Carbon Sense

Introduction

Welcome to the world of Carbon Sense, where we delve into the fascinating topic of carbon emissions and their impact on our planet. In this document, we will explore the causes and consequences of excessive carbon emissions, as well as discuss potential solutions to mitigate their effects. Whether you are a concerned individual or a policy maker, this document aims to provide you with valuable insights and knowledge to foster a more sustainable future for all. So, let's embark on this journey together and deepen our understanding of carbon sense!

Vision and Mission

1 User Management

The system must allow users to register, log in, and manage their profiles.

2 Carbon Emissions Tracking

The system must allow users to input data related to their activities (e.g., electricity usage, travel, etc.) and calculate the corresponding carbon emissions.

3 Monthly Emissions History

The system must store and display a history of the user's carbon emissions on a monthly basis.

4 Data Visualization & Reporting

The system should provide visual representations of the user's emissions data over time and allow users to generate reports of their carbon emissions.

Non-Functional Requirements

Performance

The system should calculate and display carbon emissions data with minimal latency

Scalability

The architecture should support increased load as more users begin tracking their emissions.

Security

Data must be encrypted in transit and at rest. Use JWT for authentication and authorization.

Availability & Maintainability

The system should have an uptime of 99.9%, with failover mechanisms in place. Code should follow SOLID principles, with high modularity and low coupling.

Technologies Used

Backend

Programming Language: Java 17 for backend services.

Frameworks: Spring Boot for building microservices, Spring Security for authentication and authorization.

Database: MongoDB for storing persistent data.

API Communication: RESTful APIs using Spring Web.

Frontend

Angular for building the user interface.

Other

Containerization: Docker for containerizing services.

High-Level Design: Architectural Overview

1

API Gateway

Acts as a single entry point for all client requests, routing them to the appropriate microservice.

2

User Service

Handles user-related operations such as registration, login, and profile management.

3

Carbon Emissions Service

Manages the tracking of user activities and the calculation of carbon emissions.

4

History Service

Stores and retrieves historical carbon emissions data for each user.

5

Reporting Service

Generates reports and visualizations based on user emissions data.

High-Level Design:

1

User Logs In

The user logs in and views their dashboard.

2

User Enters Activity Data

The user enters activity data (e.g., electricity usage, travel data).

3

System Calculates Emissions

The system calculates the corresponding carbon emissions.

4

System Updates Emissions Record

The system updates the carbon emissions record.

5

User Requests Report

The user requests an emission report.

6

System Generates Report

The system generates and displays the report.

Low-Level Design: Detailed Component Specification

Component	Description
Controller	Exposes RESTful endpoints and handles HTTP requests.
Service	Contains the business logic and interacts with repositories.
Repository	Manages data persistence and retrieval from MongoDB.

Low-Level Design: Security Considerations

Authentication

JWT is used for secure user authentication.

Authorization

Role-based access control ensures users only access permitted resources.

Data Encryption

Sensitive data is encrypted both in transit and at rest.

