Application Green Quake

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Github Link:
https://github.com/PeterX12/Application-Green-Quake.git
APK Github Link:
https://github.com/PeterX12/Application-Green-Quake/blob/master/ApplicationGreenQuake.apk
APK Google Drive Link:
https://drive.google.com/file/d/1MlPChFA_Z_XOzcy3yi_Q1Gt6JyNJcC1e/view?usp=sharing

Abstract

The motive behind this research was to find out more about the current environment and ways to mitigate the effects of damage to the environment. It was also a necessity to research what works and what doesn't in every aspect of gamification and how to successfully design both in terms of UX and UI an application with the same theme as this project. Research was carried out by seeking continuous feedback and by researching the internet. While doing this research continuous knowledge was gained on these topics which allowed the creation of Green Quake. A successful environmentally friendly application.

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1 Introduction

This research document contains the research undertaken in sections in order to create my application. The aim of this application is to make it easier for people to be environmentally friendly while making it fun and keeping them motivated which will aid Europe in achieving the aims of the Green Deal by 2050. There will be two versions for this application. One for Businesses who want to have an environmentally friendly workforce and one for the general public. They will both have the same functionalities while the business one will let the employees get rewarded by their managers for performing eco-friendly actions by reaching a certain number of points or targets.

In order for this project to be successful a number of areas and topics have to be researched in depth and technologies must be tested and researched to see which are appropriate to use.

Research will begin on these topics to aid with the solution of the project. The Green Deal and the environment, Gamification, Motivation and Changing people's behaviour. This research will be carried out to see what works well and what doesn't in terms of the application encouraging people to be environmentally friendly while motivating them and keeping it fun along the way.

Similar applications will be examined to see what is good and what isn't. We will take and improve what works and try to solve or avoid what does not. As a result a better application will be built as we will learn from the mistakes of others.

Research will be carried out on how each feature will work and be implemented. What previous features have failed or succeeded and why.

Front end technologies will be examined to develop an appropriate GUI for this project.

Back end technologies will be investigated to decide on a suitable back end for this application.

In order for the application to be appealing to its users and present its idea across elegantly, research has to be carried out on it's design. Which colours are viewed as being environmentally friendly and should be used in the making of the application have to be researched along with other aspects such as UX design to see what type of designs work for people using applications.

The main focus of this project is on using gamification to encourage people to live an eco friendly lifestyle and to make them commit to it by making it feel fun and rewarding. This application will then also come with extra features that makes it easier to do so and it will provide useful information and tips also.

2 Overview

2.1 Environmental Issues

In the year 2021 we are faced with a number of problems that contribute to earth's pollution levels and climate change. If we are not careful and do not take action to slow these down or stop them it could lead to a reduced quality of life, health problems or even our downfall. Due to this I have decided to create an application called Green Quake to tackle some of these issues. To tackle these issues, research must be undertaken to help us identify some of them and help us understand them.

2.1.1 Food Waste

Our first environmental issue arises from how the population treats food. Humans throw away or waste one third of the food that is created for human consumption. This is a staggering amount of 1.3 billion tons of food thrown away or wasted a year. This contributes to 4.4 Gigatons of Greenhouse gas emission annually and this number keeps rising with the rising population levels [1]. Food waste needs to be reduced to reduce the amount of greenhouse emissions currently being released into the atmosphere.

Greenhouse gasses cause damage to both the health and the environment. They trap heat under the atmosphere and can cause respiratory problems [2].

2.1.2 Plastic Pollution

Pollution from plastic is a major environmental problem. In 2015, 419 million tonnes of plastic was produced and shockingly National Geographic has reported that as much as 91% of plastic is not recycled. As much as 11 million tonnes of plastic makes it into the seas and oceans every year and has catastrophic effects on aquatic lives killing many fish [1]. Some plastic has already made it into the human food chain as a result of eating sea creatures.

Plastic bottles are a major contributing factor to plastic pollution and are the most common form of plastic that ends up dumped somewhere or finds its way into the ocean. Evidently something has to be done to reduce or prevent this.

2.1.3 Air Pollution

Without a doubt, air pollution is arguably the worst form of pollution. Air pollution shortens the lifespan of people around the globe by an average of 3 years.Research conducted by the World Health Organization (WHO) stated that annually as many as 7 million people die worldwide from Air pollution [1]. This pollution is caused by both industries and fumes but also by deforestation which consumes a lot of the carbon pollution.

This form of pollution is caused by the following pollutants:

1. Particulate Matter: This form of pollution is formed from sulphate, nitrates, ammonia, sodium chloride, black carbon, mineral dust and water. It can be inhaled and causes health problems as they enter peoples lungs and find their way into our bloodstreams. This form of pollution is mostly caused by combustion engines.

2. Black Carbon: Black Carbon is the second leading factor behind climate change only behind C02.

3. Ground-level Ozone: This form of pollution can cause breathing problems, asthma and many other respiratory related disesas.

4. Nitrogen dioxide: This form of pollution is caused by industrial and traffic sources and can also cause many respiratory problems.

