|  |
| --- |
|  |
| GreenPath |
| Tracking Your Carbon Footprint and Beyond |

|  |
| --- |
| CSIS-4495-001  Subasinghe Mudiyanselage Indika Gayashan Upasena - 300362878  10-28-2024 |

Table of Contents

[1 Introduction 3](#_Toc181024467)

[1.1 The Need for Personalized Sustainability Tools 3](#_Toc181024468)

[1.2 Literature Review and Knowledge Gaps 3](#_Toc181024469)

[1.3 Assumptions, Hypotheses, and Benefits of the Research 4](#_Toc181024470)

[1.3.1 Assumptions 4](#_Toc181024471)

[1.3.2 Hypotheses 4](#_Toc181024472)

[1.3.3 Potential Benefits of the Research 5](#_Toc181024473)

[2 Proposed Research Project 5](#_Toc181024474)

[2.1 Research Design and Objectives 5](#_Toc181024475)

[2.1.1 Objectives 5](#_Toc181024476)

[2.2 Methodology and Justification 6](#_Toc181024477)

[2.2.1 Data Collection 6](#_Toc181024478)

[2.2.2 Personalized Recommendations 6](#_Toc181024479)

[2.2.3 Data Visualization 6](#_Toc181024480)

[2.3 Data Collection and Analytics 6](#_Toc181024481)

[2.3.1 Data Collection 6](#_Toc181024482)

[2.3.2 Analytics and Recommendation Generation 7](#_Toc181024483)

[2.3.3 Data Visualization 7](#_Toc181024484)

[2.4 Technologies 7](#_Toc181024485)

[2.5 Expected Results 7](#_Toc181024486)

[3 Project Planning and Timeline 8](#_Toc181024487)

[3.1 Phase 1: Requirement Analysis (10-09-2024 to 16-09-2024) 8](#_Toc181024488)

[3.2 Phase 2: Design & Development (17-09-2024 to 20-10-2024) 8](#_Toc181024489)

[3.3 Phase 3: Integration (21-10-2024 to 04-11-2024) 9](#_Toc181024490)

[3.4 Phase 4: Testing & Refinement (05-11-2024 to 18-11-2024) 9](#_Toc181024491)

[3.5 Phase 5: Final Delivery (19-11-2024 to 30-11-2024) 9](#_Toc181024492)

[4 Implemented Features Overview 10](#_Toc181024493)

[4.1 Introduction/Overview 10](#_Toc181024494)

[4.2 User Profile and Login 10](#_Toc181024495)

[4.3 Dashboard 12](#_Toc181024496)

[4.4 Impact Entry 15](#_Toc181024497)

[5 Lessons Learned and Future Work 18](#_Toc181024498)

[6 Concluding Remarks 19](#_Toc181024499)

[7 Appendix 20](#_Toc181024500)

[7.1 Appendix A: Installation Guide 20](#_Toc181024501)

[7.2 Appendix D: Hardware, Software, Cloud, Architecture 20](#_Toc181024502)

[7.3 References 21](#_Toc181024503)

# Introduction

Sustainability has become a pressing global concern in recent decades, largely due to the impacts of climate change, resource depletion, and environmental damage. It highlights the importance of balancing economic growth, environmental protection, and social well-being to secure a sustainable future. Human activities, especially in areas like energy use, transportation, waste production, and food systems, play a significant role in environmental challenges such as carbon emissions, water scarcity, and pollution.

The GreenPath app focuses on environmental sustainability, providing users with tools to monitor, assess, and minimize their environmental footprint. By offering tailored suggestions based on individual habits, GreenPath helps users adopt more eco-friendly practices, contributing to the collective fight against climate change

## The Need for Personalized Sustainability Tools

Despite widespread awareness of environmental issues, many individuals struggle to understand the direct impact of their daily activities on the environment and how to reduce that impact effectively. Key questions arise:

* How can individuals track their carbon footprint, water usage, and waste production?
* What personalized, actionable steps can people take to make meaningful changes in their daily behaviours toward a more sustainable lifestyle?
* How can technology be leveraged to automate sustainability tracking and provide data-driven insights?

