

# **COMPUTER ENGINEERING WORKSHOP**

## **S.E. (CIS) OEL REPORT**

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**BATCH: 2023**

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## 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.

## METHODOLOGY:

- **Technologies and Tools:**

- **Programming Language:** C for the core functionality of the system.
- **Libraries:** libcurl for making API requests, cJSON for parsing JSON data, jq to extract from JSON response in a tabular form, bc to convert temprature from kelvin to celcius.
- **Data Handling:** Using CSV for storing processed data and JSON for API response handling.
- **Shell Scripting:** Used for automating data retrieval and processing and to generate alerts/notifications.
- **Logging:** The system logs events, errors, notifications/alerts and status updates to a log file for tracking and debugging purposes.

- **System Design:**

- Queries **OpenWeatherMap API** for weather data (Karachi's latitude and longitude).
- Parses JSON data for key attributes (temperature, humidity, description).
- Converts temperature from Kelvin to Celsius and stores processed data in **CSV**.
- Maintains a **log file** for tracking successful operations and errors.
- Automates data retrieval and alert generation via **shell script**.
- Avoids duplicate timestamps and handles severe weather alerts.

- **Process Flow:**

- **Data Retrieval:** The system queries the OpenWeatherMap API using curl and stores the raw JSON response.
- **Data Parsing:** The JSON response is parsed using cJSON to extract necessary weather attributes.
- **Data Storage:** The extracted data is processed and stored in a CSV file.
- **Avoiding Duplicates:** The system checks for duplicate timestamps before writing new entries.
- **Challenges:**
  - Handling API.
  - Ensuring the system avoids data duplication in the processed file.

- **Limitations:**

→ The system is currently limited to fetching data for Karachi and can be further extended to other regions.

## RESULTS:

- **Raw Data (JSON file):**

```

C main.c C header.h { } raw_data.json X $ weather_automation.sh
project > { } raw_data.json > ...
1 [{"cod": "200", "message": 0, "cnt": 40, "list": [{"dt": 1732222800, "main": {"temp": 297.78, "feels_like": 298.02,
"temp_min": 297.78, "temp_max": 298.89, "pressure": 1014, "sea_level": 1014, "grnd_level": 1011, "humidity": 66, "temp_kf": -1.
11}, "weather": [{"id": 800, "main": "Clear", "description": "clear sky", "icon": "01n"}], "clouds": {"all": 0}, "wind":
{"speed": 3.76, "deg": 273, "gust": 3.91}, "visibility": 10000, "pop": 0, "sys": {"pod": "n"}, "dt_txt": "2024-11-21 21:00:00"}],
{"dt": 1732233600, "main": {"temp": 298.13, "feels_like": 298.38, "temp_min": 298.13, "temp_max": 298.58, "pressure": 1013,
"sea_level": 1013, "grnd_level": 1011, "humidity": 65, "temp_kf": -0.45}, "weather": [{"id": 800, "main": "Clear",
"description": "clear sky", "icon": "01n"}], "clouds": {"all": 0}, "wind": {"speed": 3.67, "deg": 289, "gust": 3.93},
"visibility": 10000, "pop": 0, "sys": {"pod": "n"}, "dt_txt": "2024-11-22 00:00:00"}], {"dt": 1732244400, "main": {"temp": 299.
02, "feels_like": 299.28, "temp_min": 299.02, "temp_max": 299.02, "pressure": 1014, "sea_level": 1014, "grnd_level": 1012,
"humidity": 62, "temp_kf": 0}, "weather": [{"id": 800, "main": "Clear", "description": "clear sky", "icon": "01d"}], "clouds":
{"all": 0}, "wind": {"speed": 3.08, "deg": 273, "gust": 3.94}, "visibility": 10000, "pop": 0, "sys": {"pod": "d"},
"dt_txt": "2024-11-22 03:00:00"}], {"dt": 1732255200, "main": {"temp": 301.1, "feels_like": 301.91, "temp_min": 301.1,
"temp_max": 301.1, "pressure": 1015, "sea_level": 1015, "grnd_level": 1013, "humidity": 54, "temp_kf": 0}, "weather":
[{"id": 800, "main": "Clear", "description": "clear sky", "icon": "01d"}], "clouds": {"all": 0}, "wind": {"speed": 4.33,
"deg": 264, "gust": 3.93}, "visibility": 10000, "pop": 0, "sys": {"pod": "d"}, "dt_txt": "2024-11-22 06:00:00"}],
{"dt": 1732266000, "main": {"temp": 301.58, "feels_like": 302.42, "temp_min": 301.58, "temp_max": 301.58, "pressure": 1012

```

- **Processed Data (CSV file):**

| 1  | Timestamp           | Temperature (C) | Humidity (%) | Feels Like (C) | Description     |
|----|---------------------|-----------------|--------------|----------------|-----------------|
| 2  | 2024-11-22 18:00:00 | 25.07           | 65.00        | 25.33          | clear sky       |
| 3  | 2024-11-22 21:00:00 | 25.21           | 64.00        | 25.46          | clear sky       |
| 4  | 2024-11-23 00:00:00 | 25.23           | 65.00        | 25.51          | clear sky       |
| 5  | 2024-11-23 03:00:00 | 25.76           | 65.00        | 26.09          | clear sky       |
| 6  | 2024-11-23 06:00:00 | 27.69           | 57.00        | 28.72          | clear sky       |
| 7  | 2024-11-23 09:00:00 | 28.11           | 55.00        | 29.07          | clear sky       |
| 8  | 2024-11-23 12:00:00 | 27.24           | 60.00        | 28.39          | clear sky       |
| 9  | 2024-11-23 15:00:00 | 26.19           | 65.00        | 26.19          | clear sky       |
| 10 | 2024-11-23 18:00:00 | 25.81           | 67.00        | 26.20          | broken clouds   |
| 11 | 2024-11-23 21:00:00 | 25.47           | 68.00        | 25.85          | overcast clouds |
| 12 | 2024-11-24 00:00:00 | 25.04           | 68.00        | 25.38          | overcast clouds |
| 13 | 2024-11-24 03:00:00 | 25.54           | 65.00        | 25.85          | broken clouds   |
| 14 | 2024-11-24 06:00:00 | 27.22           | 57.00        | 28.13          | broken clouds   |
| 15 | 2024-11-24 09:00:00 | 28.07           | 54.00        | 28.91          | few clouds      |
| 16 | 2024-11-24 12:00:00 | 27.37           | 58.00        | 28.39          | few clouds      |

