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Introduction

The rise in global temperatures and the intensifying effects of climate change have made it essential for individuals to take actionable steps toward sustainability. Household waste, a significant contributor to carbon emissions, often goes overlooked in the larger conversation about environmental responsibility. Recognizing this gap, *'Carbon Wise'* was developed as a mobile application designed to help users measure and manage their carbon footprint from household waste.

This app is grounded in the scientific principle of carbon footprint calculation. Each type of waste material, whether plastic, paper or organic, has an associated carbon emission factor, an established metric indicating its greenhouse gas emissions. By integrating these factors into an accessible platform, *which* offers a practical, data-driven approach to raising awareness and promoting sustainable behaviours.

Building the Project

Mobile Application (Carbon Wise)

The 'Carbon Wise' mobile application was developed using the Sketchware platform, a mobile app-building tool that integrates user interfaces, databases, and logic systems. The app's core components include:

User Interface – Simple and intuitive, guiding users through the waste tracking process.

Database – A repository of emission factors for different waste types.

Calculation Module – Computes real-time carbon emissions based on user input.

Feedback System – AI-generated suggestions to help users reduce their carbon footprint.

Arduino-Based Automated Emission Calculator

To improve accessibility and accuracy, an Arduino-based system was developed. This embedded system allows users to measure waste weight and calculate emissions without needing a manual weighing scale. Key components include:

HX711 Load Cell Sensor – Precisely measures the weight of waste.

Physical Buttons – Used to navigate waste categories (plastic, paper, glass, etc.).

Carbon Emission Factor Integration – Multiplies the weight by predefined emission factors to determine CO_2 emissions.

16x2 LCD Display – Shows real-time weight updates, waste category selection, and final emissions.

Standalone Operation – Works offline, making it accessible to all users.

How the System Works

Carbon Wise Mobile App

The app operates in three main stages:

1. Home Screen
   - Displays the last calculated carbon emissions in a pie chart format.
   - A prominent “Calculate My Footprint” button invites users to start a new calculation.
2. Input Screen
   - Users select waste categories (plastic, paper, food waste, etc.).
   - They enter the quantity of each waste type in kilograms.
   - Clicking “Add to List” saves the data.
   - Once all inputs are entered, users click “Calculate” to see results.
3. Results Screen
   - A summary of total carbon emissions is displayed with a pie chart visualization.
   - AI-generated feedback messages provide motivation and actionable advice.

Arduino-Based Automated System

This system eliminates the need for manual input by automating the waste measurement process:

1. Users place waste on the load cell sensor.
2. Then the user navigate waste categories using physical buttons.
3. The system automatically calculates emissions using:

$$TE = (Weight \times Emission\ Factor)$$

4. Results are displayed on the LCD screen, with scrolling text for longer messages.

Example Calculation (Both Mobile & Arduino Systems):

If a user inputs the following details:
Plastic: 5kg with an emission factor of 6$kg\ CO2/kg$
Paper: 10kg with an emission factor of 1.2$kg\ CO2/kg$
Food Waste: 8kg with an emission factor of 1.9$kg\ CO2/kg$
The total emission is calculated as:

$$TE = (5 \times 6) + (10 \times 1.2) + (8 \times 1.9)$$

$$TE = 30 + 20 + 12 = 57.2kg\ CO2\text{e}$$

Why Carbon Wise Matters

The app's benefits extend beyond calculation:

- **Education and Awareness**: It helps users understand how their daily habits contribute to environmental challenges.
- **Empowerment**: Users are equipped to take meaningful steps to reduce their carbon footprint.
- **Informed Decision-Making**: Data-driven insights guide better waste management practices.
- **Sustainability Impact**: By fostering eco-conscious habits, the app supports a larger movement toward reducing greenhouse gas emissions.

Applications

- **Households**: Encourages families to track and reduce their waste emissions collectively.
- **Educational Institutions**: Serves as a tool for teaching students about sustainability and waste management.
- **Community Programs**: Promotes awareness campaigns on environmental conservation.