These questions are important because individual actions collectively have a significant influence on global environmental health. However, without clear, data-driven tools to measure personal impact and suggest actionable improvements, many people feel disconnected from the environmental consequences of their choices. By addressing this gap, the GreenPath app seeks to bridge the disconnect between awareness and action, providing users with the necessary information and guidance to make more sustainable decisions.

## Literature Review and Knowledge Gaps

Research on sustainability has been extensive, covering topics from carbon emissions tracking to waste reduction, renewable energy adoption, and individual behavioural changes toward sustainable living. Multiple studies have shown that tracking and awareness can significantly impact consumer behaviour. For example:

* **Carbon footprint calculators** like CoolClimate have been developed to estimate emissions based on various factors such as transportation and diet (Jones & Kammen, 2011).
* Studies on **behavioural nudges** have demonstrated that personalized feedback and goal-setting can lead to more sustainable consumer behaviour (Allcott & Rogers, 2014).
* **Gamification** and social features, as explored by Hamari et al. (2014), have proven effective in driving engagement and motivation toward eco-friendly practices.

However, existing research often highlights certain limitations and knowledge gaps:

* **Personalized insights**: Most carbon footprint calculators and sustainability tools provide static, generalized feedback, but lack the ability to offer dynamic, personalized recommendations based on user data.
* **Difficulty in maintaining user engagement**: Many sustainability apps and platforms struggle to retain users over the long term, largely because of limited interactivity and a lack of personalized goal setting.
* **Integration challenges**: Existing tools tend to address single dimensions of sustainability (e.g., energy consumption or waste) without offering a comprehensive approach that considers various aspects of environmental impact.

By building on these findings, GreenPath aims to address these gaps by providing a holistic platform that integrates multiple environmental factors, such as carbon emissions, water usage, and waste production tailored suggestions to users.

## Assumptions, Hypotheses, and Benefits of the Research

### Assumptions

* Individuals are more likely to adopt sustainable behaviours if they can easily track their environmental impact and receive personalized, actionable recommendations.
* Gamification and community engagement features will motivate users to actively pursue sustainability goals.

### Hypotheses

* Users who actively track their environmental impact through GreenPath and receive personalized recommendations will demonstrate a measurable reduction in their carbon footprint, water usage, and waste production over time.
* The introduction of gamified elements (e.g., challenges, badges) and social features (e.g., leaderboards, group activities) will lead to higher user engagement and a sustained commitment to eco-friendly practices.
* GreenPath users will show greater awareness and understanding of how their daily activities contribute to environmental issues, compared to users who do not use similar tracking tools.

### Potential Benefits of the Research

The findings from this project could provide valuable insights into the role of personalized feedback and gamification in driving sustainable behavior. By helping individuals make more informed choices, the GreenPath app has the potential to:

* Reduce individual carbon footprints: Users will be more aware of how to lower their emissions through specific lifestyle changes (e.g., dietary adjustments, energy-saving practices).
* Promote water conservation: With detailed tracking and goal-setting features, users will be able to reduce unnecessary water usage in daily activities.
* Reduce waste production: By encouraging recycling, composting, and conscious consumption, users will produce less waste, contributing to waste reduction initiatives.

At a larger scale, GreenPath could serve as a model for future sustainability tools that integrate comprehensive and personalized recommendations to help society move toward a more sustainable future.

# Proposed Research Project

## Research Design and Objectives

The proposed research project involves the development and evaluation of the GreenPath app, a web-based platform and android mobile app (a companion app supports the main web-based application with a focus on adding data) that helps users track and reduce their environmental impact. The app will focus on key sustainability areas, such as carbon emissions (via transportation and energy usage), water consumption, and waste production. By providing users personalized recommendations and progress tracking, GreenPath aims to empower individuals to adopt more sustainable behaviours.

### Objectives

* Develop a platform that allows users to input data related to their carbon footprint, water consumption, and waste production.
* Offer personalized, actionable recommendations based on user data to help them reduce their environmental impact.
* Provide intuitive visualizations of environmental data to help users understand their sustainability progress.
* Evaluate the effectiveness of the app in promoting sustainable behaviour by analyzing user engagement and environmental impact over time.

## Methodology and Justification

The research methodology combines data collection, analysis, and user engagement through the following components:

### Data Collection

Users will manually input data for tracking of energy use, transportation, and waste habits. This allows the app to calculate environmental metrics.

