Coursework 1: Software Design Brief - Greenize

1. Introduction

Greenize is an application that has as purpose to track the carbon footprint of personal mobile devices, targeted towards young adults, and customizable per user and their digital activities. The Computing Industry contributes about 2.1% to 3.9% to the global share of greenhouse gas emissions (Freitag et al., 2021). It is predicted that smartphones will generate 146 million tons equivalent emissions (CO_2e) in 2022. Popularly known, these emissions consist mostly of the creation and transport of mobile devices. However, user-related emissions from the already existing smartphones generates about 11% of this total (Lee et al., 2021). The aim of Greenize is to bring awareness of the carbon footprint of personal computing usage through the monitoring of the carbon footprint and providing offsetting solutions through a payment scheme.

A thorough requirement investigation was performed through literature reviews, regarding the role of smartphones in greenhouse emissions and global warming, academic and news articles about technologies available in the field, and the observation and testing of currently existing API and apps that provide similar services. For example, the Guardian (2008) published an interview with Andreas Zachariah, system inventor of Carbon Diem, which uses an algorithm to identify the mode of transport being used through GPS. This measures the user's speed and pattern of movement, which can then calculate the amount of Carbon Dioxide (CO_2) emitted into the atmosphere. Since then, technology has advanced, and the usage of mobile devices has grown and become more complex. Currently, there are several apps that have been observed for this design brief that keep mode of transportation in mind as well. By just searching "carbon footprint tracker" in either the Google Play Store and Apple Store, countless apps show up, either relying on user input, or using a similar Location Tracking technology. Some of these applications also consider food waste and electricity use, which solely depends on user input, such as Carbon Footprint & CO_2 Tracker by the Capture Club (Capture Club, 2019). Notably, there is a small hand full of tools that think of the carbon footprint of digital activities, such as Cloud Carbon Footprint (Cloud Carbon Footprint, 2021), EarthHero and Earth Hero: Climate Change application (Earth Hero, 2019), and Carbon.fyi by Offsetra (Offsetra, 2022).

Greenize will solely focus on the emissions of the phone and digital activities by combining some of these ideas, relying on as little user input as possible and as much automation through safe access pathways. These digital activities can be customized per user, catering to different people that will have an interest in the environmental impacts of their digital lives. Stakeholders include:

***Direct or primary users*.** The users that will directly use the application and system that will be created. They will be interested, as it will provide them insight in their online carbon footprint and provide an offset scheme to counteract this footprint. It will further educate them of the impacts of their digital activities. These users will either be iOS or Android users.

***Beneficiaries*.** These may include Google (of the Google / Android Play Store) and Apple (from the App Store), as the application will be available on their platforms. Allowing users to download the app through here also comes with a fee that must be paid to Google and Apple.

***Partner Organizations*.** These include the later-mentioned organizations that own the technologies and API Greenize will integrate, such as TR[1]BE, Climatiq, Offsetra, KlimaDAO, Cloud Carbon Footprint and Cloverly. They will have interest, as the application will integrate their technology against a financial compensation, but also get to further their mission to the users of this application.

***Project Build Team and Developers*.** The team that will build the application. Along with financial compensation, they have the technological and non-technological expertise to create the application and fulfil the mission and vision they have for this project.

***The Company*.** The application will exist under their name. Mostly will benefit from the financial compensation and the transactions that users may make.

Investors and Shareholders. Benefit from the financial return and compensation in their part of the project. They (also) provide the budget and funds to research, design and create the application.

Authorities and Government. They are not necessarily involved but have authority over the project in legal and regulatory ways. They will govern the usage of the application. They may benefit of this application through users decreasing their carbon footprint, which contributes to the issue of global warming and greenhouse emissions.

2. Summary of the proposed solution

Greenize will focus on tracking the digital activities of the user, personalizing it depending on who the user is. The application is made in a manner that it is used daily, as the data and statistics will be shown daily. This data will then be saved, so the carbon footprint and the possibly offset carbon can be viewed on a daily, weekly, monthly, and yearly basis. (Similarly, to how you can view your step count.)

