NPS2001D Milestone 1

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Our Problem Statement

Our project aims to address, in part, the environmental impact of transportation choices Singaporeans take on a daily basis. Today, the decisions we as modern citizens make regarding our mode of travel significantly contribute to climate change (Fu et al., 2020). The excessive use of conventional transportation modes, such as gasoline-powered vehicles, has fueled an increase in greenhouse gas emissions, exacerbating the global environmental crisis (Aminzadegan et al., 2022). In a world where the fight against climate change is increasingly paramount, being conscious about our individual carbon footprint becomes critical for preserving the earth's ecological balance. The urgency to find sustainable and eco-friendly transportation options stems from this need to become more conscious about carbon footprint. Additionally, with Singapore's gradual transition to more sustainable transportation alternatives such as electric vehicles (Transport, n.d.), this project will serve to compliment such aspirations.

The App: Functionality & Algorithm

Our "eco-transportation" app will recommend users the most environmentally friendly transport options for any given route. On top of the existing factors considered by the Google Maps shortest-path algorithm (such as distance, bus timings etc.), our app will factor in the energy efficiency of the vehicle used, available infrastructure for eco-friendly transportation, and the user's preference for which eco-friendly transport options when recommending routes. The app will calculate and display to the user the carbon footprint of all available routes, while promoting the use of routes which are more eco-friendly but still relatively fast. This app firstly shows users various green transportation options which conventional map apps might not recommend, providing users with the information necessary to make this green shift in their lifestyles. Secondly, the prioritization of routes which have lower carbon footprint in sorting the different options and the visual display of the carbon footprint for each route (green text for the eco-friendly options, red text for the more harmful options) would nudge users to choose routes with lower carbon footprint.

A sorting and selection algorithm will be used to recommend the route and mode of transportation with the least carbon emissions. After calculating the estimated carbon emissions for each possible route, the algorithm will sort all values and present the options with the least 5 values, with the route with the least value labeled as most recommended (Mailund, 2014). In instances where the user does not have a specific destination in mind, and wants to search by a type of amenity available (eg. nearest supermarket, 24-hour clinic), the algorithm will adopt a breadth-first search to identify the nearest options (Khan Academy, n.d.). In the event that there are different routes with similar carbon emissions, Djikstra's algorithm will be used to determine the shortest route for the convenience of the user (Navone, 2020). In the event that the user needs to travel to multiple destinations successively in no particular order (akin to the traveling salesman problem), the algorithm will determine the most optimal route that passes each point exactly once and returns to the origin (Applegate, 2006; Britannica, 2024). The cited sources help explain these algorithms.

Prerequisites for Our Team to Build This App

Building this algorithm requires us to access environmental emissions data in Singapore, through the National Environment Agency, Land Transport authority or other reputable sources. Additionally, we need to grasp the principles behind calculating parameters for efficient travel and adapt them to the user's activities. Beyond compiling data to ensure our app accurately reflects the carbon emissions of each route,

we need to understand the sorting algorithm behind how Google Maps chooses which route (from different vehicle options) to recommend to the user. This is necessary for us to tweak the algorithm such that it weights the factors of carbon emissions significantly, to encourage a shift towards eco-friendly travel, but not too significantly as to start recommending unrealistic, highly inefficient paths. To understand how the Google Maps algorithm weights the different factors in recommending routes, we will need some proficiency in the language that it is coded in (or the algorithm of any open-source alternative like OpenStreetMaps). Applying the various selection and sorting algorithms mentioned previously will also necessitate some level of familiarity with coding, so we can understand how to tweak the variables in general templates of these algorithms for the purposes of our project.

Using Our App: Application by Users and Target Demographic

Prior to embarking on their journey, users can plan their route from their current location, such as home, work, or school, to their planned destination. The application provides a variety of route options, and is specially designed to prioritize routes which contribute to less carbon emissions. Ultimately, the choice of route rests with the user, who selects the most suitable option, balancing convenience with eco-consciousness. Upon completing their journey, users can review their achievement, and determine the amount of their carbon footprint reduction. Furthermore, incentives and rewards can be awarded to individuals who hit a specific amount of carbon emission reduction during their trip. Ideally, these incentives, paired with a point system and visible representations of carbon footprint achievements, serve to inspire users to adopt increasingly eco-friendly travel choices.

The application caters to a wide user demographic, especially those who own a smart device with gps or Google Maps features and are familiar with navigating on these platforms. The target audience includes students, working professionals, and even the elderly. As people plan their journeys, our app serves as a gentle reminder that eco-friendly options are readily available at the tip of our fingers. Particularly for car owners, our app's functionalities play an important role in heightening their awareness of their carbon footprint contribution each time they use Google Maps. The hope is that this increased awareness would encourage individuals to actively evaluate and choose environmentally friendly transportation options. Conversely, for people who rely on ride-hailing services like Grab as their main form of transportation, our app is a great resource as it not only guides consumers towards sustainable options like public buses, MRT trains, and shared bike rentals, but it also introduces new ways to save money by decreasing dependency on frequent Grab bookings.

Potential Issues With Implementation of Our App & Preliminary Solutions

Firstly, users may initially be reluctant to switch from their current transportation solutions (for example, Google Maps) to our app. By extension, users may discontinue using the app after an initial period. While there might be an initial impetus to start using the app, maintaining long-term user engagement is crucial. Keeping this in mind, the app must continuously provide value and incentives to attract users and ensure sustained usage. This could involve incorporating features such as rewards programs, gamification, or regular updates to keep users engaged. Secondly, the presentation of numerical carbon emission figures might be a potential barrier, as these values may not immediately make sense to the average person. To address this, the app should translate complex numerical data into relatable and understandable terms. Usage of comparisons and analogies that resonate with users' everyday experiences will make it easier for them to grasp the environmental impact of their transportation choices.

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