**Justification**: Research (e.g., Allcott & Rogers, 2014) shows that personalized feedback can drive sustainable changes, which GreenPath builds upon by offering multi-domain tracking.

### Personalized Recommendations

GreenPath will provide rule-based recommendations tailored to users’ specific habits. For example, if energy consumption is high, the app may suggest using energy-efficient appliances or lowering thermostat settings.

**Justification**: Studies like Abrahamse et al. (2005) support the use of tailored feedback for behaviour change, which GreenPath applies across carbon, water, and waste domains.

### Data Visualization

The app will use charts and graphs to display trends in users' sustainability metrics, such as carbon emissions or water consumption, with goal indicators to motivate improvement.

**Justification**: Visual feedback and gamification are proven to engage users (Hamari et al., 2014), which can foster long-term behaviour change.

## Data Collection and Analytics

### Data Collection

Data for the project will be collected through user inputs via web app and mobile app. Users will be able to input data about their daily habits (e.g., energy usage, transportation methods, water consumption, waste production).

To start the project, I will:

* Build the data input forms and API integration modules.
* Set up a backend system to store user data
* Ensure data privacy by securing sensitive user data.

### Analytics and Recommendation Generation

Once data is collected, the app will:

* **Analyze Usage Patterns**: For each user, the app will track their daily activities and compare them to sustainable benchmarks (e.g., average carbon emissions for transportation).
* **Generate Personalized Recommendations**: Using rule-based algorithms, the app will generate recommendations like reducing energy consumption or adopting more sustainable food choices. These recommendations will be tailored to specific behaviours that deviate from sustainability goals.

### Data Visualization

* The app will present user data visually through interactive charts and graphs. For instance, the user’s carbon footprint over time will be shown through line graphs, while water usage trends will be displayed in bar charts.
* Color-coded indicators will signal whether users are meeting their sustainability goals (e.g., green for improvement, red for exceeding limits).

## Technologies

**Platform**: Web based application which runs on browser and android mobile application

**Programming language**: JavaScript, Java

**Database**: MongoDb

**Front-end and backend:** ReactJs / VueJs and NodeJs

## Expected Results

The expected outcomes include:

* Reduced Carbon Footprint: Users will lower emissions by following personalized recommendations, such as adopting greener transport or reducing energy use.
* Water and Waste Reduction: Users will conserve water and manage waste more effectively through actionable advice on daily habits.
* Increased Engagement: Visual feedback and gamified elements will drive long-term engagement, fostering sustained behavioral change.

Practical Contributions:

* For Individuals: The GreenPath app will provide users with a tool to better understand and manage their environmental impact, empowering them to make data-driven choices that contribute to sustainability.
* For the Environment: On a larger scale, collective use of the GreenPath app could lead to meaningful reductions in carbon emissions, water usage, and waste production, contributing to broader environmental goals like mitigating climate change and preserving natural resources.

# Project Planning and Timeline

**Project Duration**:

* **Start Date**: 10-09-2024
* **End Date**: 30-11-2024
* **Total Duration**: 12 weeks

The project is divided into 5 key phases: Requirement Analysis, Design & Development, Data Collection & Integration, Testing & Refinement, and Final Delivery.

## Phase 1: Requirement Analysis (10-09-2024 to 16-09-2024)

**Duration**: 1 week  
**Key Milestones & Deliverables**:

* **Milestone 1**: Finalize functional and non-functional requirements.
  + Deliverable: Requirements document, outlining core features such as carbon tracking, water usage, waste tracking.
* **Milestone 2**: Technology stack selection.

## Phase 2: Design & Development (17-09-2024 to 20-10-2024)

**Duration**: 5 weeks  
**Key Milestones & Deliverables**:

* **Milestone 3**: User interface (UI) and user experience (UX) design.
  + Deliverable: Wireframes and mockups for the GreenPath app
* **Milestone 4**: Front-end development.
  + Deliverable: Functional UI for the app (dashboard, user input forms).
* **Milestone 5**: Android mobile app development.
  + Deliverable: Functional mobile UI.
* **Milestone 6**: Back-end development.
  + Deliverable: Back-end infrastructure with API integrations and database setup for storing user data.