2.1 Tracking Process

Firstly, informed consent is gathered through Terms and Conditions that must be accepted, which allows the application to utilize the user's screen time and iCloud or Google Cloud. Then the user may select up to 3 options specifying what they want to use the app for: tracking the carbon footprint of digital activities; cryptocurrencies and transactions; cloud and online usage.

If digital activities are selected, the application will connect to the user's screen time data. This screen time will be used as the basis to integrate Climatiq API, which allows the calculation of emissions in real-time. If cryptocurrencies and transactions are selected, the address of the wallet, for example the Ethereum address, can be input by the user. The application will use Carbon.fyi's technology to provide an estimate of the CO2 footprint, which includes emissions for outgoing transactions and gas spent on incoming transactions. If cloud and online usage is selected, the application will connect to the user's cloud of choice. The application will then integrate Cloud Carbon Footprint to connect to the user's data. Further, if the user wishes to, further activities or wallets can be added at any time. This may include purchases made through other applications, or when certain access is rather not given by the user. This must all be done safely, to prioritize confidentiality. This must further happen in a high-performance manner, so the user only has to wait a minimum time to receive their statistics.

Most importantly, as the app can be catered to what the user wants, this allows for a flexible and quick way to provide the wanted results. Further, the user has to input a minimum amount of information when consent is given, enabling a quick process with minimum effort and maximum amount of value given in return.

2.2 Offsetting Scheme for a Monthly Fee

An offsetting scheme is offered through the application as well, through the integration of Cloverly's API. This allows every transaction to be made carbon neutral. This allows no controversial opinions about a purchase being made online, contributing to the overall gas emissions, but also allows the user to offset purchases they have made (which can be added). Additionally, KlimaDAO's technology will be integrated to offset on behalf of an Ethereum or other cryptocurrency address. Lastly, other digital activities can be offset by integrating TR[1]BE, which funds tree and biodiversity protections, counteracting the carbon footprint (about 49 pounds a month).

The target will mostly be youth (18-34) that is interested in their digital carbon footprint (Tyson et al., 2021) and utilizes their digital resources the most (Johnson, 2021). These users will have specific digital activities, which is, as aforementioned, why the application will be catered towards the activities of the user. The application further targets the individual, not businesses or bigger corporations. However, individuals within a business may be able to use this app regardless, as it uses technologies that are also made for these purposes. For example, a small-business, shops that have one cloud or company devices, and businesses surrounding suggestions and trading of cryptocurrencies.

3. Requirements

In this section, a use case diagram is portrayed to show the system and its uses. Additionally, non-functional requirements are highlighted and expanded upon. It further includes a narrative that summarises the use case diagram.

3.1 Provide Consent

This Use Case begins when the User opens the application for the first time. The User agrees to the terms and conditions and the privacy policy by clicking "Get Started". The User allows the application (system) Greenize to track their data.

3.2 Personalize Account

The User creates an account. The User personalizes their account by specifying what activities they want to track. The User inputs their cryptocurrency address. The User allows the application Greenize (system) access to their screen time. The User allows the application Greenize (system) access to their cloud to which their phone is connected. The User may add other activities.

3.3. View Digital Footprint

The User's digital carbon footprint is calculated by Greenize (system), using the integrated API and technology. The system visualizes the carbon footprint information and shows it to the User. The User can view their Digital footprint.

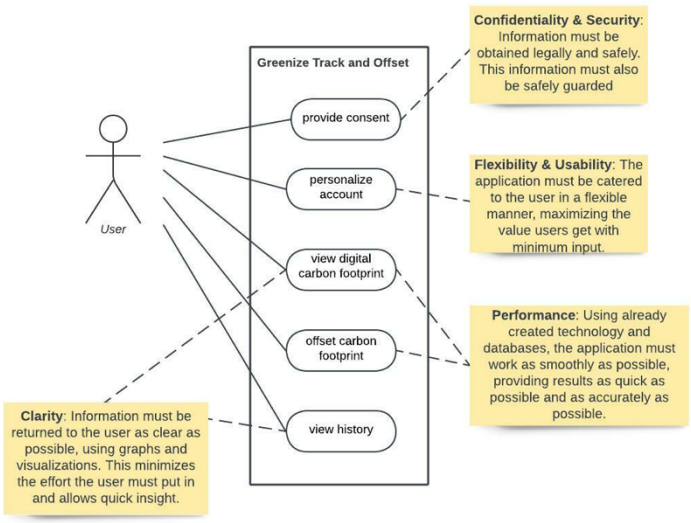

Figure 1: Use Case Diagram

3.4 Offset Carbon Footprint

The User may select to offset their carbon footprint. The User purchases this premium version of the application by a Android / iOS integration. Through the Cloverly Integration, the User's carbon footprint is offset by the system.

