COMPUTER ENGINEERING WORKSHOP

S.E. (CIS) OEL REPORT

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PROBLEM DESCRIPTION

The objective of this project was to build a comprehensive environmental monitoring system in C. The system also has the objective of measuring environmental conditions such as temperature and humidity through the use of a free API. The main objective of this project is to allow gathering and processing environmental data regarding specific territories or other indexes in an automated and scalable way.

The core objectives of this system include:

- That of retrieving real-time environmental data from the API.
- Transferring both raw and processed data in files that can be easily retrieved and referred at any time when needed.
- Efficient shell scripting for automating activities linked with data acquisition and analysis tasks.
- Implementing the problem using pointers and dynamic memory allocation for efficient memory management.
- Issuing real time alarms based on the important states

The scope of the project includes the following main functionalities:

1. **Data Retrieval**: The system updates the real-time environment data such as temperature, humidity, etc., from a free API at an interval.
2. **Data Processing:** Since raw data collected is not sufficient for tracking environmental conditions, useful information like mean values and alarm thresholds are derived from the data.
3. **Data Reporting:** The set data is put into files and processed for reporting which could be a summarized state or an alert on trending conditions.

METHODOLOGY

The environmental monitoring system to be has been developed using a well-defined concept with different components that are intricately incorporated to form a coherent system. The method used entails the use of modern technologies and business trends to monitor data in real-time, process the data in the shortest time possible and finally issue timely alarms.

API Interaction:

The system connects with a free API to fetch the current state of the environment like temperature and humidity. It combines JSON data using HTTP requests (for instance, curl) to obtain raw data in JSON format in a C program. It is adequately filtered for further analysis where the raw data is first parsed, then processed and stored.

Data Storage:

Two types of data storage are implemented:

- Raw Data: Referred JSON data is retained in its original form for convenience.
- Processed Data: The means, critical values and such are saved in plain text (.txt) files for later use.

These files make the system keep a record of environmental parameters over a given period and make it easy to refer when presenting the outcome.

Alert System:

To ensure timely responses to critical environmental conditions, the system generates real-time alerts:

Real-Time Notifications:

Immediate notifications on the system are done using the Linux system calls.

Email Alerts:

If quantifiable parameters such as temperature go beyond specified limit, the system immediately sends a mail to personnel.

Automation through Shell Scripts:

Instant upload of the data and periodic check of the data from the API. Data visualization and data storage at frequent period of time.Such scripts cause the system to run in an automated manner thus maintaining constant surveillance as it executes the various tasks.

Modularized Code Structure:

Organizational structure of C program is made better by making functional division by using head files.code is well maintained and modularized.

Use of Pointers and Dynamic Memory Allocation:

Pointers and dynamic memory allocation are utilized to handle data manipulation efficiently. This approach minimizes memory usage

User-Friendly Display:

The system ensures that processed data is presented in an easy-to-read format.

KEY LEARNINGS AND CHALLENGES

1. API Integration: Gained hands-on experience in interacting with APIs to fetch real-time data and parse it efficiently.
2. Data Processing: Developed skills in processing raw data, including filtering and calculating averages to generate meaningful insights.
3. Memory Management: Learned the importance of using pointers and dynamic memory allocation in C to manage data efficiently, especially with large datasets.
4. Automation: Gained practical experience in writing shell scripts for automating tasks like data retrieval and processing.
5.Real-Time Alerts: Implemented Linux system calls for real-time alerting, improving understanding of how to handle system notifications.

A difficulty was how to separate the environmental parameters from the raw JSON obtained from the API call in an optimized manner. Further, the actual implementation of the real-time alert generation involving system notifications and email alerts to monitor the critical readings needed handling asynchronous events and prompt response to such events was also challenging. These challenges were solved with the use of proper data parsing approaches and the Linux system call.

