COMPUTER ENGINEERING WORKSHOP

S.E. (CIS) OEL REPORT

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CHAPTER 1

PROBLEM DESCRIPTION

Environmental monitoring has become increasingly important due to the rising impact of climate change and the need for sustainable development. This project focuses on developing an **Integrated Environmental Monitoring System** using **C programming** that interacts with a free API to retrieve real-time environmental data, including temperature and humidity.

The core objectives of this system are:

- To **retrieve, process, and store environmental data** efficiently.
- To provide **real-time alerts** for critical environmental conditions.
- To employ **C programming fundamentals**, such as pointers, dynamic memory allocation, and modularization, to ensure optimal functionality.
- To leverage **Linux shell scripting** for task automation.

The project aligns with **Course Learning Objective-1 (CLO-1)** by providing hands-on experience with contemporary technologies and **Program Learning Outcome-5 (PLO-5)** by focusing on the modern tools of computer engineering.

METHODOLOGY

This section provides a description of the step-by-step procedures carried out in designing and implementing the weather monitoring system. The methodology includes data collection, processing, analysis, logging, and scalability, thus providing a systematic approach for the entire system.

Data Collection and Processing and Storage:

The first major step is real-time weather data obtained by using an API such as OpenWeatherMap. The system inquires and gets weather data at regular intervals, thus obtaining essential information about temperature, humidity, wind speed, and pressure. This data is then stored in a JSON format (**weather_history.json**), the raw data archive.

Once the data is collected, the next step involves also its processing and cleansing. This is where the erroneous and missing values are treated, errors that may have arisen on account of network issues or differences in the data emanating from a specific source. For example, temperature values from the source might be in Fahrenheit, whereupon all temperate readings are converted to Celsius. The processed data will then be compiled and saved in processed_data.txt for use in subsequent analysis, ensuring its cleanliness, correctness, and proper formation.

Calculation and Averaging of Daily Temperature:

After the data has been cleaned, the system calculates the average daily temperature, which aggregates temperature readings taken throughout the day. This involves summing together all the temperature readings taken at different times of the day and dividing that value by the total number of readings taken to produce the daily average. Average temperatures will be saved to a separate file (average_temperatures.txt), which will help to track long-term trends in temperature fluctuation.

This temperature analysis not only informs on the general weather of the day but also provides a basis for anomaly detection. For instance, temperature readings thought to be unusually high or low would generate alerts. This is an important step in the recognition of extreme in climate events that is then useful in the building of early warning systems.

Alert Generation and Logging:

After processing the data and performing the analysis, the system goes on to check for anomalies in temperature, such as extreme deviations from normal or sudden extreme changes that can indicate hazardous weather. When these anomalies are detected, alerts are generated in order to warn the user of possible extreme conditions, such as heat waves or cold spells.

These alerts, along with normal system operations, are logged in logfile.log. The system logs not only successful actions-such as data collection, processing, and alert generation-but also any errors or failures that are encountered. Alerts are distinctly marked in the logs with time stamps and severity levels to allow quick identification. For instance, a value exceeding temperature thresholds might generate a high-priority alert, whereas some minor systems-event would be logged as routine entries.

The main goal of this process is to ensure transparency and provide an audit trail for troubleshooting. Any errors, like failed data collection or processing, are recorded. The system either retries to fix the issue or handles errors smoothly to keep it running. Transparency is key, and the auditor can use the records to check the system's status and perform periodic cleanups.

System Reliability and Transparency:

To ensure smooth operation, the system includes strong error handling and transparency features. It detects and logs any faults or missing data for quick correction. The system automatically retries failed API calls and notifies the user if the issue persists after retries. This design reduces the need for human intervention, improving the system's reliability during operation.

Logfiles log any and all activity, success or not. They serve as a complete record of every one of the system's activities, which will facilitate monitoring performance, trend detection, and regular maintenance of the system's well-being. Such alerts for extreme weather events are highlighted in the log; accordingly, remedial action from the user can come swiftly.

Scalability and Future Enhancements:

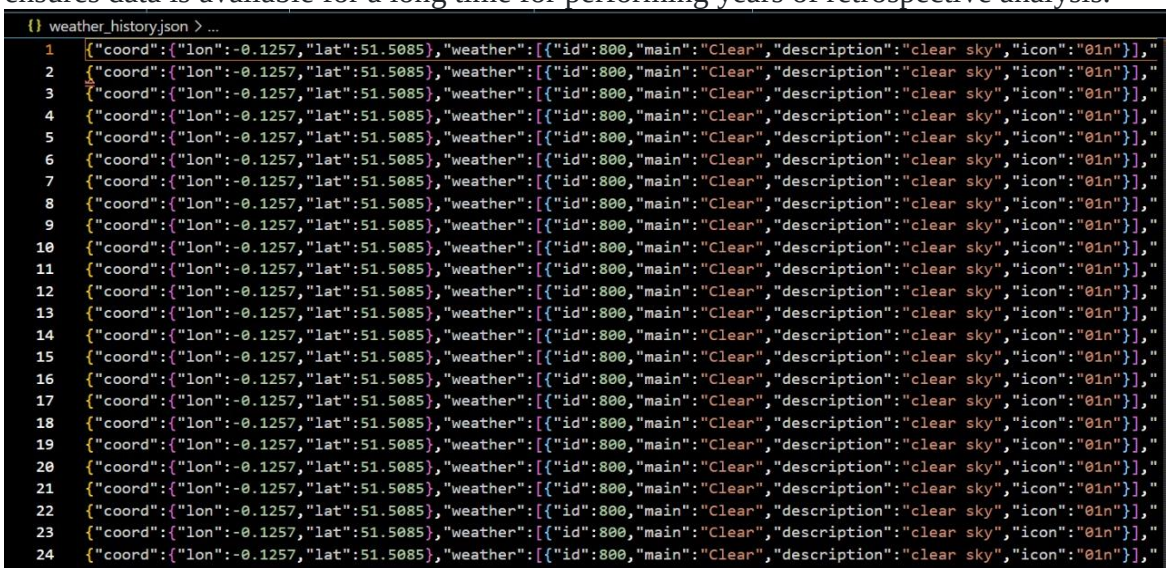
The architecture of the system provides for future scalability, including the possibility to add new features easily. Think for example new data sources, such as satellite weather feeds, would provide a wealth of weather data that is richer and more context-sensitive.

Following this systematic approach, the weather monitoring system will give an accurate value for its weather data by monitoring and alerting in real-time, providing an architecture easily scalable in the future.

RESULTS

Weather History File (**weather_history.json**):

This is a JSON file which stores historic data of all ungodly data from the API. This ensures data is available for a long time for performing years of retrospective analysis.

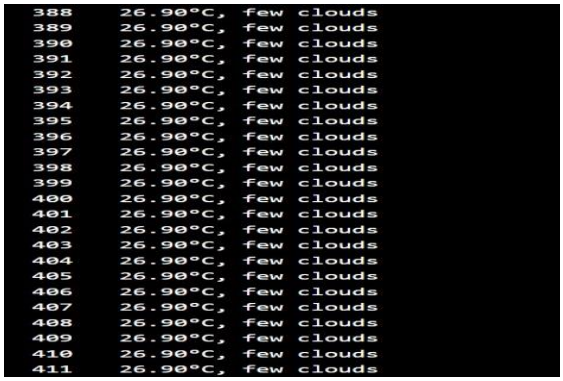


Average Temperature Report **(average_temperatures.txt):**

This report gives the average temperature after every 24 readings. It shows time trends and the way the system processes and, in summary, summarizes enormous amounts of data.

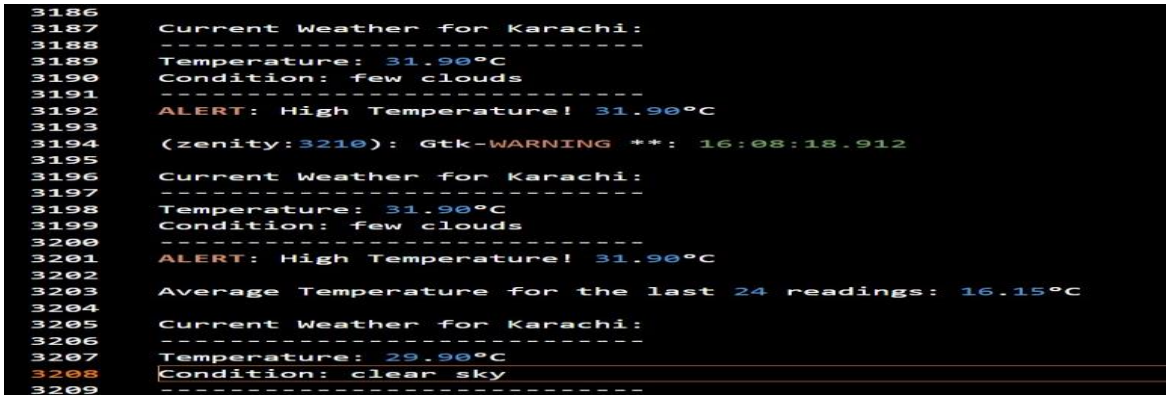
Processed Data File (processed_data.txt):

This is data that has been processed into a simple format in which humans can read it lightly. It contains the temperature of the weather description. The report favors fast manual review of very important environmental factors.



Log File with Alerts (logfile.log):

The alerts ensure timely operator notifications for serious environmental readings.



Log File without Alerts (logfile.log):

This log contains the usual operations of the system when no alerts have been triggered.