## Phase 3: Integration (21-10-2024 to 04-11-2024)

**Duration**: 2 weeks  
**Key Milestones & Deliverables**:

* **Milestone 7**: API integration for carbon, water, and waste tracking with web and mobile applications.
  + Deliverable: Integrated web app and mobile app with API connections for transportation, energy, and water usage data.

## Phase 4: Testing & Refinement (05-11-2024 to 18-11-2024)

**Duration**: 2 weeks  
**Key Milestones & Deliverables**:

* **Milestone 8**: Unit testing and integration testing.
  + Deliverable: Test cases and reports ensuring the core functionalities (data input, API integration, recommendations) are working as expected.
* **Milestone 10**: Refinement and bug fixing.
  + Deliverable: Updated, refined version of the GreenPath app

## Phase 5: Final Delivery (19-11-2024 to 30-11-2024)

**Duration**: 2 weeks  
**Key Milestones & Deliverables**:

* **Milestone 11**: Final version of GreenPath app.
  + Deliverable: Fully functioning web app and mobile app with carbon, water, and waste tracking features, data visualization, and personalized recommendations.
* **Milestone 12**: Documentation and project report.
  + Deliverable: Final project report, including technical documentation, user guide

A graph with numbers and a bar

Description automatically generated with medium confidence

# Implemented Features Overview

## Introduction/Overview

This section outlines the completed development work for the GreenPath app, a web-based platform that encourages sustainability practices by tracking carbon emissions, water usage, and waste generation. These core features align with the project’s objective of offering users personalized insights and a streamlined way to record their environmental impact. The timeline is on track, with Phase 1 (Requirement Analysis)**,** Phase 2 (Design & Development) and Phase **3** (Integration)nearing completion. While minor changes were made, such as adjusting the backend API integrations for better data handling, the development remains focused on creating a robust, scalable solution for tracking and visualizing sustainability metrics.

The following sections highlight specific progress in the implemented features, including login and user profiles, dashboard elements, and impact entry forms for different sustainability categories.

## User Profile and Login

**Login:**

The login functionality uses bcrypt for password encryption, ensuring secure handling of user credentials. The backend logic for authentication is complete, though front-end integration is pending. This feature will provide a secure login environment as part of GreenPath’s commitment to user data privacy.

A computer screen shot of a program

Description automatically generated

Figure 1:User Password Encryption Backend Code

**User Profile Creation:**The front-end interface for user registration and profile creation has been designed, allowing new users to input details to personalize their tracking experience. Backend logic for profile creation will complete user onboarding by storing personal data such as name, email, and sustainability preferences.

A screenshot of a computer

Description automatically generated

Figure 2: User Profile Creation

## Dashboard

**Summary Cards:**  
The dashboard includes summary cards displaying total carbon emissions, transport emissions, energy emissions, and waste emissions. Each card pulls data from corresponding backend APIs, which perform data aggregation for a quick, at-a-glance summary of user impact metrics.

A screenshot of a computer

Description automatically generated

Figure 3: Dashboard Emission Summary

**Charts:**  
The dashboard features three primary charts, providing users with a graphical overview of their impact metrics:

* **Carbon Footprint (Donut Chart)**: Visualizes the breakdown of carbon sources.
* **Waste Management (Pie Chart)**: Displays waste distribution by type.
* **Daily Water Consumption (Bar Chart)**: Shows daily water usage trends.

All charts are dynamic, updating as data entries are logged by the user. Backend aggregation APIs fetch and process data based on the user’s profile, enabling real-time data visualization.

A close up of a pie chart

Description automatically generated

Figure 4:Dashboard Charts 1

A graph of blue rectangular bars

Description automatically generated with medium confidence

Figure 5: Dashboard Charts 2

A computer screen shot of a program code

Description automatically generated

Figure 6: Backend Chart Api Code for Daily Water Usage

**Recommendation Widget:**  
The recommendation widget is currently under development and aims to provide users with personalized suggestions for reducing their environmental impact. This feature will further enhance the app’s value by actively engaging users in sustainable practices.

## Impact Entry

Each impact category (carbon footprint, water usage, and waste management) has a dedicated entry form with corresponding API integrations, allowing users to log and update their daily metrics efficiently. The forms are designed in tab views for seamless navigation:

**Carbon Footprint Entry**:

Users can enter daily transport data, including distance travelled and mode of transport. The system supports multiple entries per day, accommodating different travel types (e.g., car, train). The backend API aggregates data, calculating carbon emissions using predefined emission factors. A summary view displays the daily emissions total after submission.