5. Sulfur dioxide: Just like Nitrogen oxide this form of pollution can have dire effects on respiratory health and is mainly formed from burning fossil fuels,

6. Carbon monoxide: This form of pollution is very dangerous as it impairs the amount of oxygen that is transported in the bloodstream to critical organs. This gas is also odourless and colourless and is mostly formed from vehicle exhaust gums and machinery that burn fossil fuels [3].

Air pollution is increasing every year and it is evident that people need to decrease or eliminate it as it causes climate change and health problems for humans and the wildlife.

2.2 The Green Deal

The aim of Application Green Quake is to help the environment and to help bring Behavioural, social and cultural change for the Green Deal [25]. To do this research must be conducted on the Green Deal.

2.2.1 What Is The Green Deal?

Both Environmental issues and Climate Change are a threat to Europe and the world and this was recognised by the European Commission. As a result the green deal is a set of policies brought in by the European Union with an aim to make Europe climate neutral by 2050.

2.2.2 Helping The Green Deal

Application Green Quake can help the European Green deal in a number of ways. Primarily it's users will be shown how to be eco friendly and kept motivated to stay this way by being able to log their actions and score points and earn badges. They will also be placed on a scoreboard. Food waste will be tackled by the app's ability to keep track of food items scanned or inputted by the user and reminding the user that the food is about to expire. Plastic pollution will be reduced by encouraging the user to use a refillable bottle instead of purchasing and throwing away plastic bottles. The app will provide refill station locations and the user will be able to pin these too. Users will also be shown relevant information and be educated on these topics.

In addition to this, businesses will be able to get this application and reward their employees for eco friendly actions if they want to use it to promote themselves as eco friendly.

3 Methods, Topics and Technologies Researched

3.1 Motivation

For this application to be successful we need to understand what motivates people and what does not. The aim of Application Green Quake is to make it easier for people to be environmentally friendly, keep people motivated to stay environmentally friendly and educate them on how to be environmentally friendly and provide them with other relevant information. In order to achieve this we will research motivation, what makes things easy and fun to do and how to change an individual's motives and behaviour.

3.1.1 What is Motivation?

Motivation is the reason behind people's actions. Motivation is what begins and keeps an individual's goal oriented behaviours. It is what causes you to do something. The action being getting food and the motivation behind the action being hunger or wanting to gain size. When the motivation is strong the action is easy and vice versa [4].

Once you know someone's motivations you are able to predict their behaviours, know what they like and get them to do things easier. Motivation is caused by biological, emotional, social, and cognitive forces that activate behavior. It is why humans do the things they do [4].

3.1.2 Types of Motivation

There are two main types of motivation [4]. These are Extrinsic motivation and Intrinsic motivation. Intrinsic motivations are motivations that come from the inside. It is doing something for no external reward but because it feels good or feels rewarding.Such as playing a football game because you simply enjoy the game of football. On the other hand Extrinsic motivations are motivations that come from the outside. Such as playing a football game but not because you necessarily enjoy playing that particular game but playing it to win a trophy, impress someone or other external reward.

3.1.3 How to Motivate Someone

So how do we motivate someone? To motivate someone, one has to appeal to people's emotions. One can motivate someone by installing fear in them but this is not the best approach. The best way to motivate someone using their emotions is to make them feel excited, proud or give them a sense of belonging. To motivate someone you also need to make the task seem easier and less time consuming or worth it. The more reasons you give someone to do something also corresponds to how much you are motivating them. To motivate people you must also lead by example and inspire them. You need to be able to trust people and challenge them and believe that if you do all the right things they will too [5].

3.1.4 How not to Motivate Someone

When it comes to Motivating someone it is important to know what not to do so we do not make these mistakes. The most important thing not to do to motivate someone is punishing them. Punishing people builds resentment and associates negative behaviour with whatever

we are being punished for. Also just like punishing someone it is important not to reward someone for the wrong behaviour [6].

3.1.5 Changing an Individuals Behaviour

In order to change someone's behaviour we must lead by example. We must make sure that if we want someone to behave differently then we must behave that way too [7]. We must practice what we preach as people are far more likely to follow someone's actions while seeing evidence that their actions work rather than just following peoples requests and commands.

Goals need to be set and encouraged. People have a tendency to favour short term goals for short term rewards rather than long term goals with long term rewards even if the long term ones are far more beneficial. Long term goals are for people who are disciplined. In order to help someone change we must set short term goals which will ultimately lead to long term success [7].

Giving the correct feedback is essential in changing someone's behaviour. There are two forms of feedback. Positive feedback and negative feedback. Positive feedback is praising someone for doing something. This form of feedback will encourage the individual to keep going. Negative feedback is criticizing someone for what they have done or how they have done it. This form of feedback will either inspire the individual to learn from it and change their approach or put them off entirely. While both forms of feedback are essential in changing someone's behaviour it is crucial to know when to use which form of feedback. At the early stages of changing someone's behaviour or getting them to start something, it is important to use positive feedback rather than negative feedback. This is because as humans we like hearing positive feedback far more than negative feedback and this helps build a positive mindset towards what we are trying the individual to change into. Negative feedback could just put them off entirely and make them feel like they are not capable of completing the task and making them feel overwhelmed. Saying this negative feedback is crucial and should be given when needed but is best saved for later in the process [7].

