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A MOBILE-BASED MODEL FOR PROMOTING SUSTAINABLE LIFESTYLE CHOICES THROUGH DIGITAL AND ENVIRONMENTAL LITERACY

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Abstract
Over the years, human activities have significantly increased the concentration of greenhouse gases in the atmosphere, leading to climate change which has become one of the greatest global health threats. Addressing this challenge requires individuals to adopt sustainable lifestyle practices. This paper presents a mobile based model designed to promote sustainable lifestyle choices by integrating digital and environmental literacy. The model features interactive learning modules, feedback mechanism and carbon footprint calculator to raise awareness on environmentally harmful behaviours and guide users towards sustainable alternatives. The calculator estimates carbon emissions from daily activities and provides recommendations on positive behavioural changes in arears such as transportation, waste management, energy consumption and diet. By integrating digital literacy and environmental education, the model empowers individuals to make informed choices that reduce their personal carbon footprints, thereby contributing to climate change mitigation, environmental protection and improved public health.
Keywords: *Greenhouse Gas, Climate Change, Environmental Education, Digital Literacy, Sustainable Lifestyle, Mobile-Based Model*

Introduction

Anthropogenic activities have been identified as major drivers of escalating environmental degradation and climate change over the years (Bhagarathi & DaSilva, 2024). According to Nogueira et al. (2022), the World Health Organization (WHO) has declared climate change a public health emergency, describing it as one of the greatest global health threats. This underscores the need for behavioural change in human activities, as sustainable lifestyles are essential for safeguarding both environmental and human well-being. Reports indicate that activities such as fossil fuel combustion, deforestation, and industrial processes increase the emission of greenhouse gases and aerosols, which result in environmental degradation and significantly affect public health outcomes worldwide (Evseeva et al., 202; Rahmani & Ahmadi, 2024; Raghavendra, 2024). WHO projects that between 2030 and 2050, climate change will cause approximately 250,000 additional deaths annually (World Health Organization, 2023). This projection is worrisome and emphasizes urgent need for sustainable mitigation strategies, particularly the adoption of sustainable lifestyle choices in areas such as waste management, energy consumption, diet, and transportation, in order to secure planetary and human health.

Environmental sustainability awareness is crucial in achieving the required behavioural change. However, traditional approaches to promoting sustainable lifestyle awareness often rely on physical meetings and community engagements and these usually fail to deliver deep personalized outcomes, hence, the need to leverage digital platforms. The innovation of mobile technologies bridges the gap in delivering interactive, scalable and deep personalized interventions. The results of an experimental intervention by Batcup et al. (2023) suggest that digital feedback systems play a pivotal role in increasing awareness of emission consequences of daily activities. A systematic review by Haji-Hassan et al. (2024) found that digital solutions such as virtual reality and learning platforms promote better sustainability awareness.

Mobile apps, which act as a key enabler of environmental education play a significant role in combating climate change and environmental degradation by integrating educational content with interactive features and motivational strategies (Cipi et al., 2025). Digital solutions allow people to effortlessly access, evaluate, and act upon environmental information more effectively (Istifa & Ali, 2025). However, despite the advances in combating climate change and efforts to protect public health through digital solutions, a holistic system that combines digital literacy, environmental education, interactive learning, timely feedback and a carbon footprint calculator within a mobile platform tailored for behavioural change remains underexplored. Existing research tends to focus on singular intervention such as carbon tracking app (Sulistyo et al., 2024), digital media for children or isolated app usage and rarely integrates broader literacy perspective that empowers individuals to make informed choices to reduce their personal carbon footprints.

This study seeks to fill this critical gap by introducing a mobile based model that integrates digital literacy and environmental awareness to promote sustainable lifestyle choices through interactive learning modules, real-time feedback and carbon footprint tracking, thereby supporting transformative behavioural changes and fostering environmental sustainability and overall human health.

Review of Related Works

The adoption of sustainable lifestyle choices is achievable when individuals have access to relevant information that guides them toward alternative practices. There is an increasing evidence that technology, particularly mobile-based personalized learning has a positive impact in environmental education (Sebastián-López & de Miguel, 2020). This review evaluates existing literature on the use of mobile-based intervention for promoting sustainable lifestyle choices.

