**Design Chapter of Final Report**

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This chapter discusses the design for the social mobile app created in this project. Firstly, insights from the literature review discussed in the previous chapter will be presented, then a requirements analysis from the field of Human Computer Interaction (HCI) is presented with insights from this, before finally presenting both low and high-fidelity prototypes.

# **Literature Review Insights**

The literature review discussed in chapter two of this report examined the areas of carbon footprints and carbon footprint calculators, behavioural psychology and effective gamification design. Based on the literature review, the prioritised value-adding features which should be implemented are achievement and social features, competition and cooperation, a quick and easy footprint calculation and a way to educate users. As discussed in the literature review there are a variety of ways to include these features, and the specific ways implemented in this social mobile app are points, a leaderboard and an individual progress chart for achievement features, team and individual leaderboards for social features, to focus on meat consumption and transport for a quick footprint calculation, individual leaderboard for competition, team leaderboard for cooperation and finally to view the emissions from various activities to educate users. All of these insights are illustrated in figure 1 below.

Table

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Figure 1: Table representing the recommended features from the literature review in the 1st column, with how the feature is implemented in the app in the 2nd column.

As discussed in the literature review and illustrated in figure 1 above, competition, cooperation, information, achievement features and social features are highly effective functional requirements for implementing mobile applications targeted at motivating pro-environmental behavioural change.

In addition, a quick, reduced user effort footprint calculator is needed, focusing on meat consumption and transport. This is because meat consumption, transport and energy usage are the three most contributary components of an individual’s carbon footprint, but energy usage requires pre-prepared knowledge of utility bills and information which is more difficult for users to collect, as well as not having control of these emissions such as how a home is powered when renting or living with parents, as previously outlined in the literature review. Thus, meat consumption and transport are the emission factors this app focuses on collecting from user input.

It is important to note that the literature review also referenced other features which could add value such as immersive gamification features (avatars, narration), but with the limited time constraint of this project and adhering to agile best practices, the features which add the most value are of the highest priority.

# **Requirements Analysis**

This section implements the frameworks used in the field of Human Factors (HF), or Human Computer Interaction (HCI), namely scenarios and hierarchical task analysis, to develop further insight into what users may feel, experience and what they are trying to achieve by using the gamified mobile app in this project. By implementing the scenario and hierarchical task analysis frameworks, improvements can be made to the design of the app to provide a more seamless experience for the users.

## **Scenarios**

This section provides a user scenario associated with the mobile application to be built for this project. The scenario illustrated in this section is that of an unmotivated environmentalist. The purpose of this section is to gain insight into how the users feel, what they experience and what they are trying to achieve when using the mobile application, taking into account their personal characteristics and diverse backgrounds.

### **Unmotivated Environmentalist**

Dave is a student at Trinity College Dublin, where he studies Environmental Science. Dave has always been fascinated by science and often spends his time outdoors enjoying nature and watching documentaries about the environment. Dave is environmentally concerned but lacks motivation to take meaningful action to reduce his carbon footprint because there is nothing holding him personally accountable for his environmental actions and it is too easy to avoid change. Any consequences for his lack of action he feels is too distant and does not affect him directly. Dave wishes there was an easy way to increase his motivation to reduce his individual carbon footprint.

While researching academic papers for an assignment, Dave comes across a gamified social mobile app where students compete individually and in teams through their carbon footprints. Dave has experience using carbon footprint calculators and has frequently found them to be too time-consuming, requiring too much effort and ultimately frustrating and de-motivating him. If the calculation of his footprint does not require much effort, Dave would like to use the app to compete against his friends, hopeful that this app will help him feel accountable. Ultimately, Dave sees this app as a great opportunity to help him achieve his goal of increasing his motivation for reducing his individual carbon footprint.

After signing in to the app with his credentials, Dave observes the screen displayed to him. He notices the “Add Emission” button and decides to click it. Next, Dave sees the option to select either a transport emission or a food emission. Dave selects a transport emission. Dave sees a list of fields he needs to fill in and immediately feels concerned because of his experience using time-consuming carbon footprint calculators in the past. Dave is prompted to select what size car he uses, which he has no idea. He notices there is a key explaining how a small car is a mini, and a large car is an SUV. Dave drives an SUV so he selects a large car. Dave is grateful the app is helpful for selecting the appropriate answers.