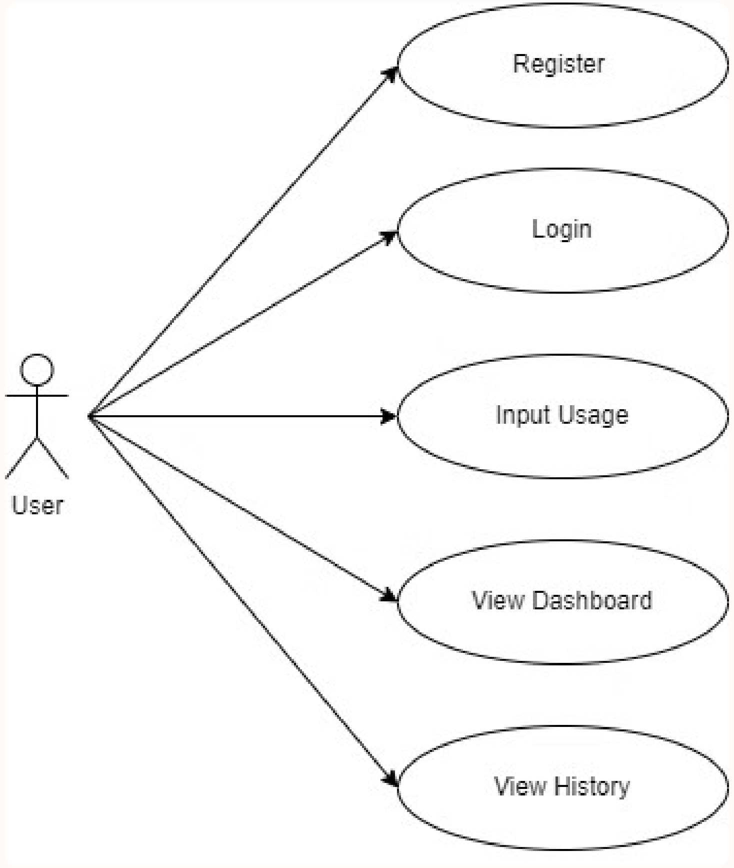
Input Validation

All user inputs are validated to prevent injection attacks.

Exception Handling

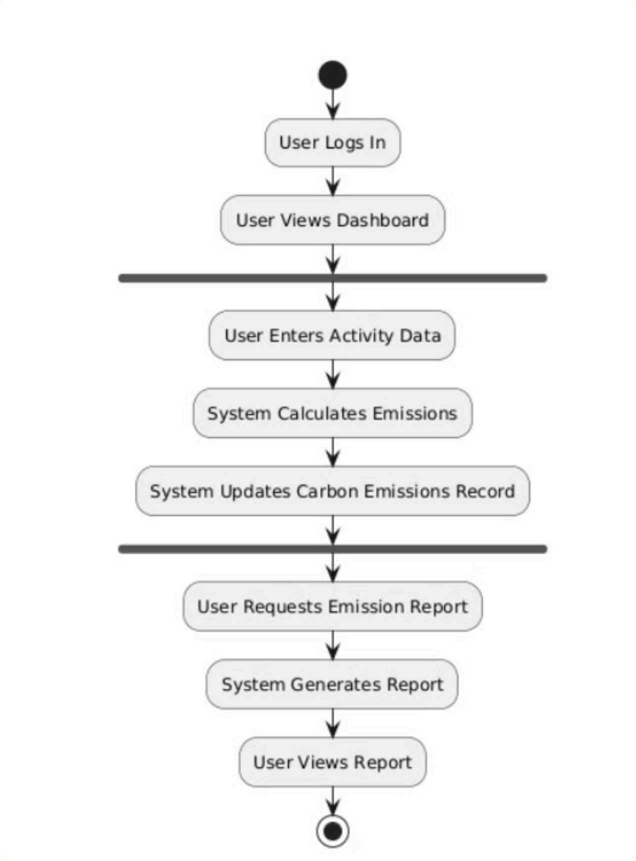
1. **Global Exception Handling** Use a centralized error handler to manage exceptions across all microservice layers. Return custom error responses with detailed messages and appropriate HTTP status codes.
2. **Input Validation** Validate incoming requests to ensure they meet required formats and constraints. Validate DTOs using annotations like @NotNull, @Size, @Email.
3. **Client-Side Error Handling**
   - **Input Validation**: Before sending data to the server, the client-side (typically Angular) validates the input to prevent sending incorrect or malformed data.
   - **Error Interceptors**: HTTP interceptors are used to handle errors centrally in the Angular application, providing user-friendly error messages and handling specific error codes appropriately.
4. **Security Error Handling**
   - **Authentication and Authorization Failures**: Proper error handling mechanisms are implemented to handle cases where authentication or authorization fails. Unauthorized access attempts return a 401 Unauthorized or 403 Forbidden response.