Medeiros et al. (2024) proposed a mobile application that promotes sustainable lifestyle choices through gamification and an interactive map of eco-friendly options. The study focuses on recycling as a measure for waste management, and incorporated data on geographical location using map to direct users to designated locations where waste could be deposited for recycling. The work of Hynes and Fahy (2024) highlights the need for effective design and deployment of mobile apps as tools for promoting sustainable lifestyle changes. The study identifies barriers like market overcrowding and user attrition in delivering environmental awareness, and further underscores the importance of relevance and functionality in mobile app development. Yang et al. (2024) evaluates a socioecological model-guided, smart device-based intervention (3LIFE) that aims to promote sustainable lifestyle choices among Chinese community residents. The proposal focuses on reducing unhealthy behaviours through a multi-level empowerment approach and self-management strategies over a 6-month period.

Mehellou et al. (2023) proposed an approach to design a mobile application for sustainable behaviours based on SHIFT framework, aiming to shift users' unsustainable practices to sustainable ones. The app features ethical concerns and persuasive messages to help users adopt sustainable lifestyle. The work of Triantafydiou & Zabaniotou (2022) aims to promote sustainability through a digital application called "Go sustainable living". The app allows users to upload their green activity, earn points, and redeem them for discounts at local stores, thereby incentivizing environmentally friendly behaviour through gamification and community engagement.

Delivering environmental education through mobile platforms has been identified to foster sustainability awareness and lifestyle changes, but deeper integration of literacies, particularly awareness of carbon footprint which is the total amount of greenhouse gases emitted directly and indirectly by individuals from their actions is still nascent. Hence, this study intends to holistically integrate a broader perspective of digital and environmental literacy to guides users toward sustainable lifestyle practices, while also providing tools for calculating, monitoring and reducing their carbon footprint to enhance overall well-being.

Materials And Methods

Methodology

The methodology adopted for the proposed system is Objected-Oriented Hyper-Media Design Methodology (OOHDM). It uses a model-based approach that combines object-oriented modeling with hypermedia design principles to help software designers create interactive applications that are well-structured, maintainable, and user-friendly. OOHDM is structured into four main phases:

i. Conceptual Design: This involves modeling the system’s underlying domain using an object-oriented model to define classes, relationships and attributes.
ii. Navigational Design: This phase defines navigational views, modeling how users will move through the application’s content.
iii. Abstract Interface Design: The user interface objects are defined at this stage. Structure of pages and how users interact with them are also defined.
iv. Implementation: The final step that maps the abstract interface and navigation design to a target environment.

the sustainability lifestyle model

The proposed model focuses on empowering users to live a sustainable lifestyle through the delivery of personalized learning contents via mobile platform, integrating digital literacy and environmental awareness, while allowing users to leverage carbon footprint tracking tool to calculate the amount of carbon emitted through their daily actions. The model performs carbon computation by prompting users to respond to questions in the areas of energy usage, dietary habits, daily transportation and waste management. Feedback on course progress and recommendations based on the result of the carbon footprint are also provided to the user, by this, the user gets informed of best alternative lifestyle practices and recommendations on how to sustain a healthy living. The data flow diagram of the model is depicted in Figure 1.