Future Enhancements

The current version of ‘*‘Carbon Wise”* is only the beginning. Future updates could make the app even more impactful, with features such as:

- Mobile-Connected Arduino System: The current Arduino-based system calculates emissions based on waste weight but lacks AI-powered feedback. A future update could integrate it with the mobile app using
- Bluetooth or Wi-Fi, allowing users to receive real-time AI-driven suggestions and insights directly on their phones. This would bridge the gap between physical waste measurement and intelligent digital analysis.
- Expanded Waste Database: The app and Arduino system could incorporate more waste categories and refined emission factors based on the latest environmental research, improving accuracy in carbon footprint calculations.
- Recycling Guidance: The app could connect users with local recycling services and suggest proper disposal methods, making it easier to adopt eco-friendly habits.
- User Motivation & Engagement: To encourage sustainable practices, the app could introduce personalized challenges, progress tracking, and reward systems, making waste reduction more interactive and engaging.

Impact on Sustainability

By providing an easy-to-use tool for understanding and managing waste emissions, *‘Carbon Wise’* contributes to a cleaner, healthier planet. The app not only promotes sustainable behaviours but also fosters a culture of environmental responsibility. Small changes made by individuals today can lead to significant collective impact tomorrow, and *‘Carbon Wise’* is a step in that direction.

Conclusion

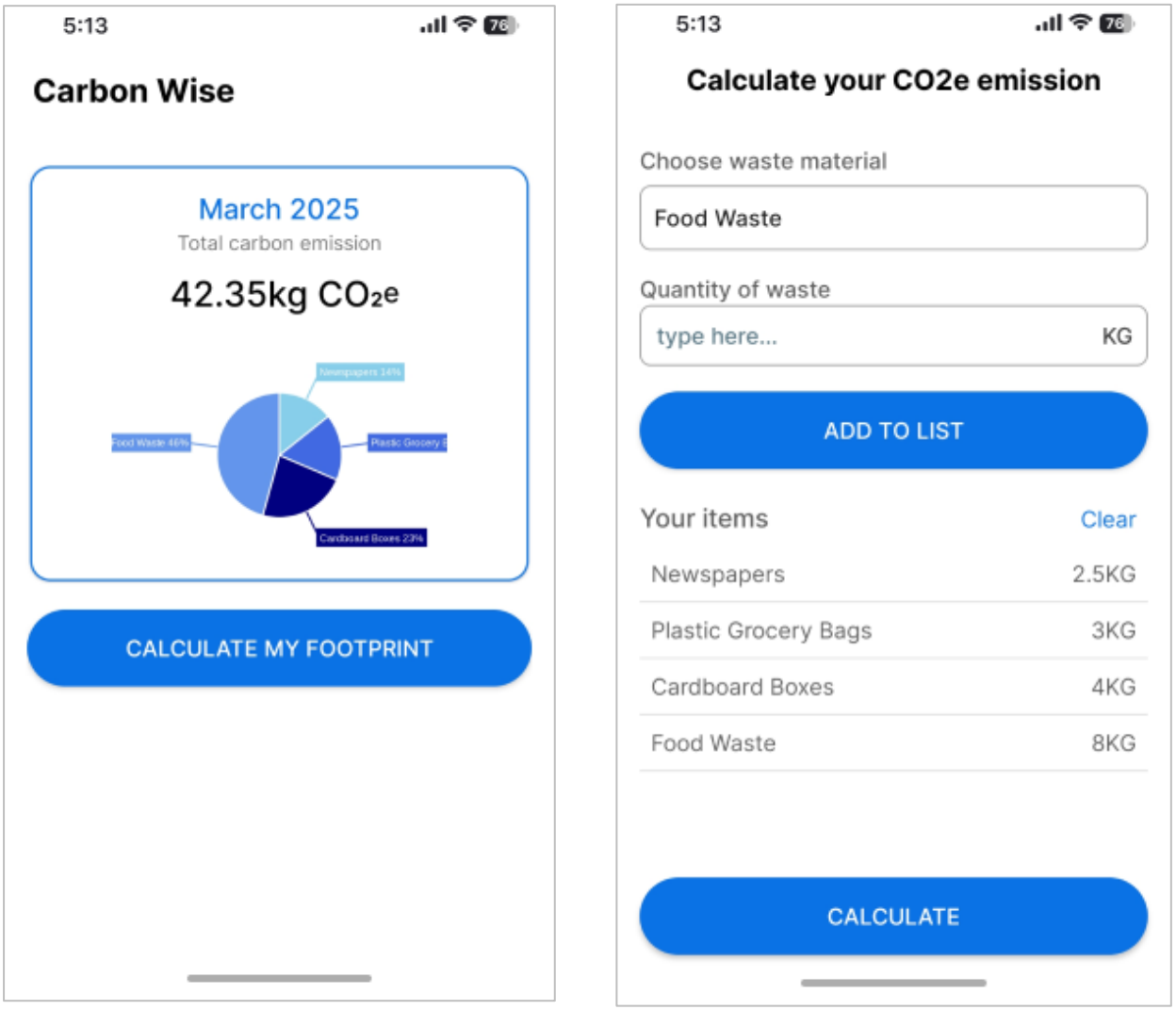
The "Carbon Wise" project provides an efficient way to track and reduce household carbon emissions. By integrating an AI-powered app for insights and an Arduino-based system for real-time waste measurement, it ensures accurate calculations and informed decision-making. Future enhancements, such as connecting the Arduino system to the app for AI-driven feedback, will further improve accessibility and effectiveness. This project encourages sustainable habits, making it easier for individuals to contribute to a healthier environment.