Creating supportive environments by creating a network of people with the same goals also works as people are likely to work and be more passionate about a goal when they are part of a team where they feel like they belong [7].

The final way of changing someone's behaviour is by remembering that humans are lazy. If you make the undesired behaviour difficult to perform then the person might not do it just because it is too much effort. A great example of this is in California where smoking was reduced because it was banned in some areas and people did not want to walk far just to smoke and come back [7].

3.1.6 Conclusion

From our research we have learned what motivation is and the different types of motivation. More importantly we have discovered what works when motivating someone and what does not and how to go about changing one's behaviour. One of the main aims of Application Green Quake is to motivate people to be environmentally friendly and for them to stay that

way. From the research that we have gathered we can achieve just that by applying what we have learned.

3.2 Gamification

The main feature of Application Green Quake will be using gamification to make being environmentally friendly fun and in turn keep people motivated to stay this way. In order for us to achieve this we will research what gamification is and what works and does not.

3.2.1 What is Gamification?

Gamefication is applying game-design elements into non gaming scenarios [26]. It is solving a non gaming problem by applying game mechanics. An example of applying gamification to a non gaming environment is a social media user being able to earn rewards for daily activities such as ordering a coffee or a meal. Some classic game elements are badges, points and leaderboards. Gamification can be used for virtually anything from Education to Health and so on.

3.2.2 Gamification for Motivation

Gamification works for motivation [8]. It can be used to reward users and allows users to network with like minded individuals. People are naturally competitive and gamification allows them to compete with other individuals for places on the leaderboard. People also find earning badges and achievements satisfying and they help them stay on track.

3.2.3 Examples of successful Gamification

Gamification has risen rapidly in popularity with almost every business using it in some form. Many businesses use gamification in their hiring process to make online interviews, coding challenges, etc more fun and engaging to do. There are a lot of applications that use Gamification in every category. From shopping apps to fitness apps to even applications that help with addiction.

Some examples of successful apps that use gamification are fitness apps that come with most smartphones, Codecademy, DuoLingo and many more. All these apps are successful and fun to use and they have major features in common. They all use tracking of the users statistics, have points, badges, achievements or leaderboards and are visually appealing. These apps track statistics and measure the progress towards a goal and some offer to post on social media so people can show off and compete with their friends [8].

3.2.4 Why Gamification Works

Gamification works when you provide a positive user experience and invoke positive emotions in the user. Here are a list of what makes gamification successful:

1. **Giving the user control:** This works because psychological research shows us that when we want to get a customer to a certain goal the customer likes to feel in control as opposed to being dragged into something [8]. A user wants to feel in control of the process.

2. **Giving the user knowledge of where he is and where he is going:** People do not like feeling lost or stupid [8]. This is a simple fact and due to this it is important to make the user know where he is at or where he is going. This can be achieved with a simple navigation bar to show where a user is in the process or with a progress bar or statistics and charts to show the user their progress. This makes the user feel a sense of control and calm as they know where they are and what they need to do.

3. **Rewarding behaviour:** When a user does something they should get rewarded [8]. This means that the user will come back and do it again. Rewarding behaviour acts on the human feel good factor. The user will come back for more rewards. In an application this can be for example when you reach a new level you get a new skin or points you can spend on things. People will keep coming back to earn more points so they can spend them.

4. **Sense of Achievement:** Achievement is one of the biggest feel good factors. If you can make a user feel like they achieved something when using the application they are almost guaranteed to come back to achieve more to get to feel this feeling again. This can be as smile as a badge for a milestone.

5. **Goals and Competition:** Humans are competitive by nature and love setting goals and competeeting them [8]. They also love competing with themselves and breaking their past records but they even more love to compete with others. This is clearly evident with gamification being implemented on social media like Twitter, Instagram and Facebook where users compete for the number of followers and likes. This can also be seen when websites or games implement leaderboards. To implement this into an application all that needs to be done is show the user their previous statistics or show them others and make beating them feel achieving and empowering.

6. **Exploring:** People love exploring and getting lost to escape from the real world [8]. To make this easier, make gamification in your application easy, Make navigation easy and interesting for the user. It has to be visually appealing and show useful interesting information with images that keeps the user reading and interested.

7. **Rewards outside of the application:** Providing rewards outside of the actual application such as gift cards, discounts or free gifts guarantees the users to keep using the application [8]. The user will want a reward again so they will come back. This can be clearly shown in video games where a user can unlock skins in games after reaching a certain milestone that they would not be able to get without spending additional money on the game.

8. **Exclusive versions:** This is an interesting form of gamification [8]. People like status and showing off. Releasing a premium version of an application that costs money can be a good idea as some users will get it just so they can use premium features or show off to other people that they have it.