3.5 View History

The User selects to view their tracking history or offset history. The system generates a visualization of their daily, weekly, monthly, and yearly carbon footprint and offset history.

4. Using the Proposed Solution

In this section, a formal User Story can be found, alongside figures 2 to 5. Figure 5 entails a Use Case Sequence diagram. See Figure 3 for prototypes of proposed screens, and Figure 4 for examples of iOS pop-ups that are referenced. Figure 3 is solely for demonstration reasons to supplement the proposed solution and does not entail the final format or a required proposed design for the application. See Figure 5 for a supplemental activity diagram.

Use Case Name:	Greenize Tracking Digital Carbon Footprint
Primary Actor:	iOS user
Value Proposal to Actor(s):	To gain insight in user's digital carbon footprint in a clear way. Possibly offsetting this carbon footprint through a purchase in the application.
Frequency:	Number of Uses: minimum of 30 per month.
Basic Course of Events:	The use case begins when the user downloads and opens the application. The user clicks "Get Started". The user allows Greenize to track data. The user specifies what they will be using the application for, for example "crypto" and "digital activities". The user allows Greenize to access their screen time. The user inputs their cryptocurrency address. Information is used to, alongside integrated API's, to visualize the digital carbon footprint.
Alternative Paths:	The user selects "digital activities" and "crypto". The user does not allow Greenize to access their screen time. The user inputs their cryptocurrency (e.g. Ethereum) address. The information that is given is used to visualize the digital carbon footprint. The user clicks the + to add other digital activities. The information is added to the visualization of the online carbon footprint.
Exception Paths:	The user does not click "Get Started", not accepting the policies, and delete the application. The user does not allow Greenize to track data. The user does not select any personalization (not fitting what they want) and delete the application.
Assumptions:	Software system is running well, and performance is high. User has screen time enabled and uses a mobile device. User wants to gain insight in their online carbon footprint.

Pre-conditions:	The user has accepted the Terms of Conditions. The user has accepted the Privacy Policy. The user has allowed the application to track certain other applications and addresses (screen time, cloud, crypto wallet). The user has created an account and selected their preferred usage of the application.
Post-conditions:	Successful tracking and percentages of carbon footprint.
Related Business Rules:	Must comply with legal (data) requirements stated by the government and the law. https://www.gov.uk/data-protection Must comply with legal requirements stated by the software system application will be used on. https://developer.apple.com/app-store/review/guidelines/
Related non-functional requirements:	Information Governance is adhered to legal and ethical requirements, regarding privacy and confidentiality. Information is flexibility represented by customizing to the user's preferences.
Project:	Greenize
Author:	Cindy Steward
Date:	19/11/2022

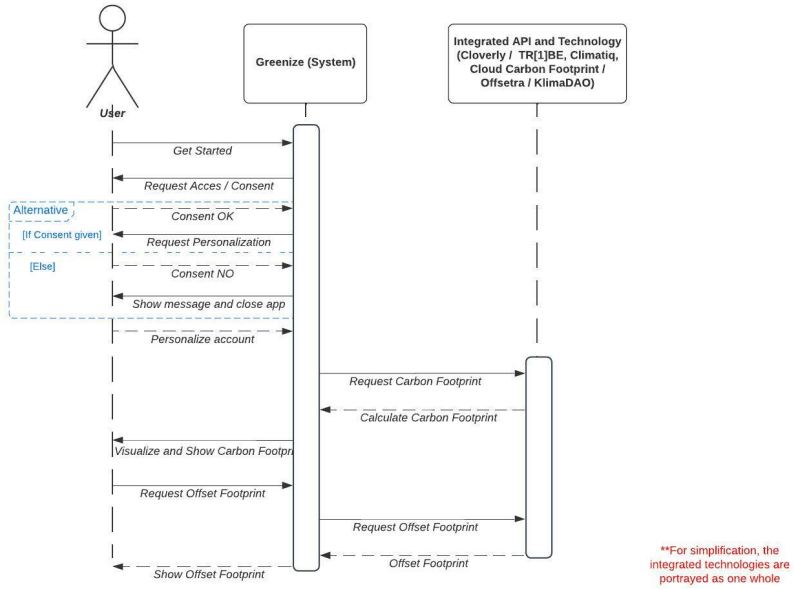

Figure 2: Use Case Sequence Diagram to show Use Case Realization.