Next, Dave selects diesel as his fuel type. Since he drove by himself to work Dave selects 1 for the number of passengers. Since Dave has driven to work every day he knows the commute distance is 4.8km. By accident, Dave enters 48 and selects kilometres. To log his commute, Dave selects “save”. After selecting “save”, Dave is shown the information he has entered and is asked to confirm the details are accurate. Dave glances through the details and notices he entered 48 instead of 4.8km and quickly fixes this mistake, before clicking confirm. Dave is grateful the app prompted him to review his entry, preventing him from logging an incorrect distance, and appreciates how easy it was to change the distance entered.

After arriving home from work, Dave opens the app to log his commute home. To his delight, Dave sees the new entry has his previous commute entry already filled in. Dave simply clicks save, confirming his new log and takes great satisfaction in not having to refill in all the details all over again.

At the end of the day, Dave views his position in the individual leaderboard and sees he is ranked third out of fifth amongst his friends. In the team leaderboard his team is coming 4th and he notices this is because his score has dragged them down. Dave feels the urge to improve his score in the future so he does not let his team down.

After logging his emissions through the app and competing with his friends through his carbon footprint score, Dave notices an overall reduction in his carbon footprint over time and takes great comfort in the environmental change the app has brought about amongst him and his friends. Dave’s environmental concerns begin to ease and he is relieved to finally feel motivated to take meaningful action to reduce his carbon footprint. Feeling personally accountable to help his team win, Dave finds it difficult to avoid changing his damaging environmental actions and that the consequences for his lack of action is reflected on a day to day basis. By competing against his friends, Dave’s motivation to improve his environmental behaviour improves greatly, giving him a great appreciation for how convenient and helpful the app is.

## **Hierarchical Task Analysis**

Following on from the scenario discussed in the previous section, this section provides the hierarchical task analysis for logging emissions, which was a focal task in the previous scenario, offering insights into the most frequent, complex, and error prone tasks.

### **Log Emission**

0. Log Emission

1. Sign in

1.1. Enter email

1.2. Enter password

1.3. Select sign in

2. Add Emission

2.1. Select add emission

2.2. Select emission type

2.3. Add transport emission

2.3.1. Select mode of transport

2.3.2. Select car size

2.3.3. Select fuel type

2.3.4. Enter number of passengers

2.3.5. Enter distance

2.3.6. Select unit of distance

2.4. Add food emission

2.4.1. Select food type

2.4.2. Enter portion size

2.4.3 Select unit of measurement

2.5. Select save

2.6. Select cancel

3. Confirm details of emission log

Plan 0: Do 1, then 2, then 3.

Plan 1: Do 1.1, then 1.2, then 1.3.

Plan 2: Do 2.1 then 2.2. If 2.2 equals transport, do 2.3., else if 2.2 equals food, do 2.4. Do 2.5 or 2.6. Do 3.

Plan 2.3: Do 2.3.1. If 2.3.1. equals dart, Luas or train, then skip to 2.3.5. Do 2.3.5 and 2.3.6 in any order. If 2.3.1 equals bus, do 2.3.4., 2.3.5. and 2.3.6 in any order. If 2.3.1 equals car, do 2.3.2., 2.3.3., 2.3.4., 2.3.5., and 2.3.6., in any order.

Plan 2.4: Do 2.4.1, then do 2.4.2. and 2.4.3 in any order.

#### **Log Emission Analysis**

With logging an emission, the most frequent tasks involve filling out all the details time and time again. This may prove to be painful for users and time consuming if they have the exact same commute to work every day, or they eat the same food for certain meals. A simple solution to solve this pain point of users could be the option to save or copy a previous entry, with the ability to edit the new copied entry.

Complex tasks are those which either take a long time, or can be confusing to achieve. Complex tasks for logging an emission involve knowing the car size, knowing the number of passengers if on a bus, Luas or dart and knowing the portion size for eating food, especially if eating out in a restaurant or when you do not have a scales to weigh food. Additionally, it could be confusing when you cycle or ate pasta or do some activity where there is no option to select this food type or mode of transport. Knowing the distance travelled is not considered complex because users can easily use google maps.

Solutions to the above complex tasks involve providing the engine size and examples beside car size selection such as 1.2L for a small car, and a small car is a mini, large car is an SUV, providing average or recommended values for fields which users may not know an accurate answer for such as portion sizes for food, or number of passengers on a bus, Luas or dart and finally to provide different units of measurement because users may be more familiar with kilograms instead of pounds, and some food packets provide different units of measurement.

Serious errors in logging emissions involve making mistakes such as forgetting to add a decimal point for distance travelled or portion size of food. Additionally, if users cannot remember if they have already logged an emission so they either have duplicate logs, or no log at all because they think they have already recorded this activity.