Usecase Diagram

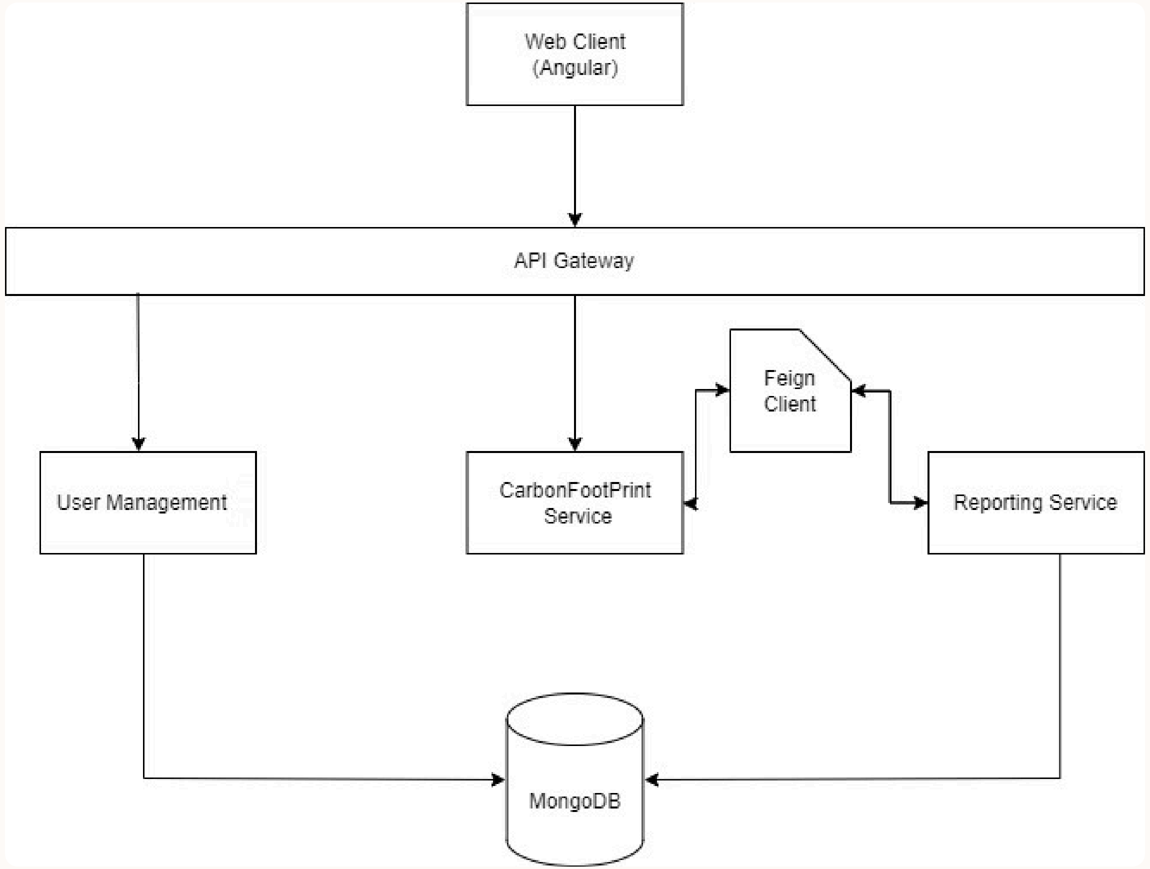


Made with Gamma

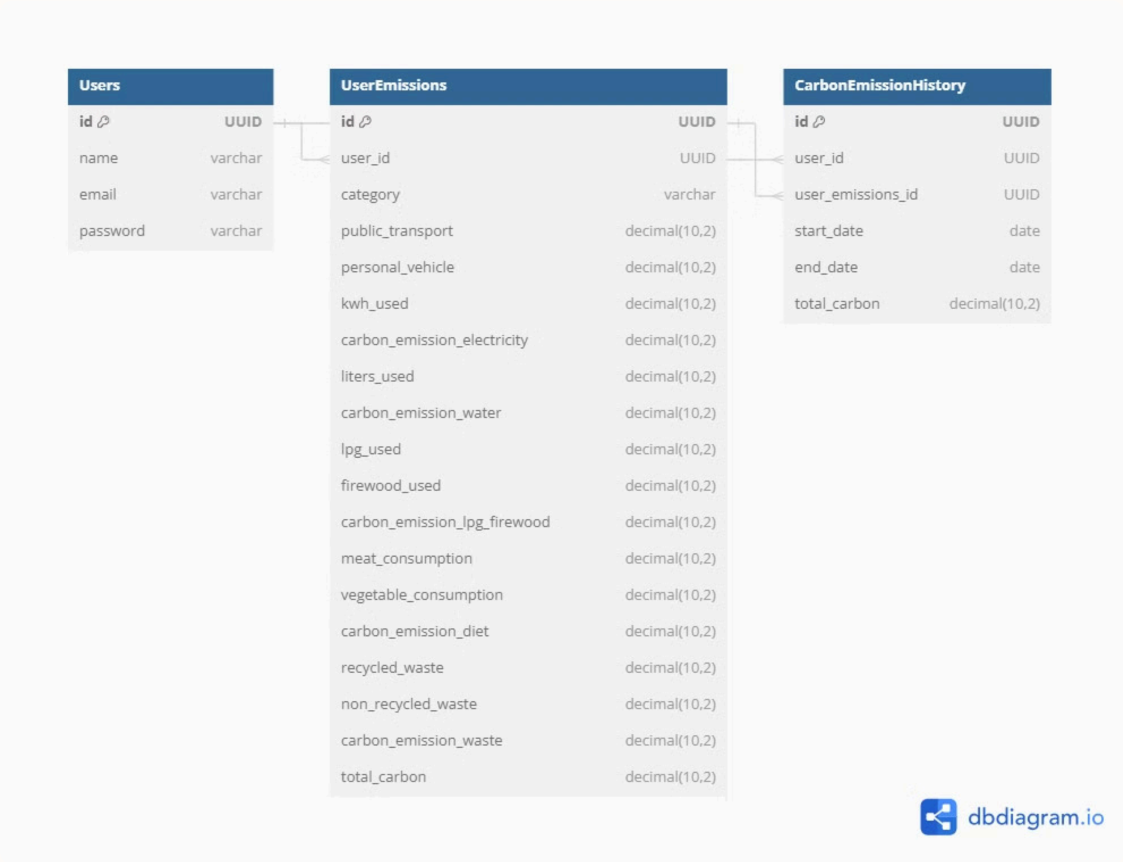
Activity Diagram


User Logs In
User Views Dashboard
User Enters Activity Data
System Calculates Emissions
System Updates Carbon Emissions Record
User Requests Emission Report
System Generates Report
User Views Report