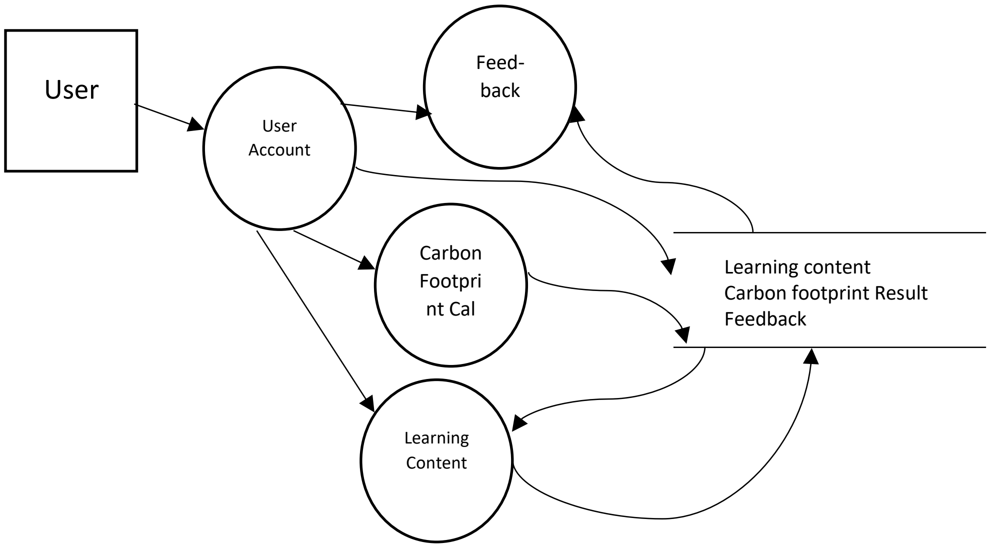

Figure 1. Data Flow Diagram of the Proposed Model

The data flow diagram clearly depicts the flow of data in the proposed model, the user creates an account before accessing the learning content, upon successfully creating an account, access is granted to all the features of the system including selection of content to learn, computation of carbon footprint and access to feedbacks and recommendation.

A class diagram was leveraged to represent the proposed model. The class diagram shows the structure of the model, the behaviour of objects of the class and how the classes interact to support digital literacy, environmental literacy, lifestyle tracking and sustainability monitoring. The model comprises:

- The User class
- Learning module class
- Carbon footprint calculation class
- Feedback and progress class

There are also two sub-classes of the learning module class. The class diagram presented in Figure 2 shows the user class contains the username and email address attributes, and the create account method. The learning module class consists of course title and course description attributes, and the course selection method. Digital Literacy and Environmental education are subclasses that inherited the course title and course description attributes of the learning module superclass. The feedback and progress class contain the username and course progress attributes, and the recommendation method. The carbon footprint calculator class comprises a number of attributes with the calculate method.