9. **Collaboration:** Humans are social animals. If we incorporate teamwork and make it clear that other people are using the application people will use it for many reasons [8]. One being FOMO: Fear of missing out. If people know others are doing or using

something they will do it just from the fear of missing out. People also love working with others on things they are passionate about with people that are like them. Combine these two and your application has guaranteed success.

10. **Addiction:** It is clear that humans get addicted to many things. Some addictions are positive and some are negative. A positive addiction being exercising and feeling out of sorts if you can't exercise. A negative addiction can be alcoholism. Gamification can be addictive [8]. If you combine all the topics discussed above you will create an addictive application which guarantees a user base that keeps coming back.

3.2.5 Conclusion

From our research on gamification we have discovered that Gamification works really well for almost anything where gamification is possible. Gamification is used by most businesses today from actual applications to the hiring process by companies. I have personally completed online job interviews where gamification was not involved and ones where gamification was involved and I can say that even if the ones with gamification were longer they were much more engaging and enjoyable to do. We have also learned how gamification works for motivation and what it must contain for it to be effective. By applying this research into our application we will be able to successfully incorporate gamification into our application.

3.3 Environmentally Friendly Businesses

For the version of the application for businesses we must research if companies want to be environmentally friendly and the benefits of being an environmentally friendly business. This research will conclude whether this version of the application is worth doing.

3.3.1 Benefits Of Being An Environmentally Friendly Business

There are many benefits for a company going green and as a result companies should try their best to be environmentally friendly. The most important reason for a business to strive for being environmentally friendly is to attract more customers and gain a better reputation. According to research 61% of people between the ages 22 and 35 stated that they would be willing to spend more money on eco-friendly products. Further to this 84% of the population across the globe seek out such products when possible. Younger generations are much more likely to choose eco friendly businesses over non eco friendly ones since as many as 92% of millennials are more likely to trust a company that supports social or environmental issues. This makes it clear that this is a massive benefit for businesses. Especially going forward as younger generations are growing more environmentally cautious and aware [9].

If a business chooses to go environmentally friendly it will also gain a major edge over its competitors. People will almost always choose a business or a product that is eco friendly if it's similar quality or similar price. This is another major reason for businesses to go eco-friendly.

Businesses who are environmentally friendly can also get Tax reliefs and grants from governments. So not only can going green make money but it can also save money.

3.3.2 Conclusion

In conclusion it is more beneficial for companies to go green than to not to. Therefore the business version of this application is a good prospect as it will allow companies to market themselves as even more eco friendly with an eco friendly workforce. This will in turn attract more customers and improve their reputation. In addition to this it will put them above their competitors who do not have this.

3,4 Operating Systems

When it comes to developing mobile applications we must first decide which operating system to develop for. To finalise this decision research must be undertaken on them to weigh out the options and choose the best approach.

3.4.1 Android Vs iOS

When it comes to developing mobile applications there are two main Operating Systems to develop for. These are Android and iOS which combined boast over 99% of the market share. This is a staggering number and as a result makes these two operating systems the only ones worth developing for.

Figure 1. Mobile Operating System Market Share Worldwide - October 2020 [10].

When choosing between Android or iOS your target audience plays a large role as there are differences how iOS and Android users behave. As you can see above Android has the highest market share by quite some margin but iOS users are much more likely to spend more money [11].

Making applications for iOS is generally considered faster and cheaper. Some estimate that Android takes 30-40% longer to develop for. This is due to the programming languages. Android uses Java which requires more code writing than Swift, Apple's programming language. Another reason is that Android is open source which leads to software fragmentation. This being said the Apple App Store is stricter and it takes longer for iOS applications to be approved [11].

Developing applications for Android allows for more flexibility. Android has more features than iOS but this also makes it more supesect to malware. iOS is generally considered safer than Android but due to the larger market share and Flexibility the fight between Android and iOS is pretty even [11].

3.4.2 Cross Platform

An alternative method to develop our application would be to make it Cross Platform. This is an alternative to the native app development we have discussed previously. Cross Platform Development allows developers to develop an application for multiple operating systems simultaneously using a single language. This saves a lot of money as you do not need additional time and resources or another team working on another operating system if you want to deploy your application on multiple platforms.

3.4.3 Conclusion

In conclusion I believe that as Application Green Quake is an application that will help the Green Deal and the planet that it should be available for everyone no matter what device they have. Due to this, I have concluded that the best approach to our application development would be cross platform development. This will require more effort on the development side but help us achieve our overall goal.