Solutions to these serious errors outlined above involve providing a summary of the emission entry asking user to confirm, cancel or edit the entry, displaying a history of logs for the current day to avoid duplicates/forgetting to enter an activity and providing the ability to edit or delete logs once confirmed if duplicates or incorrect logs are made.

## **Scenarios and Hierarchical Task Analysis Insights**

The scenario and hierarchical task analysis discussed in sections 2.1. and 2.2. provide great insight into what user’s may experience, reflecting good or bad design decisions. By taking into account diverse user abilities and backgrounds, as well as the most frequent, complex and error prone tasks of using the app, overall design of the app can be drastically improved.

By analysing the scenarios and hierarchical task analyses, value-adding features to address frequent, Table

Description automatically generatedcomplex and error prone tasks of using the mobile app can be established.

Figure 2: Insights gathered from Hierarchical Task Analysis which outlines how to improve design through adding value-adding features to improve user experience when using the mobile app to motivate pro-environmental behavioural change.

## **Conclusion**

This section has explained how in addition to the literature review insights, scenarios and hierarchical task analyses drive the design decisions rationale. After analysing the prioritised list of value-adding features from the literature review and from the scenarios and hierarchical task analyses, there is heavy overlap across these prioritised lists. Various other features could be added to the mobile app at a later stage, but to deliver the most value in the given time constraints of this project, the features outlined in the previous sections will be the focus for implementation.

# **Prototyping**

This section focuses on prototyping, further applying the knowledge from the field of Human Factors and Human Computer Interaction (HCI). In this section, low-fidelity (hand drawn) and high fidelity prototypes were created to visualise the users’ workflow, simulating their experience with using the app.

## **Low Fidelity (Hand Drawn) Prototypes**

The first stage of prototyping for this mobile app began with low-fidelity prototypes in the form of hand drawn prototypes. Hand-drawn prototypes were first created since they are very quick to create, effectively aid in visualising user flow and avoid the designer experiencing sunk-cost fallacy, where the designer is reluctant to abandon the prototypes because they have spent a lot of time working on the prototypes, even though they know abandonment would be more beneficial” (Ronayne, D., Sgroi, D. and Tuckwell, A. (2021)).

Figures 3-9 below illustrate the original hand-drawn prototypes for the app.

Diagram

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Description automatically generated with low confidenceText, letter

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Figure 3: Sign in page

Figure 4: Home screen

Figure 5: Home screen expanded

Text, letter

Description automatically generatedA piece of paper with writing on it

Description automatically generated with medium confidence

Figure 7: Log food emission

Figure 6: Log transport emission

A piece of paper with writing on it

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Figure 8: Individual leaderboard screen

Text, letter

Description automatically generatedText, letter

Description automatically generated

Figure 10: My Scores screen

Figure 9: Team Leaderboard screen

## **High Fidelity Prototypes**

After analysing and iterating through different versions of low-fidelity prototypes, high-fidelity prototypes were then created using the online software tool Figma. The high-fidelity prototypes provide a cleaner, crisper, more realistic user experience to further gauge feedback from users’ experience, frustrations and enjoyment with using the app.

Figures 11 – 17 below illustrate the high-fidelity prototypes for the app.

Graphical user interface, text, application, chat or text message

Description automatically generatedApplication

Description automatically generatedApplication

Description automatically generated with low confidence

Figure 13: Log transport emission

Figure 12: Home screen expanded

Figure 11: Home screen

Graphical user interface, text

Description automatically generated

Figure 14: Log food emission

A screenshot of a cell phone

Description automatically generated with medium confidenceA screenshot of a cell phone

Description automatically generated with medium confidence

A picture containing graphical user interface

Description automatically generated

Figure 17: My Scores screen

Figure 16: Team Leaderboard screen

Figure 15: Individual Leaderboard screen

# **Conclusion**

This chapter has focused on the design for the gamified mobile app to be implemented for this project. The scenario and hierarchical task analysis frameworks from the field of Human Computer Interaction (HCI) were implemented, gaining further insight into user experience when using the app. The design decisions rationale are motivated through the insights gained from the literature review and the scenarios and hierarchical task analyses. By iteratively creating the hand-drawn prototypes and then progressing to high fidelity prototypes, user flow was visualised and improvements to the overall design were made.

# **References**

Ronayne, D., Sgroi, D. and Tuckwell, A. (2021) How susceptible are you to the sunk cost fallacy?, Harvard Business Review. Available at: https://hbr.org/2021/07/how-susceptible-are-you-to-the-sunk-cost-fallacy (Accessed: February 5, 2023).