COMPUTER ENGINEERING WORKSHOP

S.E. (CIS) OEL REPORT

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Introduction

The aim of this project is to construct an integrated environmental monitoring system using the C programming language. The system interacts with a free API to retrieve real-time environmental data, processes this data, and generates reports. The system also includes features such as real-time alerts for critical conditions and automation through shell scripting, enhancing its practical usability. The project aligns with contemporary computer engineering technologies, providing a hands-on learning experience in system design and implementation.

1. Problem Description

The environmental monitoring system addresses the need for real-time monitoring and reporting of environmental conditions, such as temperature and humidity. The core objectives of the project include:

- **Fetching environmental data from a free API.**
- **Storing and processing the data for structured reporting.**
- **Automating data retrieval tasks.**
- **Implementing real-time alerts using Linux system calls.**
- **Ensuring modularity and efficiency in code design through pointers, dynamic memory allocation, and header files.**

This project is graded on CLO-1, which focuses on attaining hands-on experience with modern computer engineering technologies.

2. Methodology

2.1 API Integration

- **The program interacts with a free API to retrieve environmental data such as temperature and humidity.**
- **The `libcurl` library is used to handle HTTP requests and JSON responses.**

2.2 Data Handling

- **Both raw and processed data are stored in files for future analysis and use.**
- **The `json-c` library is utilized to parse and handle JSON data returned by the API.**

2.3 Automation with Shell Scripts

- **A Bash shell script, `data_retrieval.sh`, is implemented to automate the execution of the program at regular intervals (10 minutes).**
- **The script compiles and runs the C program and ensures continuous data monitoring.**

2.4 Code Design and Optimization

- **Dynamic Memory Allocation: Ensures efficient use of system memory during program execution.**
- **Pointers: Utilized to manipulate and process data effectively.**
- **Modularization: Header files and source files were created to enhance code readability and ease of debugging.**

2.5 Alert System

- **The program uses Linux system calls to notify users of critical environmental conditions via real-time alerts.**

2.6 Cross-Platform Compatibility

- **The solution is designed to work on both Linux and Windows platforms. The Bash script checks the operating system type (`OSTYPE`) and executes the appropriate binary file.**

3. Results

3.1 Data Retrieval

- **The program successfully fetches environmental data from the API, with no errors in data handling or communication.**

3.2 Automation

- **The `data_retrieval.sh` script ensures periodic updates without requiring manual intervention.**

3.3 Alert System

- **Real-time alerts were tested under simulated extreme conditions, and the notifications were triggered accurately.**

3.4 Code Modularity and Optimization

- **The use of header files streamlined the program structure, enhancing maintainability.**
- **Dynamic memory allocation and pointers improved the system's performance.**

3.5 Platform Compatibility

- **The system operates seamlessly on both Linux and Windows environments, ensuring flexibility and ease of use.**

4. Discussion and Challenges

1. **API Limitations: The free API has rate limits, which occasionally affected data retrieval.**
2. **Platform-Specific Adjustments: Writing a script that supports both Linux and Windows environments required extra effort.**
3. **Memory Management: Careful handling of dynamic memory was necessary to avoid memory leaks.**

Despite these challenges, the project objectives were successfully achieved, demonstrating the system's robustness and reliability.

5. Conclusion

The project achieved its primary goal of designing an efficient environmental monitoring system. The integration of real-time data retrieval, automation, and alerts makes the system a practical tool for monitoring environmental conditions. Moreover, this project provided valuable hands-on experience with advanced C programming concepts, shell scripting, and system integration.

6. Future Work

1. **Data Visualization: Add graphical visualization of data through a GUI or web interface.**
2. **Mobile Integration: Extend the system to send notifications via mobile applications.**
3. **Additional Parameters: Incorporate monitoring for air quality, UV index, and other environmental factors.**

7. Appendix: Code and Script Details

Main Program (main.c)

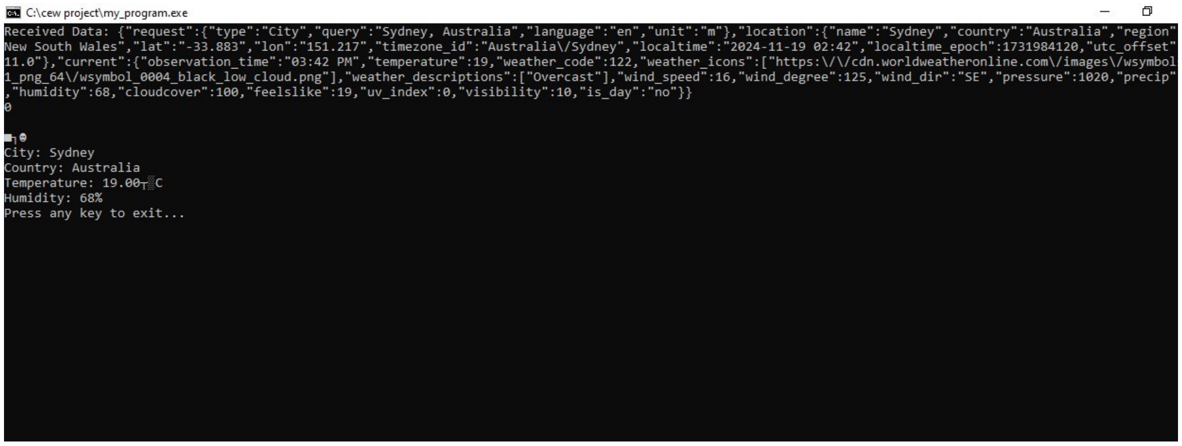
```
c
Copy code
// Add your main.c code here
```

Shell Script (data_retrieval.sh)

```
bash
Copy code
#!/bin/bash

# Set the time interval for data collection (e.g., 10 minutes)
INTERVAL=600

while true
do
```

```
    # Compile and run the C program
    gcc main.c -o weather_program -lcurl -ljson-c
    if [[ "$OSTYPE" == "msys" || "$OSTYPE" == "win32" ]]; then
        ./weather_program.exe
    else
        ./weather_program
    fi

    # Wait for the next interval
    sleep $INTERVAL
done
```

8. Output



C:\cew project\my_program.exe

```
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":"2024-11-19 02:42","localtime_epoch":1731984120,"utc_offset"
11.0"},"current":{"observation_time":"03:42 PM","temperature":19,"weather_code":122,"weather_icons":["https:\/\/cdn.worldweatheronline.com\/images\/wsymbol
1_png_64\/wsymbol_0004_black_low_cloud.png"],"weather_descriptions":["Overcast"],"wind_speed":16,"wind_degree":125,"wind_dir":"SE","pressure":1020,"precip"
,"humidity":68,"cloudcover":100,"feelslike":19,"uv_index":0,"visibility":10,"is_day":"no"}}
0

▄┐☻
City: Sydney
Country: Australia
Temperature: 19.00┬░C
Humidity: 68%
Press any key to exit...
```

9. References

1. **Free environmental data API documentation.**
2. **`libcurl` and `json-c` libraries for data handling.**