4 Similar Applications

4.1 Green Me

The first applicatiation we will look at is Green Me [12]. This application provides many suggestions for things you can do to be environmentally friendly and then asks you at the end of the day to list 5 eco friendly things that you did. The application is very simple. It has a menu where you click icons to enter categories and then you can choose from a list of sub headings and get a tip on that topic on how to be environmentally friendly. The positives I found with this application is that it is simple to use and provides good information. On the other hand it has plenty of negatives. The UX design of the application is pretty poor. It is mostly green with a white background and looks quite ugly. Upon opening the application I didn't feel like using it as it looks unprofessional. When clicking onto each category the amount of items on the list felt overwhelming and the small text was hard to read. Upon clicking on the sub heading the tips are laid out in simple bullet points on white background and again this screen looks very unappealing. Finally it asks you to submit your 5 things you did to be eco friendly but I don't see why anyone would do this or stay doing this as the app simply offers no reason to do it other than you can share it on social media. This application has a lot it could improve. It is too simple and does not have a lot of features.
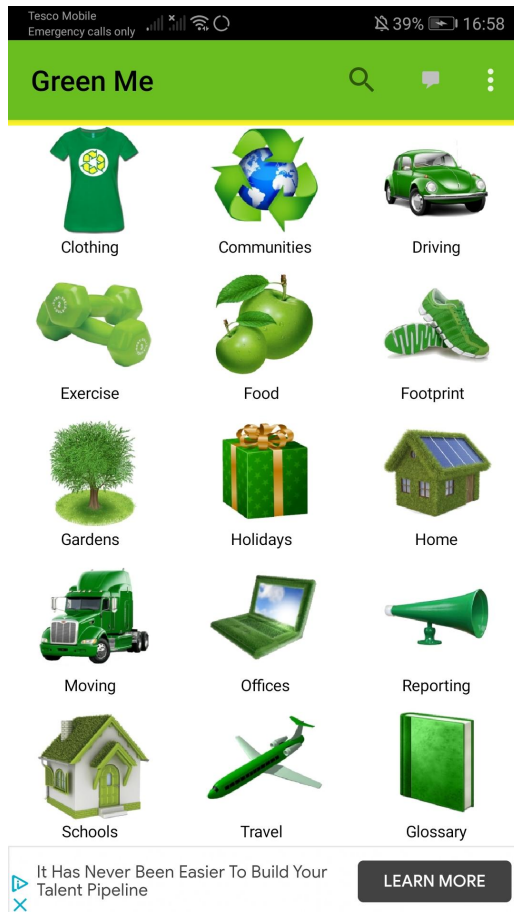
Figure 1: Green Me, Choose Category [12]

Figure 2: Green Me, Chose Sub Category [12]

Figure 3: Details [12]

4.2 Joulebug

This app focuses on gamification of eco friendly activities [13]. It uses points, badges and trophies to reward people for doing environmentally friendly actions. It uses text and video tutorials to help the user along the way. This app begins with asking you to create an account but you can continue without creating one. This application let's you choose from a variety of actions and buzz when you do it. It then lets you post about it on social media. This in turn earns you points. This app also allows you to follow people using the app. This application also has a leaderboard. Overall this application is pretty good. It has a nice system and works smoothly. Saying that the application does seem a bit overwhelming and the UX design could be better in that sense. A user cannot view their badges, trophies or statistics. All a user sees is their point total and how many of each they have. This is a big flaw of this application.
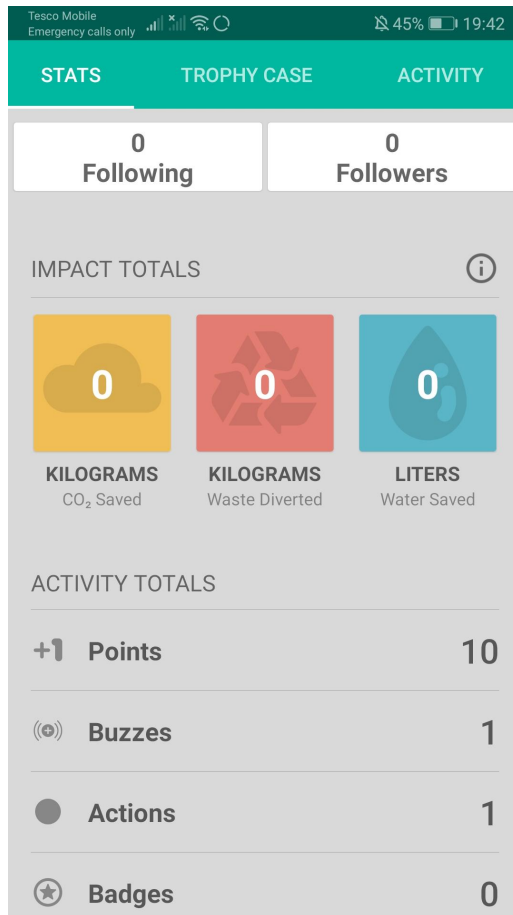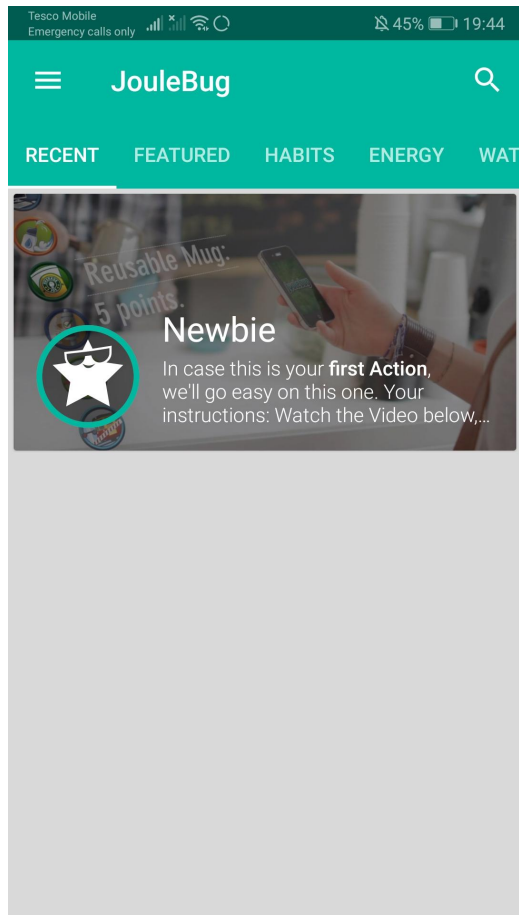
Figure 4: Profile View of Points [13]

