COMPUTER ENGINEERING WORKSHOP

S.E. (CIS) OEL REPORT

Project Group ID:

NAME OF MEMBER #1	CS23122
NAME OF MEMBER #2	CS23086
NAME OF MEMBER #3	CS23074

BATCH: 2023

Department of Computer and Information Systems Engineering

NED University of Engg. & Tech.,
Karachi-75270

CONTENTS

CHAPTER 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.

The software will be graded for CLO-1: **Attain hands on experience with contemporary technologies of computer engineering**, C3, PLO5 using the rubric at the end of this file.

Problem Outline:

· 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.

METHODOLOGY

Introduction:

This project implements an integrated environmental monitoring system using the C programming language. The methodology involves fetching environmental data, processing it, and automating its execution to generate meaningful insights and alerts. Each functionality is directly derived from the provided codebase. The implementation focuses on modular design, efficient memory usage, and real-time alert mechanisms.

Below is a description of the key functionalities and their implementation.

1. **Data Retrieval from API:** To fetch real-time environmental data.

- The fetch_weather_data() function retrieves data from the Weatherstack API using the libcurl library.
- A callback function handle_data() appends incoming data into a dynamically allocated memory buffer.

2. **Parsing and Processing Data:** To extract environmental parameters.

- The extract_environmental_data() function parses the JSON response using the json-c library.
- The extracted values include:
    1. City: Name of the city.
    2. Country: Name of the country.
    3. Temperature: Current temperature in degrees Celsius.
    4. Humidity: Current humidity percentage.
- These values are stored in an EnvironmentalData struct for efficient handling.

3. Data Logging: To persist environmental data for future analysis.

- The save_response_to_file() function writes the raw JSON response to raw_data.txt.
- The log_environmental_data() function logs processed data into environmental_data.txt, recording:
    1. City and country.
    2. Temperature.
    3. Humidity.

4. Automation of Data Retrieval: To automate periodic data retrieval.

- The data_extraction.sh shell script:
    1. Compiles the C program with the required libraries (libcurl and json-c).
    2. Executes the compiled binary at regular intervals (10 minutes by default).

3. Runs the program on both Windows and Unix-based systems

5. Real-Time Alerts: To notify users of critical environmental conditions.

- The evaluate_weather_alerts() function checks for:
    1. High temperature (>30°C).
    2. Low humidity (<20%).

6. Modular Design: To ensure code readability and maintainability.

- The weather.h header file contains:
    1. The definition of the EnvironmentalData struct.
    2. Function prototypes for core functionalities.
- This modular approach separates concerns, making the code easier to extend or debug.

7. Memory Management: To handle API responses using dynamic memory.

- The program allocates memory dynamically using malloc() for storing API responses.
- A buffer is used to accumulate data during the libcurl request.
- Memory is freed after use to prevent leaks.

Conclusion:

From fetching real-time data to logging it and automating the process, the system successfully meets its objectives. Its modular design and use of contemporary tools like libcurl and json-c make it an effective solution for environmental monitoring.

RESULTS

Attached below is the test run case:

```
root@DESKTOP-PGQ7356: /mnt/c/hcc
root@DESKTOP-PGQ7356:~# cd
root@DESKTOP-PGQ7356:~# cd /mnt/c
root@DESKTOP-PGQ7356:/mnt/c# cd "hcc"
root@DESKTOP-PGQ7356:/mnt/c/hcc# nano main.c
root@DESKTOP-PGQ7356:/mnt/c/hcc# gcc main.c -o main -lcurl -json-c
gcc: error: unrecognized command-line option '-json-c'
root@DESKTOP-PGQ7356:/mnt/c/hcc# gcc main.c -o main -lcurl -ljson-c
root@DESKTOP-PGQ7356:/mnt/c/hcc# ./main
Received Data: {"request":{"type":"City","query":"Sydney, Australia","language":"en","unit":"m"},"location":{"name":"Sydney","country":"Australia","region":"
New South Wales","lat":"-33.883","lon":"151.217","timezone_id":"Australia\/Sydney","localtime":"2024-11-23 00:39","localtime_epoch":1732322340,"utc_offset":"
11.0"},"current":{"observation_time":"01:39 PM","temperature":21,"weather_code":113,"weather_icons":["https:\/\/cdn.worldweatheronline.com\/images\/wsymbols0
1_png_64\/wsymbol_0008_clear_sky_night.png"],"weather_descriptions":["Clear"],"wind_speed":15,"wind_degree":18,"wind_dir":"NNE","pressure":1021,"precip":0,"h
umidity":73,"cloudcover":0,"feelslike":21,"uv_index":0,"visibility":10,"is_day":"no"}}
0


City: Sydney
Country: Australia
Temperature: 21.00°C
Humidity: 73%
Press any key to exit...

root@DESKTOP-PGQ7356:/mnt/c/hcc# ./main
Received Data: {"request":{"type":"City","query":"Sydney, Australia","language":"en","unit":"m"},"location":{"name":"Sydney","country":"Australia","region":"
New South Wales","lat":"-33.883","lon":"151.217","timezone_id":"Australia\/Sydney","localtime":"2024-11-23 00:39","localtime_epoch":1732322340,"utc_offset":"
11.0"},"current":{"observation_time":"01:39 PM","temperature":21,"weather_code":113,"weather_icons":["https:\/\/cdn.worldweatheronline.com\/images\/wsymbols0
1_png_64\/wsymbol_0008_clear_sky_night.png"],"weather_descriptions":["Clear"],"wind_speed":15,"wind_degree":18,"wind_dir":"NNE","pressure":1021,"precip":0,"h
umidity":73,"cloudcover":0,"feelslike":21,"uv_index":0,"visibility":10,"is_day":"no"}}
0


City: Sydney
Country: Australia
Temperature: 21.00°C
Humidity: 73%
Press any key to exit...
```

Attached below is the snapshot of the file storing raw data:

```
raw_data - Notepad
File  Edit  Format  View  Help
{"request":{"type":"City","query":"Sydney, Australia","language":"en","unit":"m"},"location":{"name":"Sydney","coun
0


{"request":{"type":"City","query":"Sydney, Australia","language":"en","unit":"m"},"location":{"name":"Sydney","coun
0
```

Attached below is the snapshot of the file storing environmental data:

```
environmental_data - Notepad
File  Edit  Format  View  Help
City: Sydney, Country: Australia, Temperature: 21.00°C, Humidity: 73%
City: Sydney, Country: Australia, Temperature: 21.00°C, Humidity: 73%
```