

# Design and Implementation of A GSM-Based Prepaid Energy Metering System

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## Abstract

A prepaid power meter represents a modern approach to measuring electricity consumption on a periodic basis. This method eliminates the need for manual meter reading and data collection typical of conventional systems. While standard meters display consumption at the load center, there is a critical need for systems that transmit this data directly to the Power Development Department (PDD). This paper details a GSM-based prepaid meter designed for enhanced transparency between users and the PDD. The GSM Automatic Power Meter Reading System (GAPMR) integrates an energy meter with a microcontroller and display to capture and maintain electricity consumption records.

**Keywords:** GSM, PDD, GAPMR, microcontroller

## 1. INTRODUCTION

Traditional electricity billing involves manual unit reading by distribution personnel, a process that is tedious, prone to human error, and lacks guaranteed accuracy. Furthermore, consumers may exceed their intended power consumption or fail to pay bills, with the utility provider having limited immediate means to disconnect the supply. To address these challenges, this project proposes a prepaid system modelled after mobile phone or DTH recharging. Users purchase energy units in advance; as electricity is consumed, the balance decreases until reaching zero, at which point the power is automatically disconnected.

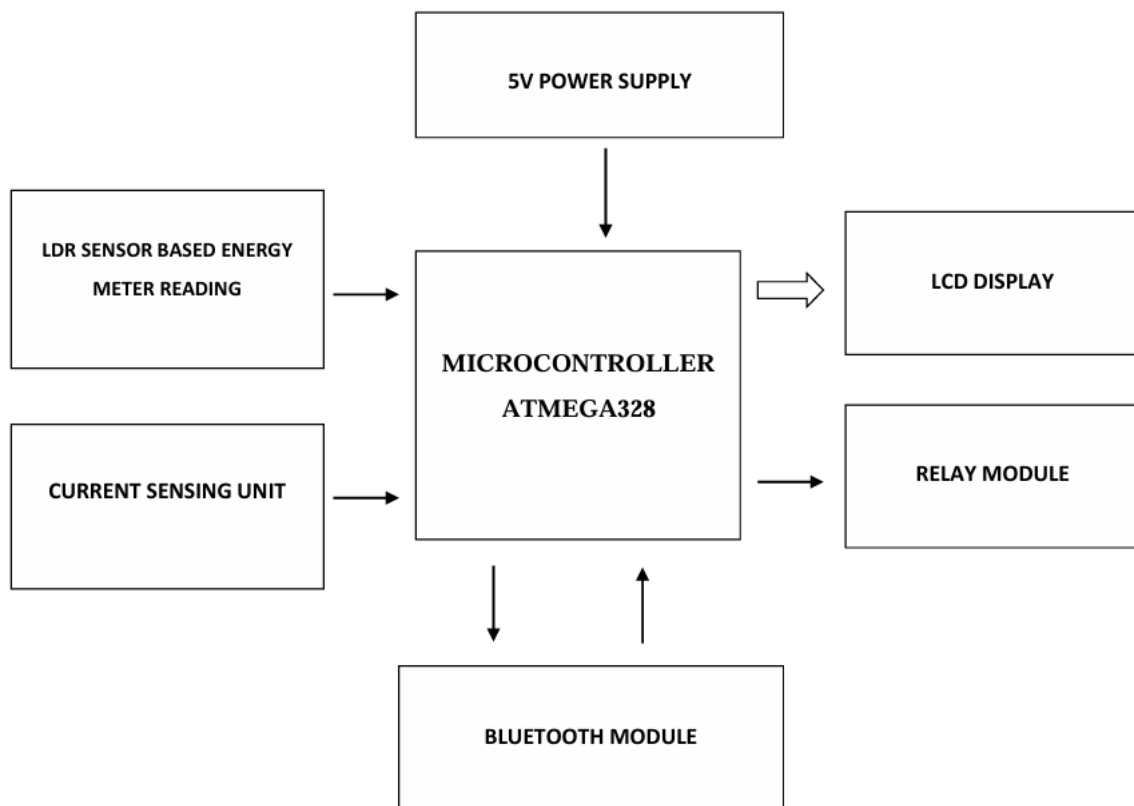
## 2. LITERATURE REVIEW

This system introduces a concept where the maximum energy demand of a consumer is monitored directly by the meter. If this demand is exceeded, an embedded system within the meter automatically disconnects the connection. Communication between the load circuit and the utility side is facilitated by a Bluetooth module (HC-05). The system not only informs the consumer of costs and units consumed but also has the capability to send readings to a control room via SMS. The system consists of the electricity meter which measures the electricity bill and informs the consumer about the number of units consumed and associated costs with it. The microcontroller coordinates the whole system with the help of its different components connected to it. The reading of the energy meter is also sent to the control room by an SMS. The Bluetooth module can also receive commands from the cell phone to control the owner's electrical loads. It uses a standard digital energy meter that delivers output pulses to the microcontroller to perform counting for necessary action. On receiving command. It can switch ON/OFF the loads.

### 3. SYSTEM ARCHITECTURE AND METHODOLOGY

The system centres on the **ATmega328 microcontroller**, which coordinates various modules:

- **Input Sensing:** The microcontroller receives data from a current sensing unit and an LDR sensor that monitors energy meter pulses.
- **Processing:** The ATmega328 processes these inputs to determine the state of the power supply.
- **Control Mechanism:** A relay module acts as an electromechanical switch to turn the load ON or OFF based on commands from the microcontroller.
- **User Interface:** Real-time status and commands are displayed on a 16×2 LCD.
- **Communication:** The Bluetooth module establishes serial communication with mobile devices for user interaction and control.



**Fig 3.1 Block diagram of PEM**

### 4. HARDWARE COMPONENT SPECIFICATIONS

- **Microcontroller (ATmega328):** An 8-bit RISC-based processor featuring 32KB flash memory and 1KB EEPROM, allowing it to retain data even when power is removed .
- **Power Supply:** A regulated 5V DC supply is achieved using a step-down transformer, bridge rectifier, and a 7805 voltage regulator .
- **LDR Sensor:** Used to detect the optical pulses of a digital energy meter by sensing changes in light levels, which in turn changes the sensor's resistance.
- **Relay:** An electromechanical switch that uses small voltages to control the high-voltage load circuit.

### 5. IOT INTEGRATION AND FUTURE SCOPE

The system aligns with Internet of Things (IoT) principles by connecting physical devices to a network to

gather and share data without manual intervention. Such integration results in improved accuracy, efficiency, and economic benefits through reduced human intervention. Future applications include digital electronics, smart parking systems, and medical instrumentation.

## 6. CONCLUSION

The GSM-based prepaid energy meter provides a transparent and efficient alternative to manual billing. By automating the disconnection process based on prepaid balance or maximum demand, the system ensures timely payments and helps utility providers manage electricity distribution more effectively.

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## BIOGRAPHY

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