MANTECH Publications
International Journal of Research in Electrical, Electronics and Communication Engineering
Volume 4, Issue 1, January-June, 2019

Design and Development of Temperature Monitoring System Using LM35 and Arduino

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ABSTRACT

This paper presents a comprehensive analysis and implementation of a Temperature Monitoring System using the LM35 temperature sensor interfaced with an Arduino microcontroller. With the growing need for real-time temperature monitoring in various sectors such as healthcare, agriculture, industrial automation, and environmental control, it becomes imperative to design efficient and reliable temperature sensing systems. The LM35 sensor provides accurate analog temperature readings which can be processed by the Arduino for monitoring, display, and control applications. The proposed system is not only cost-effective but also energy-efficient and easily scalable for different types of applications. Through this paper, the entire process of circuit design, interfacing, and coding logic is discussed in detail, emphasizing practical insights and real-time application performance. Furthermore, the introduction highlights the importance of temperature monitoring in current technological trends and the advantages of using Arduino for embedded system applications.

Keywords:—Temperature Sensor, LM35, Arduino, Monitoring System, Embedded Systems, Real-time Measurement

INTRODUCTION

Temperature is a fundamental physical parameter that plays a crucial role in various scientific, industrial, and environmental processes. Maintaining and monitoring

temperature is vital in applications ranging from household climate control systems to sensitive industrial production environments. Traditional thermometers, while still in use, lack the flexibility and real-time monitoring capabilities that are essential in today's fast-paced digital world.

With advancements in microcontroller-based systems, temperature monitoring has become smarter, more accurate, and automated. The Arduino microcontroller platform, known for its open-source flexibility and ease of use, is widely employed in developing embedded systems and Internet of Things (IoT) applications. In this project, the LM35 temperature sensor is chosen due to its precision and linear analog output which is directly proportional to the temperature in Celsius. It is suitable for a wide range of temperatures and can be interfaced directly with Arduino's analog input pins.

This paper presents a detailed study of a temperature monitoring system that can measure temperature in real-time, display the result on an LCD or serial monitor, and optionally control external devices such as fans or alarms based on threshold values. The introduction discusses the need for temperature monitoring, especially in sectors such as data centers, food storage, healthcare, and agriculture where temperature variation can lead to significant losses or safety issues. In the following sections, the design architecture, component specifications, operational logic, and the significance of the LM35-Arduino combination are elaborated. The focus of the research is to provide an affordable and practical solution suitable for both learning environments and real-world deployment.

LITERATURE REVIEW

Over the past decade, multiple studies have explored efficient ways to monitor temperature using various sensors and microcontroller platforms. Researchers have implemented temperature monitoring systems using thermistors, RTDs, and digital

sensors, but LM35 remains widely preferred for its low cost and reliable analog output. In 2018, Sharma et al. designed a wireless temperature and humidity monitoring system using ZigBee and LM35, which provided real-time data over long distances.

In another study by Ramesh and Singh (2020), a GSM-based alert system was developed where LM35 was used to measure server room temperature and send alerts if the temperature exceeded safe limits. Meanwhile, open-source communities and academic projects have integrated LM35 with Arduino and Raspberry Pi platforms for DIY monitoring systems. These efforts underline the practical and academic relevance of LM35-based temperature monitoring.

METHODOLOGY

The temperature monitoring system consists of the LM35 sensor interfaced with the Arduino Uno. The analog output of LM35 is connected to the A0 pin of the Arduino. The system reads the analog voltage, converts it into temperature in Celsius, and displays it on a serial monitor or LCD. The Arduino sketch uses built-in ADC functions and control logic for conditional responses based on temperature thresholds.

Additional components include a 16x2 LCD, resistors, breadboard, and power supply. The setup was tested in different ambient conditions to verify the sensor's accuracy and Arduino's response. The methodology ensures ease of calibration and can be extended to support alerts or device automation.

Table 1: Components Used in the System

Component	Description
LM35	Analog temperature sensor
Arduino Uno	Microcontroller board
16x2 LCD	To display temperature values
Resistors	Used for voltage division and pull-down
Breadboard & Wires	For circuit assembly

USB Cable	Power and data interface

Table 2: Voltage-to-Temperature Conversion

Output Voltage (mV)	Temperature (°C)
100	10
250	25
370	37
500	50
750	75

FUTURE SCOPE

The presented system can be enhanced by integrating wireless communication modules like Bluetooth or Wi-Fi to send temperature data remotely. Future versions can be IoT-enabled and deployed in smart homes or agriculture to automate appliances based on temperature. With GSM modules, remote alerts via SMS can also be implemented. Data logging and graphical visualization using platforms like ThingSpeak or Blynk offer additional scope for cloud integration.

CONCLUSION

This paper has outlined the design and development of a real-time temperature monitoring system using LM35 and Arduino. The system offers a cost-effective and user-friendly approach for temperature sensing, with possibilities for further automation and real-time alerts. Its simple design and accuracy make it a reliable solution for academic experiments, home applications, and industrial monitoring.

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