Embedded Temperature Monitoring and Data Logging System Using 8051 Microcontroller with GSM Alert

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Abstract - This paper presents a simple and efficient system for monitoring temperature and storing data using an 8051 microcontroller. The system uses an LM35 temperature sensor to measure temperature and displays it on an LCD screen. A Real-Time Clock (RTC) module is used to add date and time to each reading. The data is stored in an SD card for future use. If the temperature exceeds a preset limit, a buzzer gives an alert and a GSM module sends an SMS notification to the user. This system is low-cost, reliable, and useful for applications like industries, server rooms, and storage systems.

Keywords: 8051 Microcontroller, Temperature Monitoring, Data Logging, GSM Module, SD Card, Real-Time Clock (RTC), Embedded System, LM35 Sensor

I. INTRODUCTION

Temperature monitoring is important in many applications such as industries, server rooms, and storage systems. A rise in temperature can damage equipment and cause system failure.

Manual monitoring methods are not reliable for continuous observation. Therefore, an automatic system is required. Embedded systems provide a simple and effective solution [1].

In this project, an 8051 microcontroller-based system is used to monitor temperature using an LM35 sensor [2]. The system displays data on an LCD and stores it with timestamp using an RTC module [4]. When the temperature exceeds a predefined limit, a buzzer is activated and an SMS alert is sent using a GSM module [5]. Continuous data logging helps in analyzing temperature variations over time for better decision-making. The system also improves safety by providing instant alerts when abnormal conditions occur. The use of GSM communication enables remote monitoring, making the system more efficient and practical.

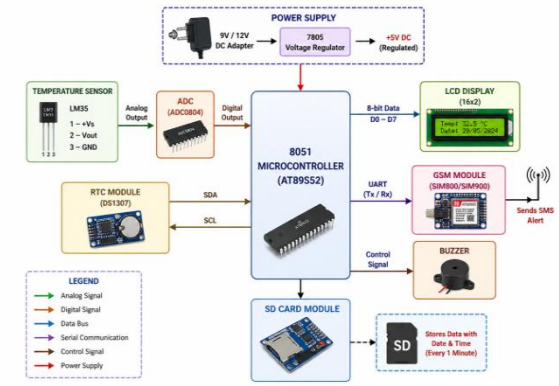

Fig. 1: Block Diagram of the System

II. LITERATURE SURVEY

Several temperature monitoring systems have been developed using microcontrollers. Basic systems only display temperature without storing data [1].

Some systems use memory devices to log data, but they lack alert mechanisms. GSM-based systems improved remote monitoring by sending SMS alerts [5], but many did not include proper data storage with timestamps.

Recent systems use IoT technology for monitoring and cloud storage, but they are more complex and costly. The proposed system combines monitoring, data logging, and alert features in a simple and cost-effective design.

III. PROBLEM STATEMENT

Existing temperature monitoring systems have several limitations. Many systems rely on manual observation, which is not reliable for continuous monitoring. Some systems only display temperature without storing data, while others do not provide any alert mechanism.
Because of these limitations, there is a need for an improved system that can:

- Monitor temperature continuously in real time
- Store temperature data with accurate date and time
- Provide instant alerts when temperature exceeds a safe limit

The goal of this project is to develop a system that overcomes these problems using an 8051 microcontroller.

IV. PROPOSED SYSTEM

The system uses an LM35 sensor to measure temperature [2]. The analog output is converted into digital form using an ADC0804 [3]. The 8051 microcontroller processes the data and displays it on an LCD.

The RTC module provides accurate time [4], and the SD card stores the data. When temperature exceeds a threshold, a buzzer is activated and an SMS is sent using GSM [5].

V. SYSTEM ARCHITECTURE

The system consists of the following modules:

1. Temperature Sensor (LM35)
2. ADC Converter
3. 8051 Microcontroller
4. RTC Module
5. LCD Display
6. SD Card Module
7. GSM Module
8. Buzzer

All components are interconnected to perform monitoring, storage, and alert functions.

VI. HARDWARE DESCRIPTION

The system consists of several hardware components connected to the 8051 microcontroller. The AT89S52 microcontroller acts as the main controller and manages all operations. The LM35 sensor measures temperature and gives an analog output, which is converted into digital form using the ADC0804.

A DS1307 RTC module provides accurate date and time for data logging. The 16×2 LCD is used to display temperature and system status. The SD card module stores temperature data with timestamp for future analysis.

For alert functionality, a GSM module (SIM800/900) is used to send SMS notifications when temperature exceeds a set limit, and a buzzer provides an audible alert. The entire system is powered using a regulated 5V supply.

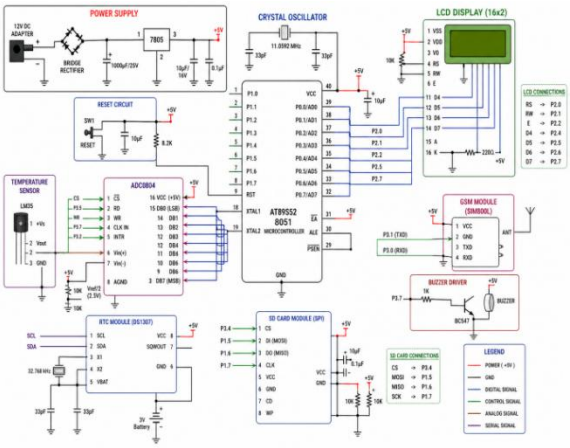

Fig. 2: Circuit / Connection Diagram

VII. SOFTWARE DESIGN

The system is programmed in Embedded C.
Steps:

1. Initialize all modules
2. Read temperature from LM35
3. Convert analog signal using ADC
4. Read time from RTC
5. Display on LCD
6. Store data in SD card
7. Check threshold
8. Activate buzzer and send SMS if needed
9. Repeat process

VIII. WORKING PRINCIPLE

The system works by continuously measuring temperature using the LM35 sensor, which produces an analog signal proportional to temperature. This analog signal is converted into digital data using the ADC and then processed by the 8051 microcontroller.

The microcontroller reads the current date and time from the RTC module and displays the temperature along with the timestamp on the LCD. At the same time, the data is stored in the SD card for future analysis.

If the temperature exceeds a predefined threshold value, the system immediately activates the buzzer

and sends an SMS alert to the user through the GSM module, ensuring both local and remote notification.

IX. RESULTS AND DISCUSSION

The system was tested under different conditions and successfully measured and displayed temperature on the LCD. The data was stored correctly in the SD card with date and time. When the temperature exceeded the set limit, the buzzer was activated and an SMS alert was sent through the GSM module. The results show that the system is reliable and suitable for real-time monitoring.

Date	Time	Temperature (°C)
29/04/2026	10:40:00	30.5
29/04/2026	10:41:00	31.2
29/04/2026	10:43:00	32.0
29/04/2026	10:44:00	41.0(alert)

Table I: Temperature Data with Timestamp

X. FUTURE SCOPE

The system can be enhanced by integrating IoT technology for remote monitoring through mobile or cloud platforms. Additional sensors can be added to monitor parameters like humidity or gas levels. Features such as automatic control systems and real-time data visualization can further improve the system.

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