Data Logger Using Arduino and SD Card

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Abstract— This paper presents the development of a low-cost and accessible environmental data logger using an Arduino microcontroller. The device records sensor data, specifically temperature values, every three seconds and stores the information in a text file on an SD card. This raw data can later be used to generate graphical analysis using tools like Excel or Google Sheets.

Components such as the DS3231 RTC Module, SD Card Module, and DHT11 Temperature Sensor were used. The system logs real-time data with time stamps and stores them in the SD card in text format. The entire process is driven by open-source tools and libraries.

I. Introduction

A data logger is an electronic device used to automatically record data from various sensors over time. It stores this information in a digital format, commonly in files such as .txt or .csv, which can later be accessed and analyzed using spreadsheet software. Data loggers are essential in numerous fields, including environmental monitoring, industrial automation, scientific research, and education. They provide a reliable way to track changes in physical parameters without manual observation, making them especially useful in long-term studies and remote locations.

In this project, we have designed a simple yet functional temperature data logger using the Arduino Uno microcontroller. The system reads the ambient room temperature every three seconds using a temperature sensor and stores the recorded values on a microSD card in a readable file format. This allows users to collect environmental data over extended periods and later review the results on a computer. The primary goal of this project is to demonstrate the core principles of data logging while providing a scalable foundation for more complex monitoring systems. With minor modifications, the project can be extended to log additional data such as humidity, pressure, or light levels, making it highly versatile and educational.

II. Components and Hardware Setup

The core of the data logger system is built around the Arduino Uno, a widely-used and beginner-friendly microcontroller board. Alongside it, we use a microSD card module to store data, and a temperature sensor—typically an LM35 or DHT11—to measure the room temperature. The LM35 is a simple analog temperature sensor that provides a voltage output directly proportional to the Celsius temperature, making it easy to integrate with the Arduino. The microSD card must be formatted to the FAT32 file system for compatibility with the SD library used in Arduino IDE.

To assemble the system, the LM35 sensor's VCC pin is connected to the Arduino's 5V pin, the GND to the Arduino's ground, and the output pin to the analog input A0. The SD card module connects to the SPI interface on the Arduino: CS to digital pin 10, MOSI to pin 11, MISO to pin 12, and SCK to pin 13. Once the connections are made, the circuit is ready for coding and testing. Proper wiring ensures reliable data capture and storage. Using a breadboard and jumper wires makes the setup cleaner and easier to debug, especially for beginners. After inserting the formatted SD card into the module, the system is ready to log temperature data.

III. Literature Survey

Environmental data logging systems have seen increasing use in both research and industry, particularly for applications in agriculture, weather monitoring, and environmental science. Various studies have explored the design of data loggers using microcontrollers and open-source hardware to provide affordable and scalable solutions.

In [1], a temperature and humidity monitoring system using Arduino and DHT11 sensors was implemented for greenhouse applications. The data was displayed on an LCD screen and stored locally for analysis. However, the study lacked timestamping, which limited the ability to analyze trends over time.

Another approach was presented in [2], where a data logger using the DS1307 RTC module and SD card was developed for long-term temperature tracking. Although effective, the project relied on older RTC modules with less precision compared to the DS3231, which is used in the current study for improved accuracy.

A similar work in [3] developed a multi-sensor data logger incorporating soil moisture, temperature, and light sensors. While comprehensive, the system was relatively costly due to the integration of multiple sensors and complex shielding boards.

Recent works have emphasized the use of open-source platforms. In [4], an Arduino-based environmental monitoring system was designed using open-source libraries for SD card data handling and RTC synchronization. The system allowed for periodic data collection and graphical visualization using Excel.

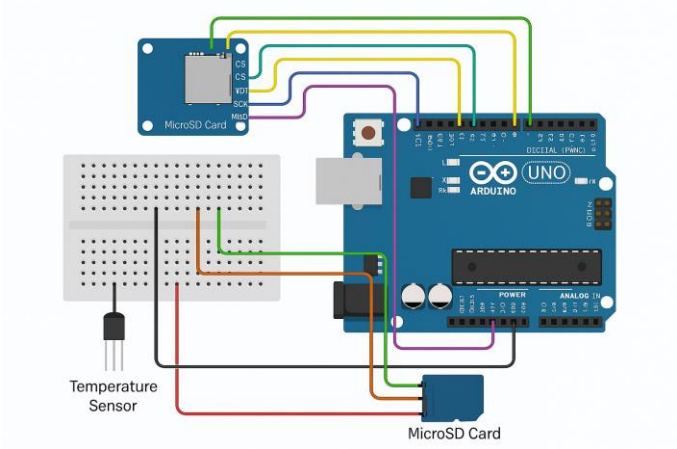
Compared to prior studies, the present work aims to develop a simplified, low-cost solution focusing specifically on temperature monitoring using the DHT11 sensor. By integrating the DS3231 RTC for timestamping and using common Arduino libraries, the system offers accurate and time-based data logging, suitable for academic, agricultural, and environmental applications.

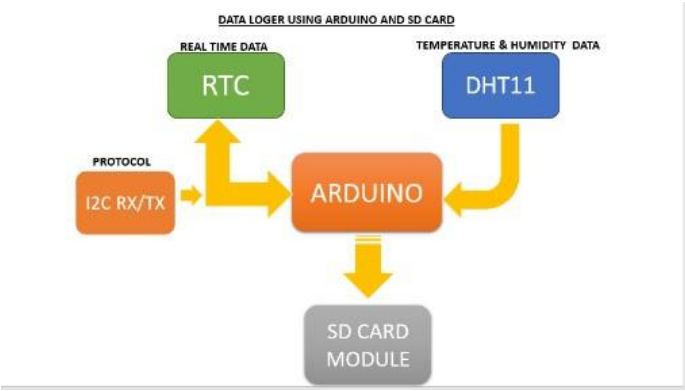
IV. DATA ANALYSIS AND PROJECT EXPANSION

Once data logging is complete, the SD card can be removed and inserted into a computer. Opening the "datalog.txt" file reveals a series of entries formatted with timestamps and temperature values. These can be imported into spreadsheet software such as Microsoft Excel or Google Sheets. By creating line graphs or bar charts, users can visually observe trends, patterns, or sudden changes in temperature over the logged period. This makes the project especially useful in applications like monitoring room conditions, performing scientific experiments, or testing the efficiency of insulation and ventilation systems.

The flexibility of the Arduino platform allows this project to be easily extended. For example, instead of just logging temperature, users can integrate additional sensors such as DHT11 or DHT22 for humidity, BMP280 for atmospheric pressure, or light sensors for brightness levels. Adding a real-time clock (RTC) module like the DS3231 allows the system to log actual timestamps, making the records even more accurate and useful. Moreover, the system can be upgraded to send data wirelessly using Wi-Fi modules like the ESP8266 or Bluetooth modules like HC-05. This opens possibilities for remote environmental monitoring and IoT-based applications. A small LCD screen can also be added to display live readings.

In conclusion, this Arduino-based data logger project provides a practical and scalable solution for recording temperature data. It combines basic electronics, programming, and data analysis into a single educational tool that can serve as the foundation for more complex systems. Whether used for learning, research, or real-world applications, it introduces essential concepts in data collection, automation, and sensor integration





V. CONCLUSION:

We successfully created an affordable, portable data logging device using Arduino. The modular nature allows expanding this project to other sensor types. The simplicity of using SD card modules with Arduino and the availability of libraries make it a suitable solution for students and researchers alike.

This project demonstrates how open-source electronics and software platforms can be integrated to create useful tools for real-world applications such as environmental monitoring, academic projects, or prototype development.

References

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