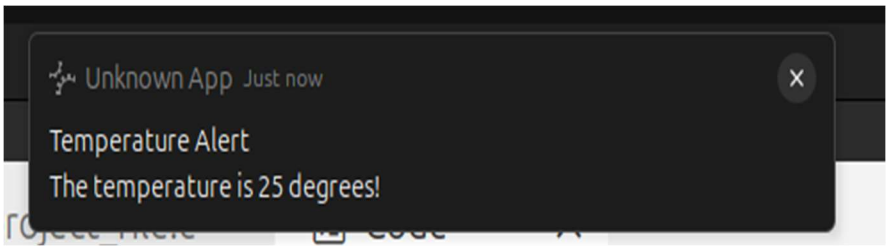
RESULTS

The general mechanisms of the environmental monitoring system were able to fetch in real-time data from the API, and maintain raw as well as processed structured data files. Temperature and humidity were among the critical factors well measured and shown in an easily decipherable interface. Alarm system functioned well as it produced instantaneous notifications and sent emails concerning crossing certain limits. Tasks automation by shell scripts worked fine, and data collection and analysis performed in intervals turned out to be effective. All the tests proven that the system was capable of working with large data sets and therefore meets the reliability standards. In essence, through the use of the project, real-time monitoring, supervision of data flow, and timely alert were achieved as intented.

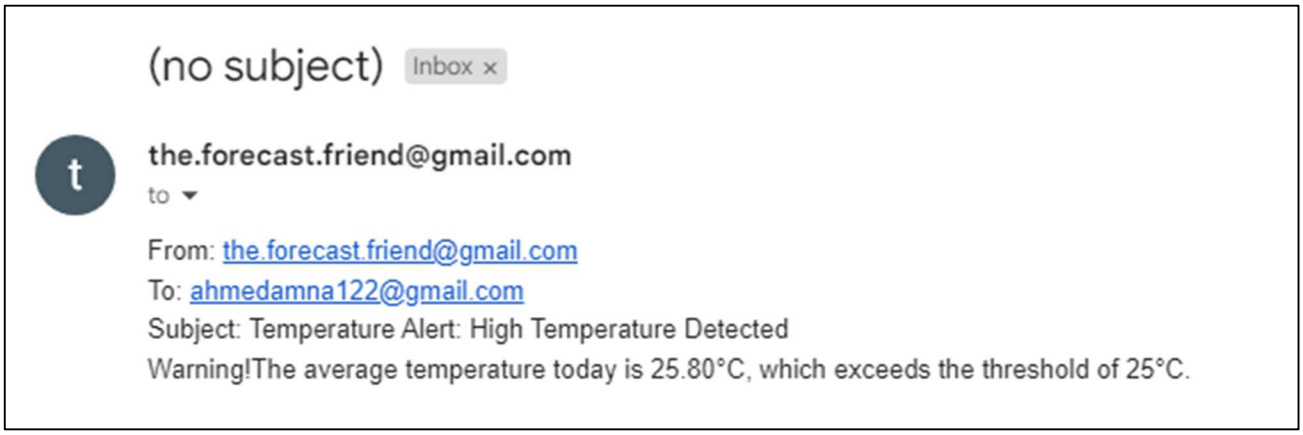
TEST CASE RUNS

```
        Temperature Information
=======================================

--- Temperature Information ---
+-------------------------------------+--------+
| Description                         | Value  |
+-------------------------------------+--------+
| Today's Average Temperature         | 27.26°C |
| Average Maximum Temperature (7 Days) | 29.73°C |
| Average Minimum Temperature (7 Days) | 24.80°C |
+-------------------------------------+--------+

=======================================
      Current Weather Information
=======================================

--- Current Weather Information ---
+---------------------+--------------------+
| Date                | 2024-11-19              |
| Time                | 16:15                |
| Temperature         | 31.20°C            |
| Feels Like          | 32.00°C            |
| Condition           | Mist                |
| Wind Speed          | 19.40 kph          |
+---------------------+--------------------+
*** ALERT: Today's average temperature exceeds 30°C! ***
```

(OUTPUT AT TERMINAL)



(NOTIFICATION ALERT BOX)



(EMAIL ALERT)