NPS2001B

Matrix Unplugged: Using Computer for Real-World Problems

AY2023/24 Semester 1

Group Milestone 1: The Carbon Converter Application

| Name	Matriculation Number
Carina Teh	A0257530H
Caspar de Jong	A0276802B
Donna Sneha Choy	A0254505J
Lee Xin Yi	A0259267N

The Problem
Carbon emissions are a primary cause for climate change. With global temperatures rising rapidly, alongside the consequences that come with it, collective responsibility is required to solve this global issue. Transportation contributes to approximately 19.2% of global carbon emissions (Abraham et al., 2012). Especially in developed countries where vehicle ownership and extensive travelling becomes more accessible, more needs to be done to slow down the rate of emissions produced. Failure to do so will result in social, economic, and environmental degradation (Pal et al., 2023).

The Solution
The Carbon Converter application aims to reduce carbon footprint derived from transportation use through incentivising environmentally conscious travelling methods. This includes walking, cycling, or taking public transportation. This app uses a range of algorithms to function.

Firstly, the app tracks daily travel routes of users by frequently storing and uploading the users' GPS data, travel speed and duration. Users will also select their mode of transportation used for accuracy of data collected. The algorithm will then run the input data through a set of pre-determined mathematical formulae to give an output amount of carbon emissions for the journey.
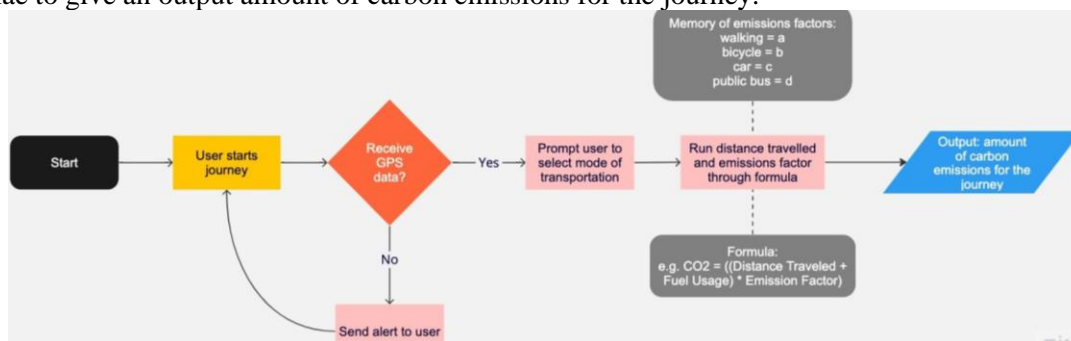

Simply, this algorithm requires the following data: (a) relevant emission factors for each mode of transportation, (b) the formula for scope 1 (direct) travel emissions. These data can be found online in carbon calculator developer websites such as IBM.