- **Maintain Log:**

```
Sun Nov 24 06:19:26 PM UTC 2024: Created processed data file processed_data.csv.
Sun Nov 24 06:19:26 PM UTC 2024: Retrieving forecast weather data...
Sun Nov 24 06:19:27 PM UTC 2024: Weather data saved to raw_data.json.
Sun Nov 24 06:19:27 PM UTC 2024: Processing weather data...
Sun Nov 24 06:19:27 PM UTC 2024: Pleasant weather with a temperature of 23.20°C at 2024-11-24 21:00:00.
Sun Nov 24 06:19:27 PM UTC 2024: Processed data for 2024-11-24 21:00:00 saved to processed_data.csv.
Sun Nov 24 06:19:27 PM UTC 2024: Pleasant weather with a temperature of 23.99°C at 2024-11-25 00:00:00.
Sun Nov 24 06:19:27 PM UTC 2024: Processed data for 2024-11-25 00:00:00 saved to processed_data.csv.
Sun Nov 24 06:19:27 PM UTC 2024: Pleasant weather with a temperature of 24.96°C at 2024-11-25 03:00:00.
Sun Nov 24 06:19:27 PM UTC 2024: Processed data for 2024-11-25 03:00:00 saved to processed_data.csv.
Sun Nov 24 06:19:27 PM UTC 2024: Pleasant weather with a temperature of 27.30°C at 2024-11-25 06:00:00.
Sun Nov 24 06:19:27 PM UTC 2024: Processed data for 2024-11-25 06:00:00 saved to processed_data.csv.
Sun Nov 24 06:19:27 PM UTC 2024: Pleasant weather with a temperature of 28.52°C at 2024-11-25 09:00:00.
Sun Nov 24 06:19:27 PM UTC 2024: Processed data for 2024-11-25 09:00:00 saved to processed_data.csv.
Sun Nov 24 06:19:28 PM UTC 2024: Pleasant weather with a temperature of 27.84°C at 2024-11-25 12:00:00.
Sun Nov 24 06:19:28 PM UTC 2024: Processed data for 2024-11-25 12:00:00 saved to processed_data.csv.
Sun Nov 24 06:19:28 PM UTC 2024: Pleasant weather with a temperature of 26.59°C at 2024-11-25 15:00:00.
Sun Nov 24 06:19:28 PM UTC 2024: Processed data for 2024-11-25 15:00:00 saved to processed_data.csv.
Sun Nov 24 06:19:28 PM UTC 2024: Pleasant weather with a temperature of 26.08°C at 2024-11-25 18:00:00.
Sun Nov 24 06:19:28 PM UTC 2024: Processed data for 2024-11-25 18:00:00 saved to processed_data.csv.
Sun Nov 24 06:19:28 PM UTC 2024: Pleasant weather with a temperature of 25.61°C at 2024-11-25 21:00:00.
Sun Nov 24 06:19:28 PM UTC 2024: Processed data for 2024-11-25 21:00:00 saved to processed_data.csv.
Sun Nov 24 06:19:28 PM UTC 2024: Pleasant weather with a temperature of 25.00°C at 2024-11-26 00:00:00.
```

- **Generate Alerts/ Notifications:**

```
Processed data for 2024-11-26 18:00:00 saved to processed_data.csv.
Pleasant weather with a temperature of 25.77°C at 2024-11-26 21:00:00.
Processed data for 2024-11-26 21:00:00 saved to processed_data.csv.
Pleasant weather with a temperature of 25.46°C at 2024-11-27 00:00:00.
Processed data for 2024-11-27 00:00:00 saved to processed_data.csv.
Pleasant weather with a temperature of 25.98°C at 2024-11-27 03:00:00.
Processed data for 2024-11-27 03:00:00 saved to processed_data.csv.
Pleasant weather with a temperature of 28.22°C at 2024-11-27 06:00:00.
Processed data for 2024-11-27 06:00:00 saved to processed_data.csv.
Pleasant weather with a temperature of 28.80°C at 2024-11-27 09:00:00.
Processed data for 2024-11-27 09:00:00 saved to processed_data.csv.
Pleasant weather with a temperature of 27.88°C at 2024-11-27 12:00:00.
Processed data for 2024-11-27 12:00:00 saved to processed_data.csv.
Pleasant weather with a temperature of 26.26°C at 2024-11-27 15:00:00.
Processed data for 2024-11-27 15:00:00 saved to processed_data.csv.
Pleasant weather with a temperature of 25.88°C at 2024-11-27 18:00:00.
Processed data for 2024-11-27 18:00:00 saved to processed_data.csv.
Weather data collection for 24 hourly readings completed.
gitpod /workspace/Environmental-monitoring-system-in-c/CEWProj (main) $
```