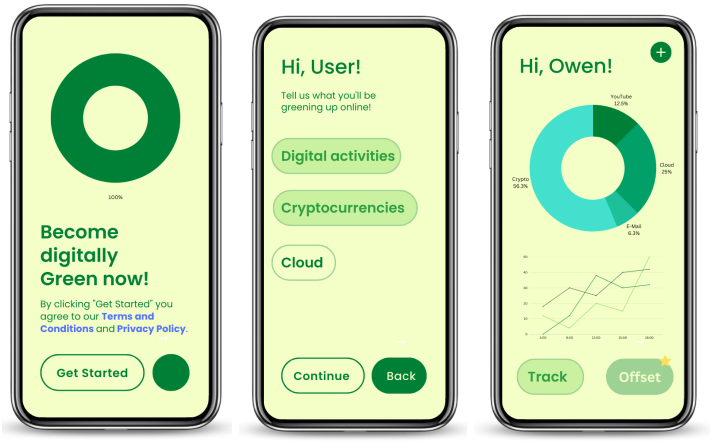

Figure 3: Prototypes of Proposed Screens of Greenize.

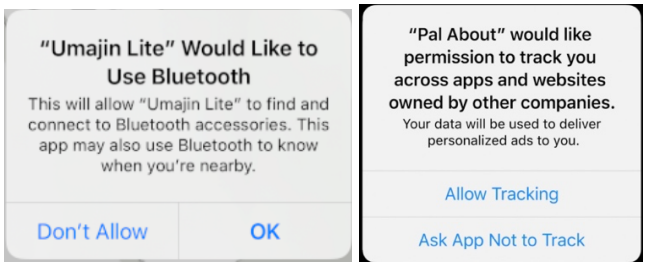

Figure 4: iOS pop-up to allow tracking of apps (Whittaker, 2020).

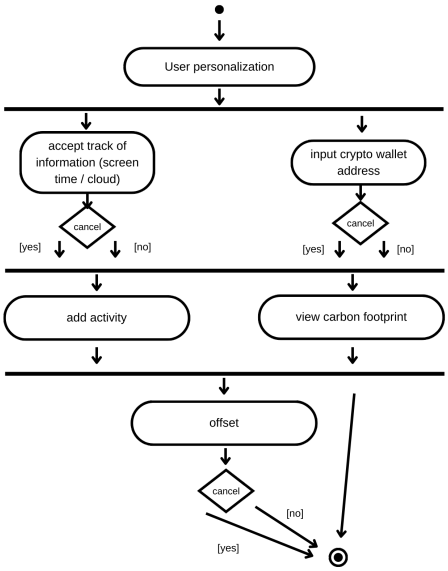

Figure 5: Activity Diagram.

5. Implementing the Proposed Solution

Figure 6 contains an implementation diagram, specifying the hardware and network infrastructure. In terms of hardware, no new components will be required. Software and interfaces must be developed and designed to implement several API's and technologies to create the proposed solution, as can be seen in Figure 2 and 3.

Climatiq API, Carbon.fyi and Cloud Carbon Footprint will be used to form a visualization of the carbon footprint. An integration will have to be created that will gather information and use these technologies and databases to create graphs that can be presented back to the user. Further, programs must be created that can transform the gathered screentime into numbers that can be used to calculate the carbon footprint. Coding languages, such as Swift in XCode and other well-known and popularly used platforms, can be used to develop the application for both iOS and Andrioid, which may require some time but is fairly feasible. Lastly, KlimaDAO's technology, TR[1]BE, and Cloverly's API can be integrated to offset the carbon footprint, when this option is purchased by the user..

