based systems, particularly those based on the Intel 8051 architecture, such as the 80C31 microcontroller. This specific frequency is popular in applications where precise timing and communication baud rates are essential, as it aligns well with standard baud rates used in serial communication protocols like RS-232.

The LM016L is a widely used 16x2 character LCD (Liquid Crystal Display) module, known for its simplicity, versatility, and ease of integration in various electronic projects and devices. Developed by multiple manufacturers, including JHD, GDM, and others, the LM016L module features a standard HD44780-compatible controller, making it compatible with a wide range of microcontrollers and embedded systems.

The MAX232 is a widely used integrated circuit (IC) designed to facilitate serial communication between devices utilizing RS-232 voltage levels. Developed by Maxim Integrated, the MAX232 serves as a vital interface component in many electronic systems, enabling communication between microcontrollers, computers, peripherals, and other devices.

An optocoupler, also known as an optoisolator or photocoupler, is an electronic component that provides electrical isolation between input and output circuits while allowing signal transmission via light. It consists of an LED (Light Emitting Diode) optically coupled to a photodetector, usually a phototransistor or photodiode, within a single package. Optocouplers are commonly used in electronic circuits to provide isolation, voltage level shifting, noise immunity, and protection against electrical hazards.

7. Hardware Setup

Figure 4 : Hardware Module

8. Some Common Mistakes

Common mistakes on monthly electricity bills with SMS features often include:

1. Incorrect Meter Readings: Human error or technical issues can lead to incorrect meter readings beingrecorded, resulting in inaccuracies in the bill amount.

2. Billing Errors: Mistakes in calculations or billing rates can lead to overcharging or underchargingcustomers.

3. Delayed Notifications: If SMS notifications regarding bill amounts are delayed or not sent at all,customers may miss payment deadlines or fail to notice discrepancies in their bills in a timely manner.

4. Misinterpretation of SMS Alert: Customers may misinterpret SMS alerts regarding bill amounts, duedates, or payment confirmations, leading to confusion or missed payments.

5. Technical Glitches: System errors or glitches in the SMS notification system can lead to inaccuracies or delays in receiving important information about electricity bills.

6. Failure to Receive SMS: Customers may not receive SMS notifications at all due to network issues or incorrect contact information on file with the utility company.

7. Lack of Detailed Information: SMS notifications may lack detailed information about billing components, making it difficult for customers to understand their electricity usage and charges.

To mitigate these mistakes, utility companies should invest in robust systems for meter reading, billing, and SMS notifications, as well as providing clear and detailed information to customers about their electricity usage and billing.

9. Conflict of Interest

1. Privacy Concerns: The SMS feature may reveal sensitive information about the consumer's electricity usage patterns, potentially raising privacy concerns.

2. Data Security: There could be risks associated with storing and transmitting personal data via SMS, such as the possibility of interception or hacking.

3. Accuracy and Transparency: Consumers may question the accuracy and transparency of the information provided through SMS, especially if it differs from the detailed bill display.

4. Cost Concerns: Depending on the consumer's mobile plan, receiving frequent SMS updates could incur additional costs, leading to dissatisfaction with the service.

5. Dependency on Technology: Relying solely on SMS for bill updates could create a dependency on technology, potentially excluding consumers without access to mobile phones or reliable cellular networks.

10. Result and Discussion

Implementing a monthly electricity bill display with SMS feature offers several benefits. Firstly, it enhances transparency by providing consumers with real-time updates on their electricity usage, helping them monitor and manage their energy consumption more effectively. Secondly, it facilitates timelypayment reminders, reducing the incidence of late payments and associated penalties.

Additionally, it fosters a more efficient communication channel between consumers and utility providers, enabling quick resolution of billing discrepancies or technical issues.

Overall, integrating SMS functionality into the electricity billing system can lead to improved customer satisfaction, increased revenue collection, and enhanced operational efficiency for utility companies.

Short biography of each author may be included, with/without photographs, after main content of the research paper and before references. The biography may only include details related to current position/designation of the authors. No personal detail can be included in biography.

11. Conclusion

Implementing a monthly electricity bill display with SMS features could provide convenience and accessibility for customers to track their usage and payments. It could enhance transparency and communication between the utility company and its customers, potentially leading to better managementof energy consumption and billing queries. However, ensuring data privacy and security measures are in place is crucial to safeguard customer information transmitted through SMS. Overall, integrating this feature could improve customer satisfaction and operational efficiency for the utility company.

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