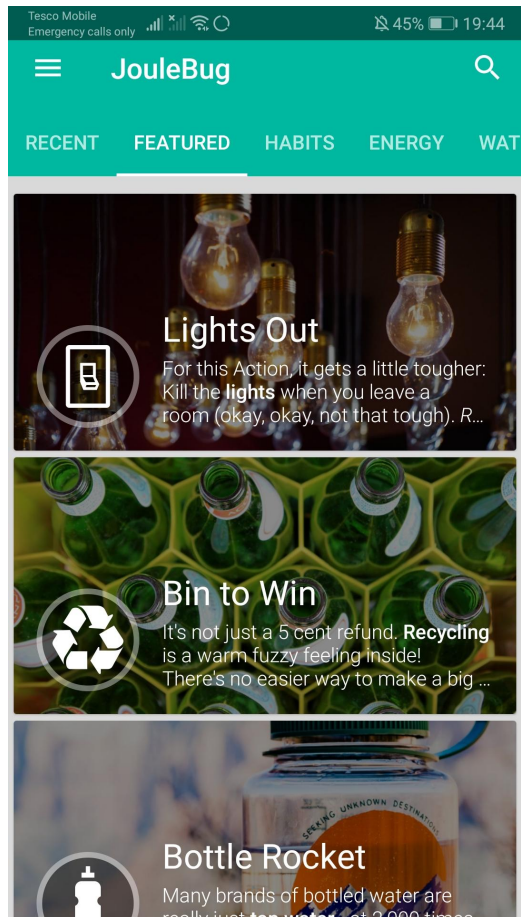**Figure 5:** View Of Recently Completed Challenges [13]

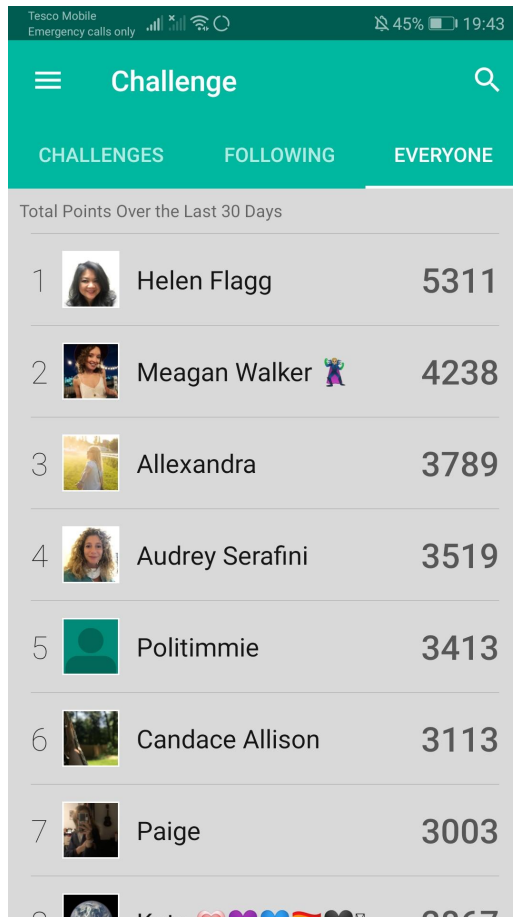**Figure 6:** View Of A Category Of Challenges [13]
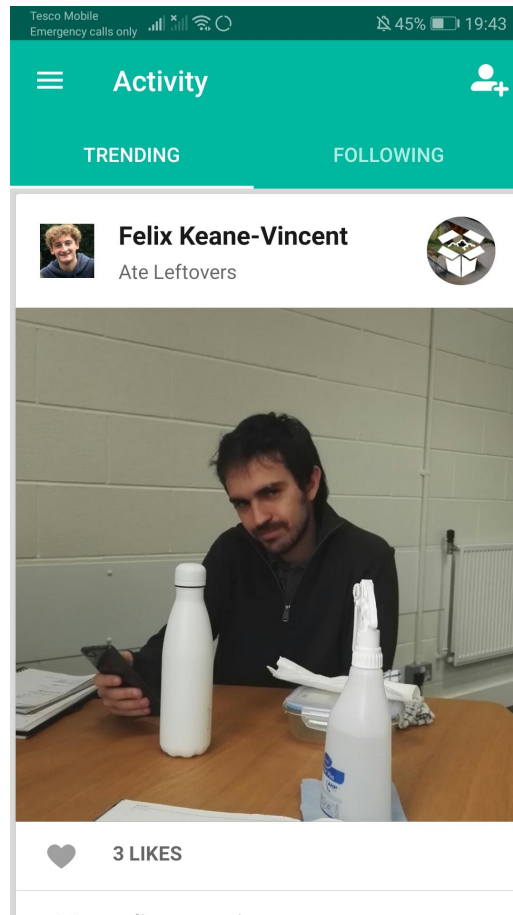
Figure 7: Leaderboard Of Top Users [13]