Next, users will receive a weekly summary and update on their carbon emissions produced and the corresponding points gained.
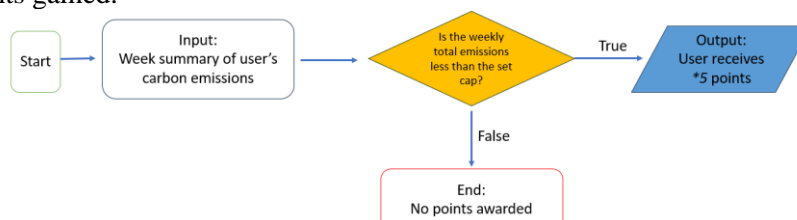
To increase users' motivation through the concept of positive reinforcement, users would be able to redeem vouchers (e.g. meal vouchers) based on the number of points collected. The greater the points gained, the higher the value of the vouchers they can redeem.
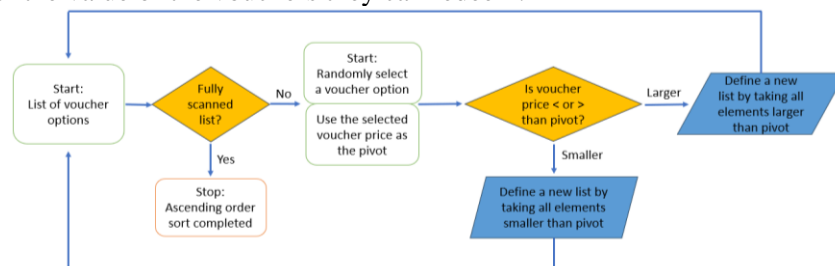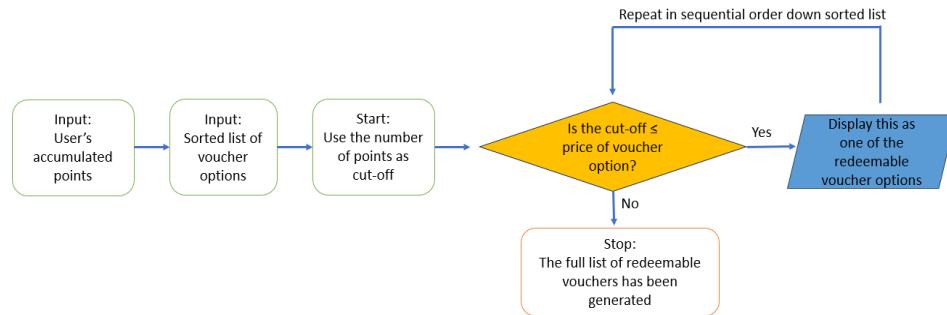
Next, to emphasise on collective effort in social change, there would be a social feature, which allows users to team up with their friends to complete challenges on the app or even track their progress on leaderboards. This is a common feature among popular fitness apps, such as Strava and Fitbit. Through algorithms that analyse the users' social graphs and collaborative filtering, the social feature in these apps can steadily incentivise users to stick to their goals. As they solve challenges which encourage reducing carbon footprint, they win points as a group. The competitive element of the leaderboard would act as a further incentive and additional element of fun.

Eventually, through analysis of collected data, the app will recommend users with time efficient travel routes and modes of transportation that focus on reducing carbon emissions (similar to Google Maps).

Demographics & Use Cases:
Our app targets a broad audience, designed for all ages and tech-savviness levels. While the carbon tracking function alone might primarily interest environmentally conscious individuals, the reward scheme and incentivisation makes this app attractive to all. This app is intended to be used when travelling, both in the foreground and the background. The foreground is for suggesting sustainable travel routes, displaying data of you and your friends, and converting points into vouchers. In the background, the app collects data when the user is travelling.

Potential Issues:
Some issues with the user experience of our app include (a) accuracy of location and carbon emission tracking, (b) privacy concerns and (c) excessive battery consumption. GPS is susceptible to error in data as slight inaccuracies in user's signal reception, or disturbance to the signal, can translate to a significant dislocation of the device's reported position (Meg, 2023). When inaccurate location data is put through the app's algorithms, users may be short changed or overcompensated with points. Secondly, users may feel discomfort and not consent to full disclosure of their location whenever they travel, posing a challenge to the data collection and accuracy. Lastly, the constant location tracking function may cause phone battery drainage (SMARTY, 2022)

References:
Abraham, S., Ganesh, K., Kumar, A. S., & Ducqd, Y. (2012). Impact on climate change due to transportation sector–research prospective. *Procedia engineering*, *38*, 3869-3879.

Meg. (2023, February 16). *Bad GPS Data*. Strava Support. https://support.strava.com/hc/en-us/articles/216917707-Bad-GPS-Data

Preeti, P., Gopal, P.R.C., Ramkumar, M. (2023) Impact of transportation on climate change: An ecological modernization theoretical perspective, Transport Policy, 130, 167-183.
https://doi.org/10.1016/j.tranpol.2022.11.008.

SMARTY. (2022, October 11). *Does having Location Services turned on drain battery iPhone?* https://smarty.co.uk/blog/location-services-drain-battery-iphone