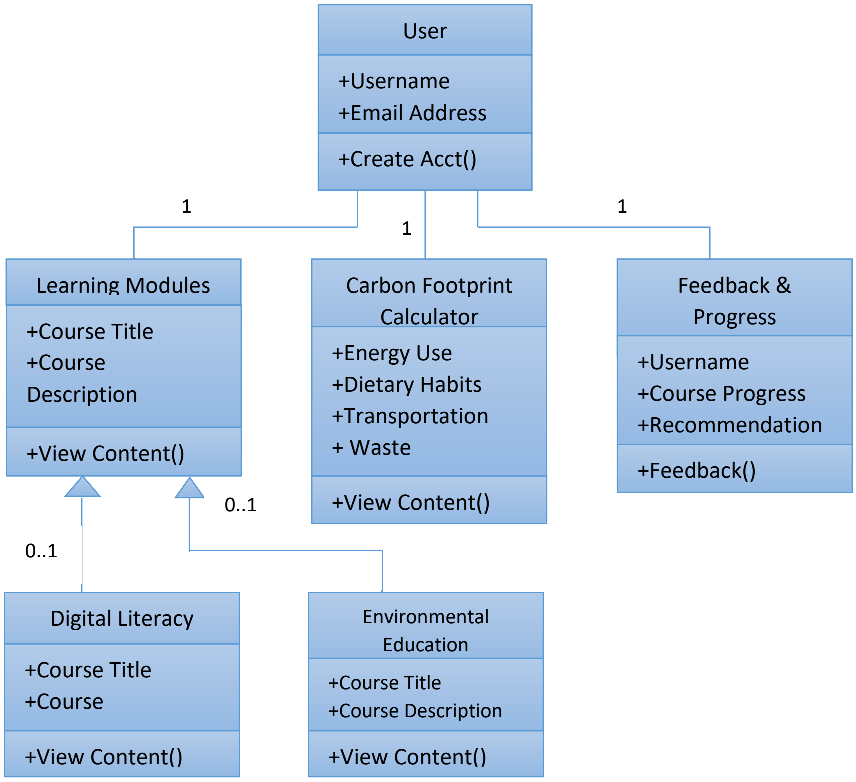

Figure 2. Class diagram of the proposed model

Considering the class diagram, the user creates account by providing a username and email address to enable the App to deliver a personalized content. Research has it that addressing learners by name enhances comprehension and user experience. The user proceeds to make selection from a list of features provided by the model; Learning contents, carbon footprint calculator can be selected depending on interest, the user can as well access feedback and recommendation. All these components are provided to promote sustainable lifestyle choices for the user. To illustrate the various functionalities of the model, the Use case diagram as presented in Figure 3 was used to depict the various functions of the system. The use case model also shows the different events initiated by the user.

JUSTIFICATION OF THE PROPOSED MOBILE-BASED MODEL FOR SUSTAINABLE LIFESTYLE

1. Existing environmental learning contents often provide knowledge without action pathway, but this model fills that gap by synthesizing education modules with tools for tracking and reducing carbon footprint.
2. Many people lack access to practical tools that connect their daily lifestyle choices to sustainability outcomes, this model seeks to promote the accessibility of such tools to individuals.
3. Given the challenge of climate change and its associated health risk, there is need for an individual level sustainable behavioural change to mitigate the effects.
4. Research indicates that feedback loops strongly influence sustainable habits, hence, the model integrates visual progress, tailored tips and recommendations to promote sustainable habits.
5. The model contributes to Sustainable Development Goals by directly supporting SDG 3, 4, 12 and 13 which focus on good health and wellness, quality education, responsible

consumption and production, and climate action as measures to combat changing climate and its devastating impacts.

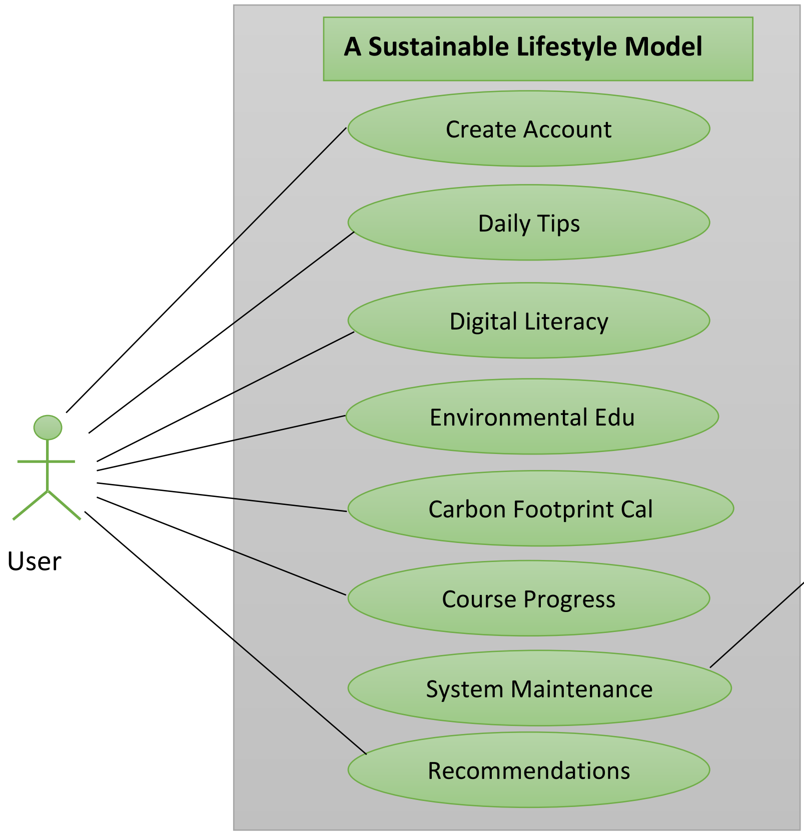

Figure 3. Use case diagram of the proposed model

High Level Model (HLM) of the Proposed System

The HLM of the proposed system represented in Figure 4, presents the primary system components and subsystems, showing how the system is modularized to enhance manageability.