Figure 8: Posts Of Apps Users [13]

4.3 Refill

This application is simple but quite brilliant. This app's goal is to get rid of plastic bottle waste by using refillable bottles instead of plastic bottles. The app has a few features but the main one being able to find the nearest refill station on google maps. A nice number is displayed of how many bottles were saved by this app. This application also lets you pin water refill stations on the map and view your statistics but one has to create an account in order to do this. You are slo allowed to make in app purchases of bottles which is a great idea. This application also has a very nice design and is straightforward to use. This application is mostly based in the UK and mainly England with only a tiny amount of Users elsewhere. I would like to implement something like this into my application but for Ireland [14]. I have also noticed some major issues with this application. Such as some features do not work and crash the app. I have also noticed minor issues such as the app not loading properly or displaying the correct things. This is definitely something Application Green Quake will try and improve upon. As this application crashes quite often.
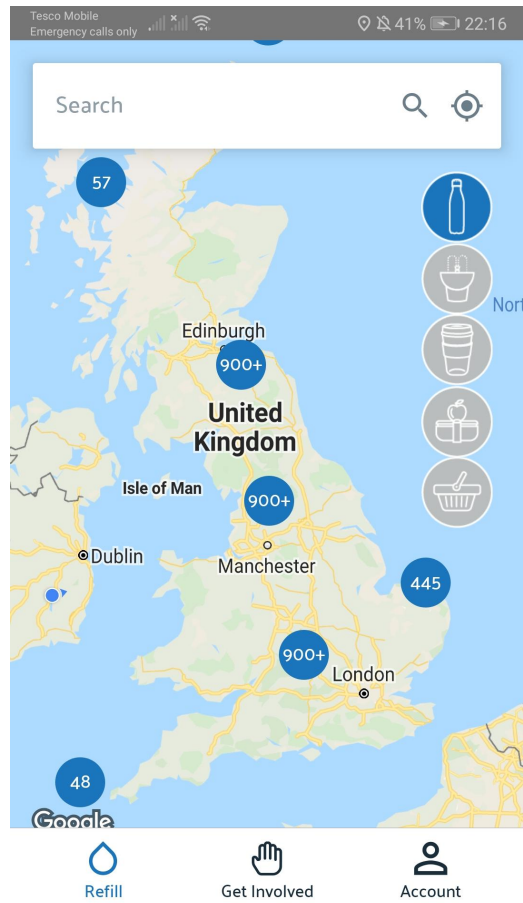
Figure 9: Home Screen [14]

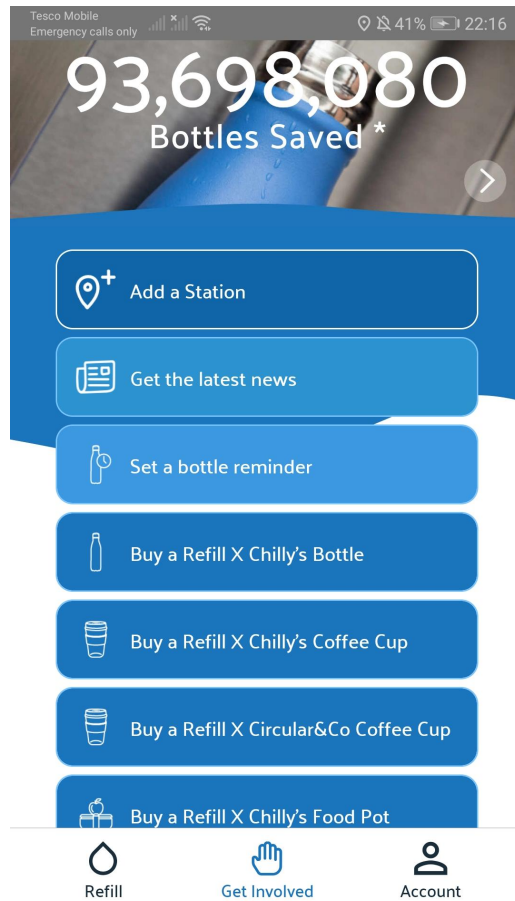**Figure 10:** Map Of Water Refill Station [14]
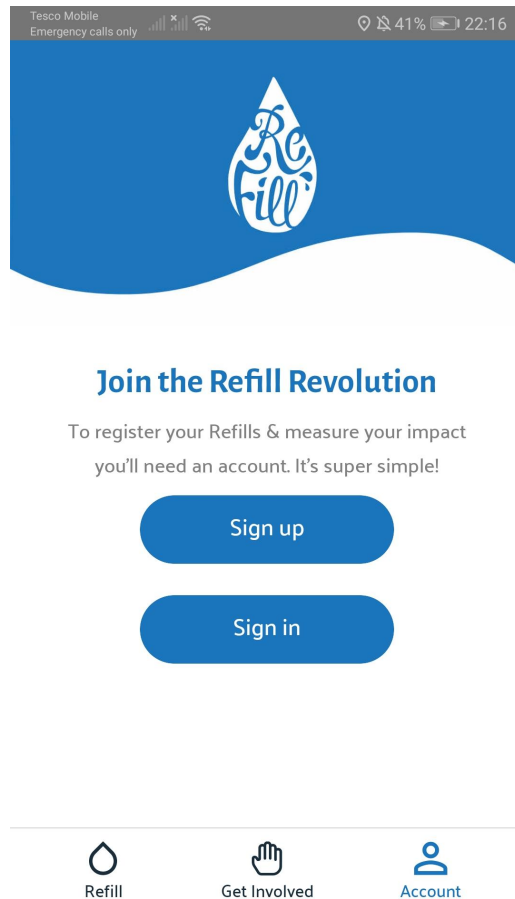
Figure 11: More Options [14]