A screenshot of a computer

Description automatically generated

Figure 7: Impact Entry - Carbon Footprint 1

A screenshot of a computer

Description automatically generated

Figure 8: Impact Entry - Carbon Footprint 2

**Water Usage Entry**:

The water usage form allows users to log their daily water consumption, with options to enter data in different units. The backend API computes the related emissions based on water usage, displaying results in the summary view.

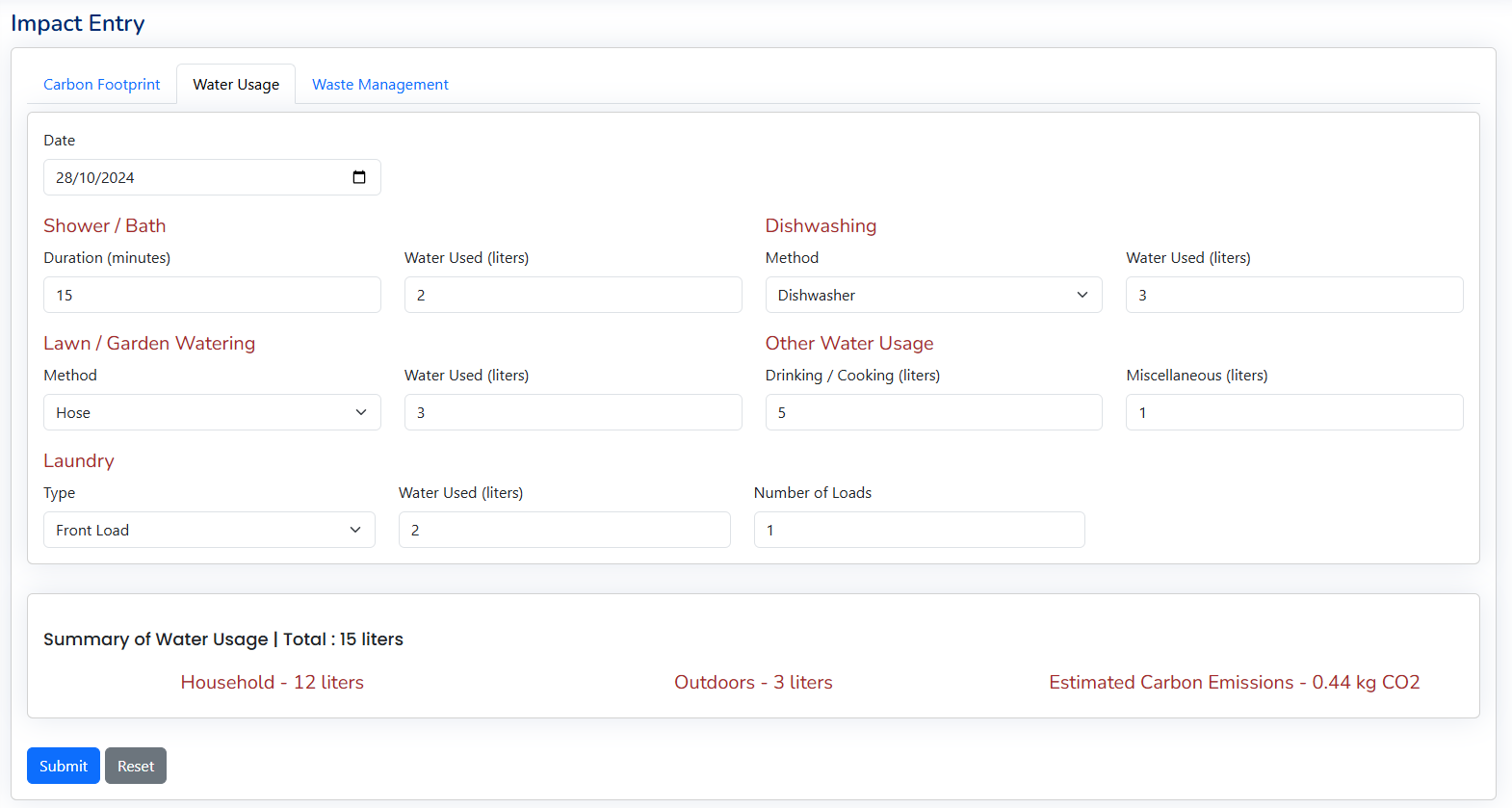


Figure 9 : Impact Entry - Water Usage

**Waste Management Entry**:

Users can record daily waste contributions, specifying waste type and quantity. The backend API supports multiple entries per day, calculating total emissions for the recorded waste. The waste summary view allows users to monitor their impact easily.

