COMPUTER ENGINEERING WORKSHOP

S.E. (CIS) OEL REPORT

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S.No	Contents	PageNo.

1. PROBLEM DESCRIPTION

Construct an integrated environmental monitoring system in C, covering a range of fundamental concepts and practical applications. The project involves interacting with a free API that provides real-time environmental data. The system's core functionalities include data retrieval, processing and reporting.

Requirements of the project include:
- Interact with a free API to retrieve real-time environmental data (e.g., temperature, humidity).
- Store raw and processed data in files.
- Create shell scripts to automate tasks such as data retrieval and processing.
- Utilize pointers and dynamic memory allocation in the C program to optimize data manipulation and enhance efficiency
- Implement real-time alerts using Linux system calls to notify relevant personnel of critical environmental readings.
- Use header files to modularize the C code and enhance code readability.

2. METHODOLOGY

Modularizing C Code

To improve readability, maintainability, and scalability of the program, the code was modularized into multiple files. This approach involved:

- **Header Files (.h)**: Used for declaring function prototypes, macros, and shared data structures.
- **Source Files (.c)**: Function implementations were separated into distinct source files based on functionality, such as API interaction, data processing, and alert generation.
- **Main Program**: The main file served as the central control unit to orchestrate the functionality of the program by integrating the modular components.

Interaction with the API

- The project uses **libcurl**, a powerful library for handling HTTP requests, to retrieve real-time environmental data such as temperature and humidity from a free API.
- The retrieved data, returned in JSON format, was processed using **json-c**, a lightweight and efficient JSON parsing library. **json-c** was chosen for its:

Data Storage

The system stores both **raw** and **processed data** in files for future reference and analysis:
- **Raw Data**: Stored in a file (rawdata.txt) immediately after retrieval to ensure the original API response is preserved.
- **Processed Data**: Extracted and structured data, such as city name, temperature, and humidity, is stored in an output file (output.txt) in a user-friendly format.

Automation with Shell Scripts

To streamline the process of data retrieval and storage, **shell scripts** were created to automate these tasks. A **30-minute timer** was set to trigger the program periodically, ensuring the system retrieves and processes real-time data without manual intervention.

Real-Time Alerts

- An alert is triggered when the **temperature exceeds 85°F**, indicating a potentially dangerous condition.
- The alert is displayed as a **desktop notification** using the Linux notify-send command, which is invoked via system calls from within the C program.

Pointers and Dynamic Memory Allocation

- A Memory **structure** was used to dynamically allocate memory for storing API responses, allowing the system to handle responses of varying sizes.
- This approach ensures efficient use of memory and prevents wasteful allocation.

Overall System Flow

1. The program retrieves data from the API every 30 minutes.
2. Data is parsed, processed, and stored in both raw and structured formats.
3. Real-time alerts are generated when critical conditions are met.
4. The modular structure and use of libraries like libcurl and json-c ensure robust and maintainable code.

3. RESULTS

```
Date and Time: 2024-11-22 19:44:26
Weather Information:
City: Karachi
Weather Description: few clouds
Temperature: 78.62 F
Humidity: 57%
Wind Speed: 4.61 m/s

Date and Time: 2024-11-22 19:44:29
Weather Information:
City: Karachi
Weather Description: few clouds
Temperature: 78.62 F
Humidity: 57%
Wind Speed: 4.61 m/s
```

```
Date and Time: 2024-11-22 19:43:08
Weather Information:
City: Karachi
Weather Description: few clouds
Temperature: 88.62 F
Humidity: 57%
Wind Speed: 4.61 m/s
ALERT: High temperature of 88.62 F detected in Karachi!
```