Architecture Diagram



ER Diagram

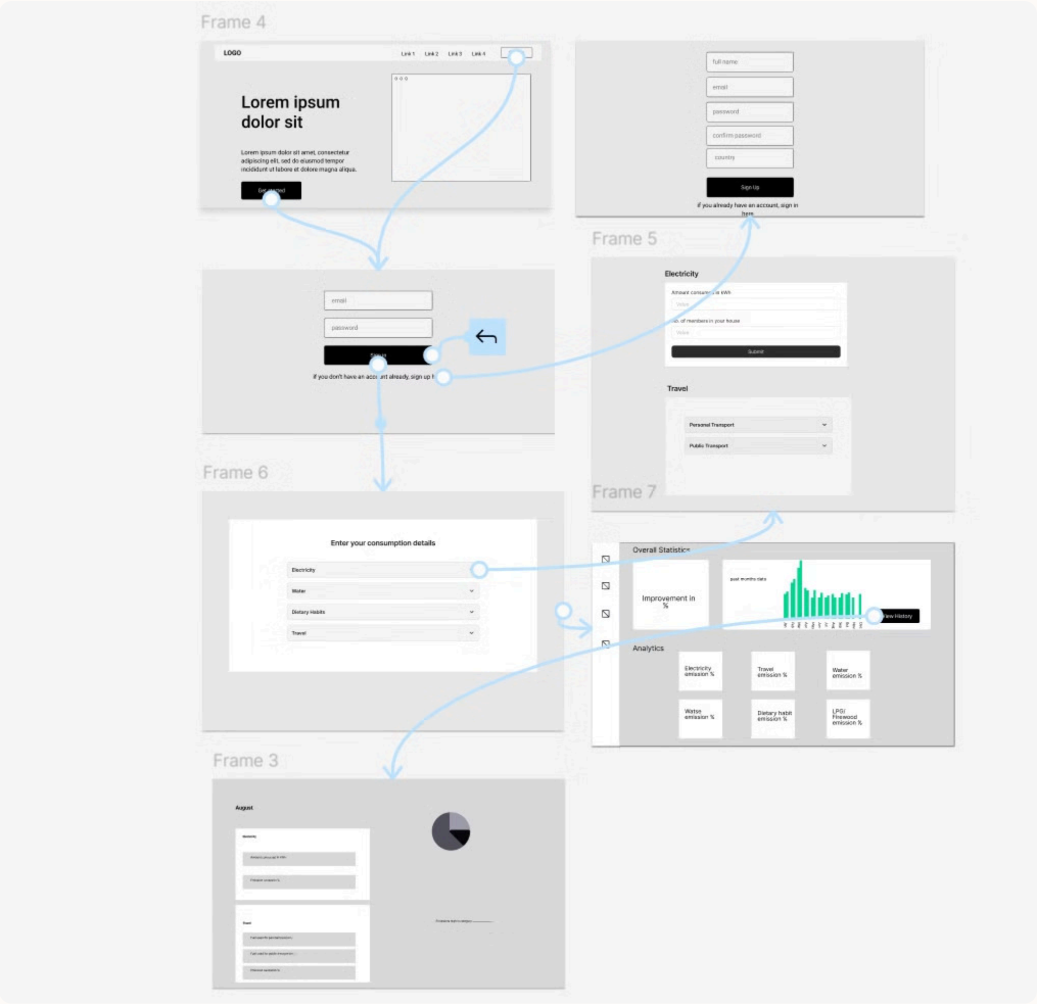


Users	
id	UUID
name	varchar
email	varchar
password	varchar

UserEmissions	
id	UUID
user_id	UUID
category	varchar
public_transport	decimal(10,2)
personal_vehicle	decimal(10,2)
kwh_used	decimal(10,2)
carbon_emission_electricity	decimal(10,2)
liters_used	decimal(10,2)
carbon_emission_water	decimal(10,2)
lpg_used	decimal(10,2)
firewood_used	decimal(10,2)
carbon_emission_lpg_firewood	decimal(10,2)
meat_consumption	decimal(10,2)
vegetable_consumption	decimal(10,2)
carbon_emission_diet	decimal(10,2)
recycled_waste	decimal(10,2)
non_recycled_waste	decimal(10,2)
carbon_emission_waste	decimal(10,2)
total_carbon	decimal(10,2)

CarbonEmissionHistory	
id	UUID
user_id	UUID
user_emissions_id	UUID
start_date	date
end_date	date
total_carbon	decimal(10,2)

Wireframe Diagram


Frame 4
LOGO
Link 1
Link 2
Link 3
Link 4
Lorem ipsum dolor sit
Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua.
Get started
full name
email
password
confirm password
country
Sign Up
If you already have an account, sign in here
Frame 5
email
password
Sign in
If you don't have an account already, sign up h
Electricity
Amount consumed in kWh
Value
No. of members in your house
Value
Submit
Travel
Personal Transport
Public Transport
Frame 6
Frame 7
Enter your consumption details
Electricity
Water
Dietary Habits
Travel
Overall Statistics
Improvement in %
past months data
View History
Analytics
Electricity emission %
Travel emission %
Water emission %
Watse emission %
Dietary habit emission %
LPG/ Firewood emission %
Frame 3
August