A screenshot of a computer

Description automatically generated

Figure 10: Impact Entry - Waste Management

A screenshot of a computer program

Description automatically generated

Figure 11: Emission Factors

A screen shot of a computer code

Description automatically generated

Figure 12: Emission Calculation Formulas

# Lessons Learned and Future Work

**Lessons Learned**

Throughout the development of GreenPath, several key insights emerged, influencing not only the project but also providing practical applications of concepts from coursework. Firstly, managing a project with both front-end and back-end elements reinforced the importance of modular architecture. By segmenting the system into manageable parts, I could optimize both development and debugging processes. This approach aligns closely with principles learned in software engineering courses, such as modularity and separation of concerns, which highlight the importance of clear boundaries between different parts of an application.

Working with MongoDB, for instance, clarified the advantages of using NoSQL databases for flexible, schema-less data structures, particularly suited to GreenPath’s varied data types. Moreover, implementing Vue.js on the front end illustrated the power of component-based frameworks, which enhanced the reusability of UI elements and simplified the integration of real-time updates.

Another lesson was the importance of data privacy, especially with personal tracking data involved. Applying encryption with bcrypt in the authentication process reinforced secure coding practices. The challenges encountered with securing user data prompted a deeper appreciation for privacy-by-design approaches, which are increasingly relevant in technology-driven careers.

**Relation to Coursework and Future Career Aspirations**

This project closely relates to several areas covered in my coursework, such as web development, full stack web development, and android app development. The database and API integration aspects drew heavily from database management classes, while front-end development in Vue.js reinforced concepts from user interface design courses.

Through GreenPath, I’ve realized the growing demand for environmental technologies in industries and the opportunities they present. This experience has motivated me to focus on developing tech solutions with a positive impact, aligning with my aspirations of working in green tech or environmental consultancy roles.

**Future Work**

Looking ahead, several areas of GreenPath present opportunities for enhancement and further research:

1. **Data Analysis and Insights**: Expanding data insights for users through advanced analysis of their emissions and usage patterns. This could include seasonality trends, comparisons with averages, and future forecasting, providing users with actionable feedback based on historical data.
2. **Enhanced Personalization**: Building on the planned recommendation feature, future work could incorporate more robust customization. Leveraging user preferences to generate personalized eco-friendly goals or badges could foster user engagement and behavioral change.
3. **Gamification and Community Features**: An important future component is to build the community and gamification aspects, allowing users to share their progress, tips, and motivate each other. Implementing a community dashboard with achievement tracking and comparisons could promote a sense of shared accountability and encourage positive habits.

# Concluding Remarks

In completing the midterm stage of the GreenPath project, I am grateful for the insights and guidance provided by Professor Bambang A.B. Sarif, whose expertise has been invaluable in navigating both technical and conceptual aspects of the project. The direction offered during our discussions helped clarify complex challenges and encouraged me to explore sustainable development practices in greater depth.

I also extend my thanks to my peers, whose feedback and collaborative spirit enriched the project experience. This phase of GreenPath has been a rewarding journey, and I look forward to continuing to build upon this foundation as I work towards delivering a comprehensive and impactful app that contributes to eco-conscious living.

# Appendix

## Appendix A: Installation Guide

Project Repo Path : <https://github.com/gayashanacd/CSIS_4495_Project_ISu878.git>

**How to run frontend VueJs app**

* Copy project file to a location and open terminal / command prompt in inside root folder.
* Run “**npm install**” to install all modules needed
* Execute “**npm run serve**” to run the application.
* Open web browser and navigate to <http://localhost:8080/> to view.