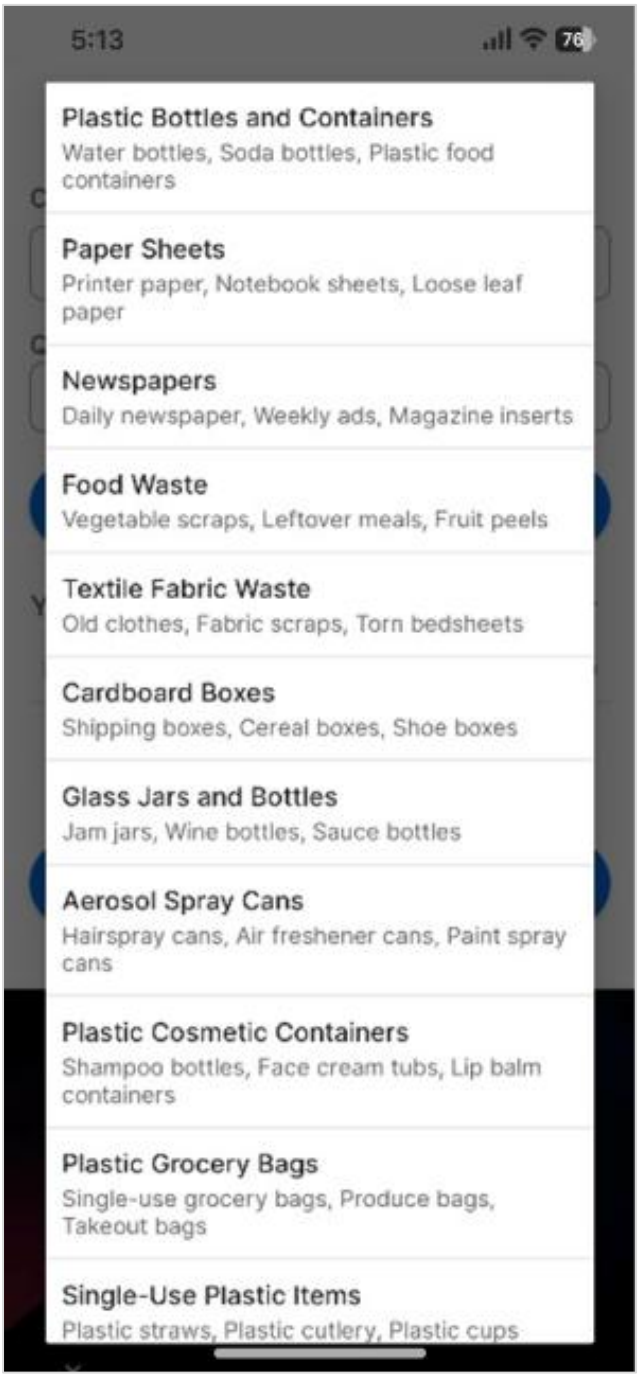
References

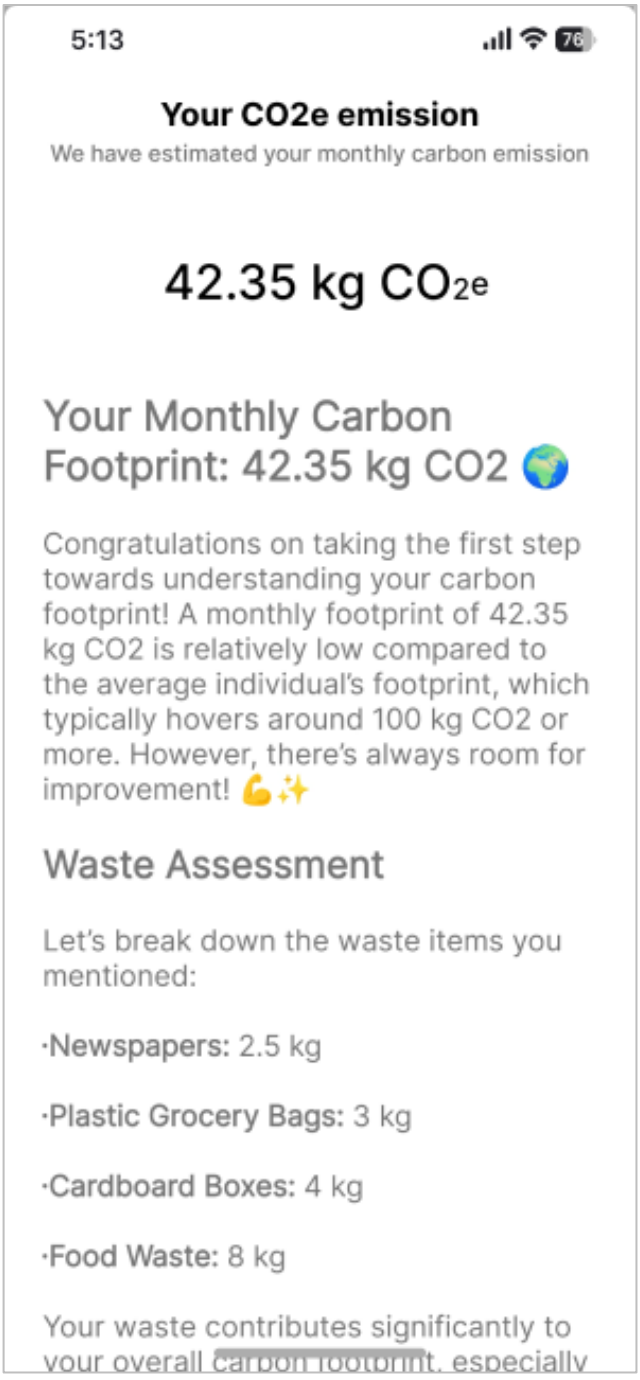
1. Central Pollution Control Board (CPCB): https://cpcb.nic.in
2. Articles from Journal of Environmental Management – Research on waste and carbon footprint calculations.
3. Wikipedia.org

Illustrations

Fig. 1: Schematic Workflow of the Carbon Wise App




5:13
Plastic Bottles and Containers
Water bottles, Soda bottles, Plastic food containers
Paper Sheets
Printer paper, Notebook sheets, Loose leaf paper
Newspapers
Daily newspaper, Weekly ads, Magazine inserts
Food Waste
Vegetable scraps, Leftover meals, Fruit peels
Textile Fabric Waste
Old clothes, Fabric scraps, Torn bedsheets
Cardboard Boxes
Shipping boxes, Cereal boxes, Shoe boxes
Glass Jars and Bottles
Jam jars, Wine bottles, Sauce bottles
Aerosol Spray Cans
Hairspray cans, Air freshener cans, Paint spray cans
Plastic Cosmetic Containers
Shampoo bottles, Face cream tubs, Lip balm containers
Plastic Grocery Bags
Single-use grocery bags, Produce bags, Takeout bags
Single-Use Plastic Items
Plastic straws, Plastic cutlery, Plastic cups


5:13
Your CO2e emission
We have estimated your monthly carbon emission
42.35 kg CO2e
Your Monthly Carbon Footprint: 42.35 kg CO2 🌍
Congratulations on taking the first step towards understanding your carbon footprint! A monthly footprint of 42.35 kg CO2 is relatively low compared to the average individual's footprint, which typically hovers around 100 kg CO2 or more. However, there's always room for improvement! 💪✨
Waste Assessment
Let's break down the waste items you mentioned:
·Newspapers: 2.5 kg
·Plastic Grocery Bags: 3 kg
·Cardboard Boxes: 4 kg
·Food Waste: 8 kg
Your waste contributes significantly to