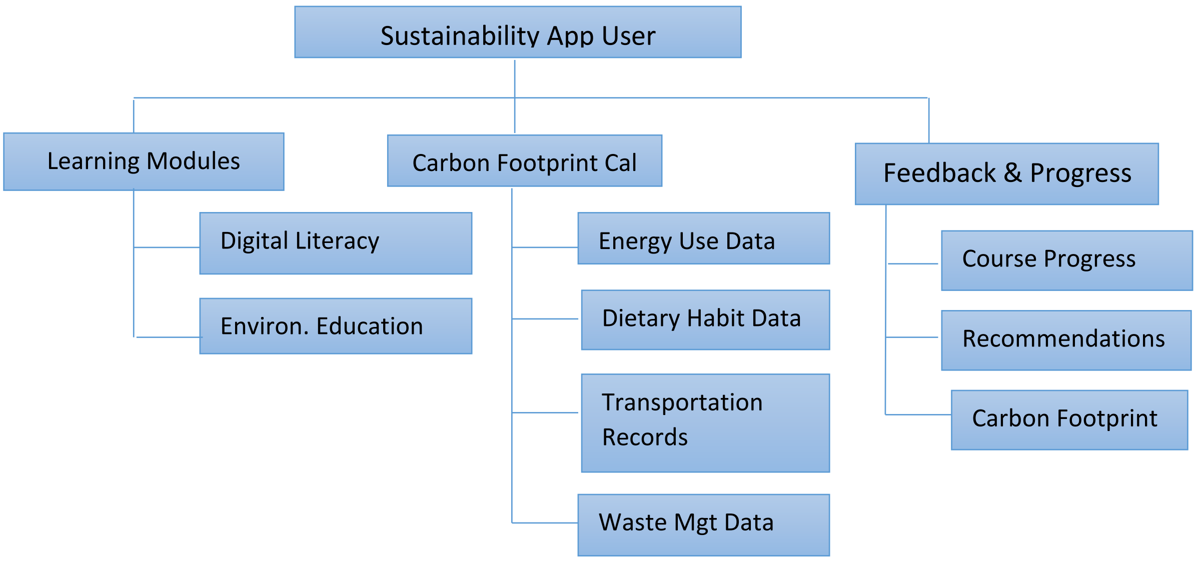

Figure 4. High Level Model of the Proposed System

Design of the Proposed Model

The proposed model seeks to promote sustainable lifestyle choices through the integration of digital and environmental literacy. The model also provides the user with carbon footprint tracking tool, while delivering health tips and recommendations on how to live and sustain a healthy lifestyle. The HLM in Figure 4, depicts the various components of the system, including the primary components and the subsystems that evolved from the main menu. The system design further defines the components and the interfaces of the proposed model.

The Main Menu

The main menu of the proposed sustainability lifestyle app describes the main actor of the system, which is the user. It involves creation of an account to enable the system identify users by name. This helps to keep record of progress and carbon footprints of every user. The user upon successful login is granted access to the dashboard and identified by name. The user is presented with options to delve into the learning modules, calculate carbon footprint or navigate to feedback and progress. The user is also provided with daily tips on sustainable living.