**How to run backend NodeJs app**

* Copy project file to a location and open terminal / command prompt in inside root folder.
* Run “**npm install**” to install all modules needed
* Execute “**node server**” to run the application.
* Open web browser and navigate to <http://localhost:5000/api/getusers> to see all users from mongo DB cloud

## Appendix D: Hardware, Software, Cloud, Architecture

**Hardware**

* **Computers**: The GreenPath application development is carried out on **Microsoft Surface 4 Pro** laptop and **Acer Aspire Z 24** – All in one PC, which provide adequate processing power, portability, and compatibility with the necessary development tools for a seamless development experience.

**Software**

* **Code Editor**: **Visual Studio Code** is used as the primary development environment, chosen for its extensive library of extensions, flexibility, and support for JavaScript and Vue.js.
* **Version Control & Repository Management**: **Git** is used for version control, while **GitHub** serves as the cloud-based repository management system, allowing collaboration, version tracking, and backup.

**Application Architecture and Technology Stack**

* **Platform**: GreenPath is a **web-based application**, designed to run on major browsers to provide users with easy access across devices without requiring an app installation.
* **Programming Language**: **JavaScript** is the core programming language, allowing for an integrated codebase across both the front-end and back-end, streamlining development and maintenance.
* **Front-End Framework**: The front end is built using **Vue.js**, selected for its flexibility, lightweight footprint, and reactive capabilities, which enable efficient user interface rendering and enhanced interactivity.
* **Back-End Framework**: **Node.js** powers the back-end, providing a non-blocking, event-driven framework that suits real-time applications and pairs well with MongoDB for high-performance data handling.
* **Database**: GreenPath utilizes **MongoDB (Atlas Cloud MongoDB)** for data storage. MongoDB’s NoSQL structure offers scalability and flexibility, which are essential for managing complex sustainability data, like carbon footprint, water usage, and waste tracking.

**Cloud and Data Storage**

* **Database Cloud**: **MongoDB Atlas** provides a managed, secure cloud database environment. This cloud-hosted MongoDB deployment ensures data accessibility, security, and backup capabilities, optimizing performance and reducing operational burdens.

## References

1. **Allcott, H., & Rogers, T.** (2014). *The Short-Run and Long-Run Effects of Behavioural Interventions: Experimental Evidence from Energy Conservation*. American Economic Review, 104(10), 3003-3037.
2. **Abrahamse, W., Steg, L., Vlek, C., & Rothengatter, T.** (2005). *A review of intervention studies aimed at household energy conservation*. Journal of Environmental Psychology, 25(3), 273-291.
3. **Hamari, J., Koivisto, J., & Sarsa, H.** (2014). *Does Gamification Work? A Literature Review of Empirical Studies on Gamification*. 2014 47th Hawaii International Conference on System Sciences, 3025-3034.
4. **Bootstrap**. "Bootstrap." Accessed from <https://getbootstrap.com/>. Bootstrap is a widely-used open-source front-end toolkit for building responsive web applications, providing CSS and JavaScript components.
5. **ApexCharts**. "ApexCharts." Accessed from <https://apexcharts.com/>. ApexCharts is a library for creating interactive charts and visualizations, which helps to enhance data representation in web applications.
6. **Wint AI**. “Carbon Impact of Water Consumption.” White paper. Accessed from <https://wint.ai/wp-content/uploads/2022/02/White-paper-Carbon-Impact-of-Water-Consumption-Final.pdf>. This paper examines the environmental impact of water usage on carbon emissions, providing essential data for sustainability analysis.
7. **U.S. Environmental Protection Agency (EPA)**. "Greenhouse Gas Equivalencies Calculator." Accessed from <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>. This calculator offers conversions for common activities into equivalent CO₂ emissions, useful for evaluating and reducing carbon footprints.
8. **ENERGY STAR**. "Building Emissions Calculator: Technical Reference." Accessed from <https://www.energystar.gov/buildings/tools-and-resources/building-emissions-calculator-technical-reference>. This document provides methodology and data tables to estimate emissions for various building activities, adaptable for personal or household-level emission estimates.
9. **Britannica**. "Carbon Footprint." Accessed from <https://www.britannica.com/science/carbon-footprint>. This entry provides an overview of carbon footprints, their measurement, and factors influencing individual and organizational carbon emissions.