Most importantly, non-functional requirements can be addressed using already existing technology, which will maximize the accuracy and quickness of the code. This allows for a maximum performance with a minimum effort from the user. Security is another central requirement, that will be addressed through safeguarding and legal collaborations with other companies (Apple, Google, Climatiq, etc.), prioritizing confidentiality.

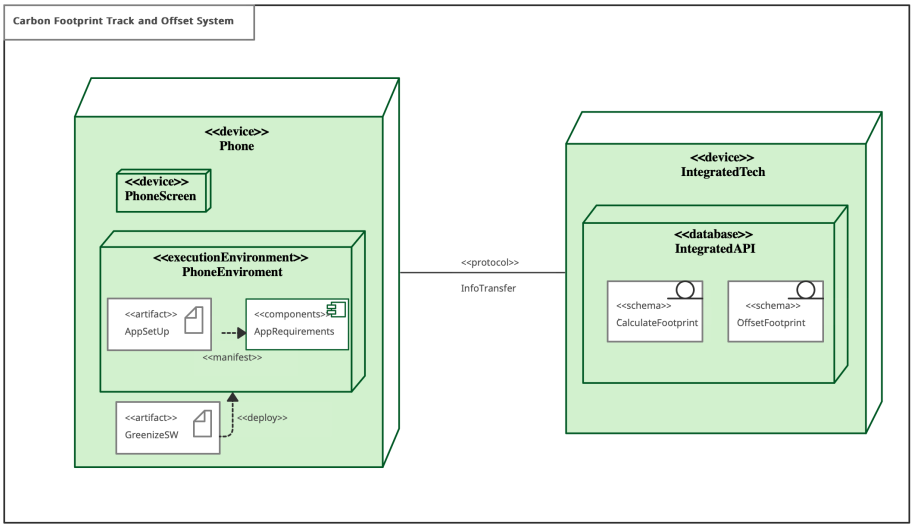

Figure 6: Deployment Diagram Greenize.

6. Conclusion

This solution, Greenize, addresses several legal, ethical, and sociological issues.
This solution enables the software to target the sociological issues of greenhouse emissions and CO2e in the computing industry, which is, as aforementioned, the aim of this entire project. By targeting the user and the individual, a unique product on the market is created. Usability and Flexibility is at the centre of this application, aiming to personalize the application in a manner that benefits the user most. Different individuals will be able to use Greenize to make the digital world a greener place. Most importantly, through legal requirements, regarding citizen's data safety, and Google and Apple's safety regulations, information is safeguarded and kept confidential. Information must not be sold to third parties, no matter the possible financial compensation. This is, within itself, an ethical issue as well. Money is earned through honest ways, helping the user to offset their carbon footprint. This can be done without the application but shows to be a helpful and easy way to do so. Information is obtained through consent, and shared information to make calculations is done through a safely integrated way.

Several considerations were made which eventually led to Greenize. As many ideas were proposed, this solution allows maximum value by catering to the user, including Cloud options and other digital activities. Further, an initial idea was to focus on cryptocurrencies (GreenMyCrypto), but this latter idea would stray too far from the company's ideas. The application will be created by using already existing technology. It is to be considered that these technologies come with a cost, alongside developing this application for both Android and iOS. However, bearing in mind these collaborations can be discussed and made, the budget of 10.000 for this phase, and a 100.000 for development, is well-achievable, within a reasonable timescale.

So, at the core of this proposal are sound software engineering principles. This software company has a responsibility in the computing world, and this strong moral responsibility enables the opportunity to create a solution to *greenize*. Through maximizing usability, safety, confidentiality, and performance in a clear and helpful way, our principles are held intact. Despite these efforts, there are several limitations and issues that this proposal fails to address. To illustrate, many smartphone companies are aiming to become carbon neutral, making some of our efforts to be in vain and not worth to invest in. However, our application will still have value to the user, perhaps just less so than before. Further, there are other applications and websites on the market that offer similar services. This will be competition to our proposal. Lastly, the integration of these technologies must be further discussed, researched, and investigated. Crossovers of this generous number of technologies may be counter-productive, unsustainable, and perhaps some may request exclusivity, or consequently demand the company to publish this project as an open-source program.

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