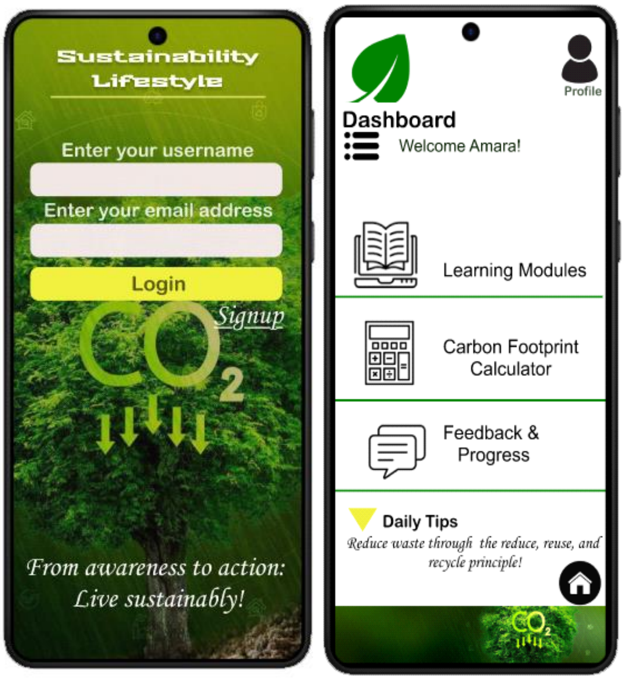

Figure 5. User Login Interface

Learning Module Component

The learning module component allows a user to access course contents which comprise of digital and environmental courses. The digital literacy component encompasses awareness of environmental tracking apps, smart home devices, environmental sensors, and wearable and health technology. It educates the user on how these technologies can help to promote sustainable living.

The Environmental education component of the learning module further exposes the user to knowledge of energy efficiency, waste management, sustainable transportation systems and Nutrition. It teaches the user the importance of environmental awareness in the journey of sustainable lifestyle. The Learning modules also incorporate activities to assess users' level of comprehension as they advance through the courses, making it interactive and engaging.

Figure 6. Learning Modules Interface

Carbon Footprint Calculator Component

The carbon footprint calculator component of the system is a tool made available to the user for estimation of the amount of greenhouse gas emitted through the user's daily activities. The calculator is sectionalized into four categories, prompting users to provide information on their energy usage, transportation choices, diet and waste management. The tool performs calculation by finding the emission factor for each activity of the user, then goes ahead to multiply the activity data by the emission factors and sums the total GHG emissions calculated for each activity to get the user's overall carbon footprint. The result is expressed in tonnes of carbon dioxide equivalent.

Figure 7. Carbon footprint calculator

The Feedback and Progress Component

The Feedback and progress component of the system provides information on the user's course progression, visualizes the result of the carbon footprints and further makes recommendation based on the result.

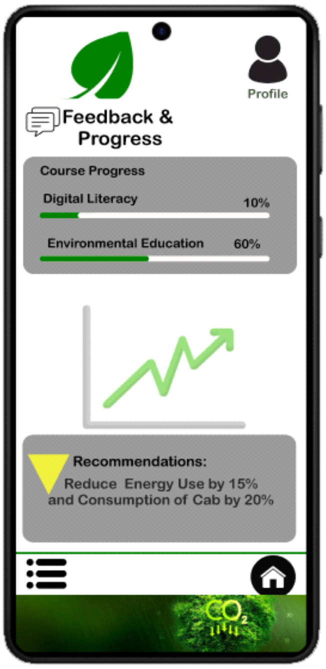

Figure 8. Feedback and Progress interface

The Database Component

The proposed model leverages SQLite to store users' information. It is an embedded relational database system that works well with React Native, which is the framework used for implementation. SQLite is used for local storage in application software, especially in mobile apps. Records of users' carbon footprint, activity log and recommendations are stored in the database.

Algorithm of Carbon Footprint Calculator Component

While Sustainability_Lifestyle_App is Active
PRINT 'Enter Username'
PRINT 'Enter Email_Address'
IF Username ='Username' and Email_Address = 'Email_Address' THEN
PRINT 'Welcome' & ' ' & Username
PRINT '1. Learning Modules'
PRINT '2. Carbon Footprint'
PRINT '3. Feedback and Progress'
If Option = '2' THEN
PRINT ' 1. Energy Consumption'
PRINT ' 2. Dietary Habits'
PRINT ' 3. Transportation'
PRINT ' 4. Waste Management'
IF Option = '1' THEN
PRINT ' Enter Energy Consumption Activities'
IF Option = '2' THEN

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PRINT ‘ Enter Diet Types’
IF Option = ‘3’ THEN
PRINT ‘ Enter Transportation Activities’
IF Option = ‘4’ THEN
PRINT ‘ Enter Waste Management Activities’
Energy_Emission = Electricity_kwh * Electricity_Factor
Diet_Emission = Diet_Factor/365
Transportation_Emission = Tranport_km * Car_Factor
Waste_Emission =Waste_kg * Waste_Factor
Total_Daily_Emission = Energy_Emission + Diet_Emission + Transportation_Emission +
Waste_Emission
PRINT ‘Total Daily Emission = ’ & Total_Daily_Emission
End.
```

Results and Discussion

The proposed mobile-based model for promoting sustainable lifestyles resulted in the development of a mobile application that integrates digital and environmental literacy on a single platform. The application provides tools for carbon footprint computation, empowers users to make healthy lifestyle choices, and offers recommendations on practical steps for sustainable living. The model was evaluated against related applications based on the quality of digital and environmental literacy content, as well as the speed and accuracy of the carbon footprint calculator. Functional testing (also known as black-box testing) and structural testing (also referred to as white-box testing) were employed to evaluate the performance of the system. Functional testing focused on verifying whether the system performed the intended functions, while structural testing examined the internal components of the system, ensuring that the actual computational results matched the expected outcomes. In addition, the speed and accuracy of the carbon footprint calculator were evaluated against comparable carbon tracking applications. The results indicated that the proposed system outperformed existing alternatives in most instances. The test results on speed and accuracy, recorded from 10 users across different sessions, are presented in Figure 9.

Table 1. Test Result of accuracy and speed of carbon footprint component

User	1	2	3	4	5	6	7	8	9	10
Speed (Seconds)	1.82	1.66	1.47	1.55	1.7	2.16	1.32	2.03	1.77	1.36
Accuracy (%)	97.77	98.78	93.93	98.29	94.61	92.55	94.17	96.57	94.81	95.36

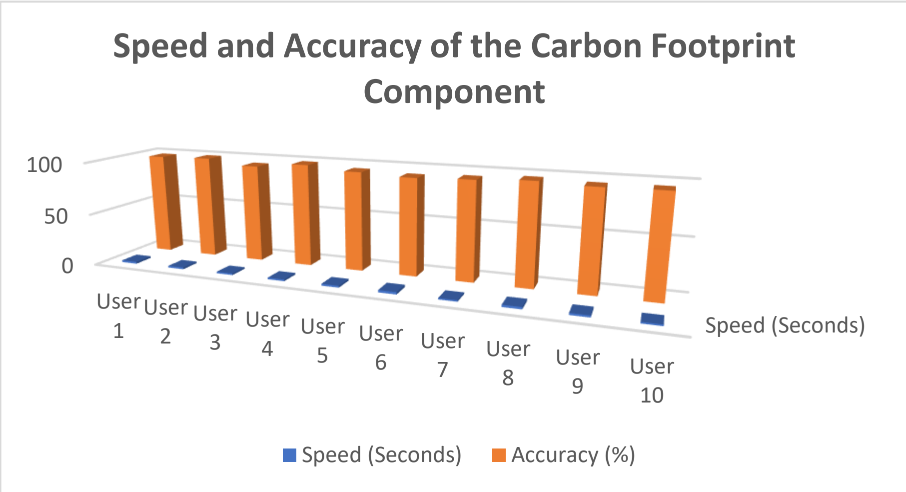

Figure 10. Column Chart depicting the test result of speed and accuracy of the carbon footprint component of the proposed model

The test results, as depicted in Figure 10, demonstrate both the accuracy and speed of the system. The carbon footprint calculator achieved accuracy levels above 90%, while the speed results show that the system computed the carbon footprint almost instantly.

Conclusion

The proposed mobile-based model for promoting sustainable lifestyle choices aligns with the United Nations' advocacy for a global coalition towards carbon neutrality. It also supports the net-zero objective of the Paris Agreement, which seeks to limit the rise in global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to restrict it to 1.5°C by 2050 (Khaffaf et al., 2024). By encouraging individuals to adopt actions that lower their daily carbon emissions, the model underscores the importance of collective efforts in fostering sustainable living and achieving a climate-resilient future. The integration of Digital and Environmental Literacy offers practical steps for raising awareness, arms users with carbon footprint tracking tool, thereby encouraging behaviour change towards sustainability. Furthermore, the system has the potential for future enhancements, including integration with real-time data sources to further support environmental consciousness and reduce carbon emissions at scale.

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