Figure 12: Create An Account Or Log In [14]

4.4 My Kitchen

My Kitchen is an application with multiple features. It allows users to keep track of what's in their inventory. The user can do this by either entering them manually or scanning their barcode. The user is then notified if their food item is close to expediting and can keep track of them. The user has the option to create a group so multiple people can use the same list. This application is simple to use but you have to pay a subscription fee to get more features and cosmetics and the free version looks quite ugly. I'd like to implement something like this as a side feature of Application Green Quake but differently [15].
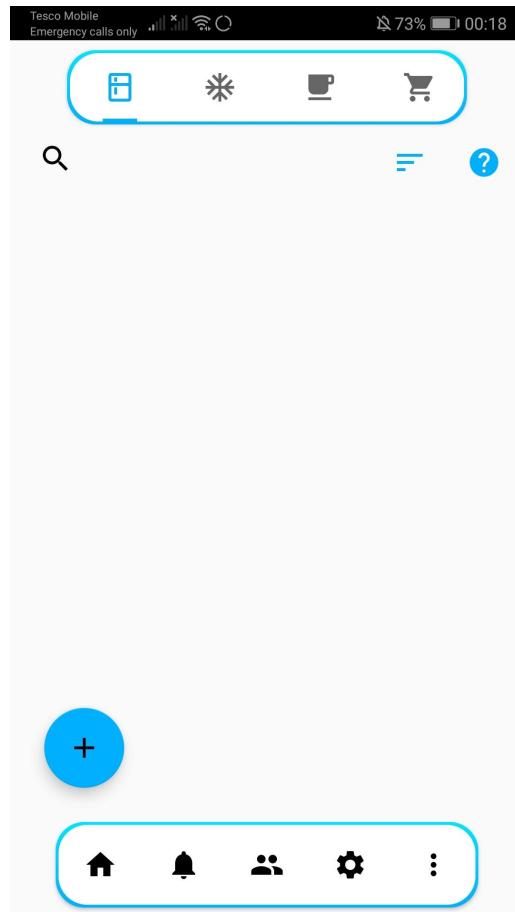
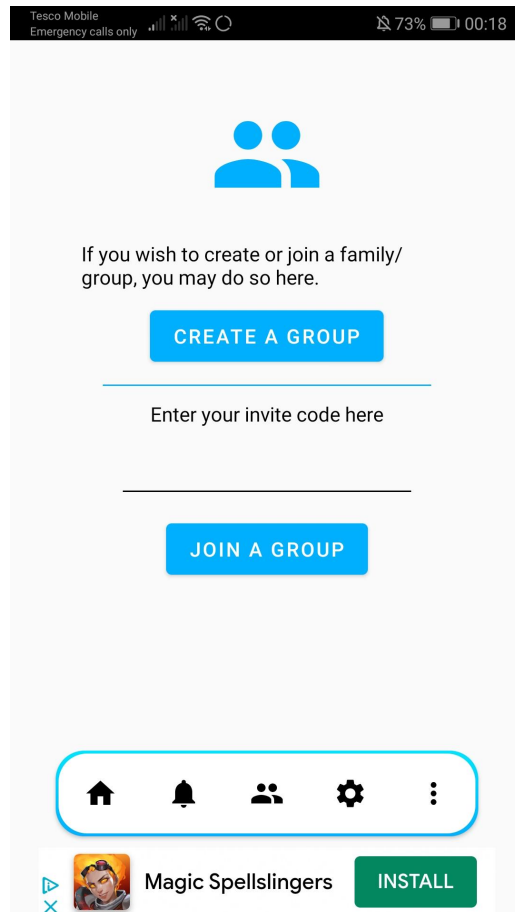**Figure 13:** Main Screen Where Items Can Be Logged [15]

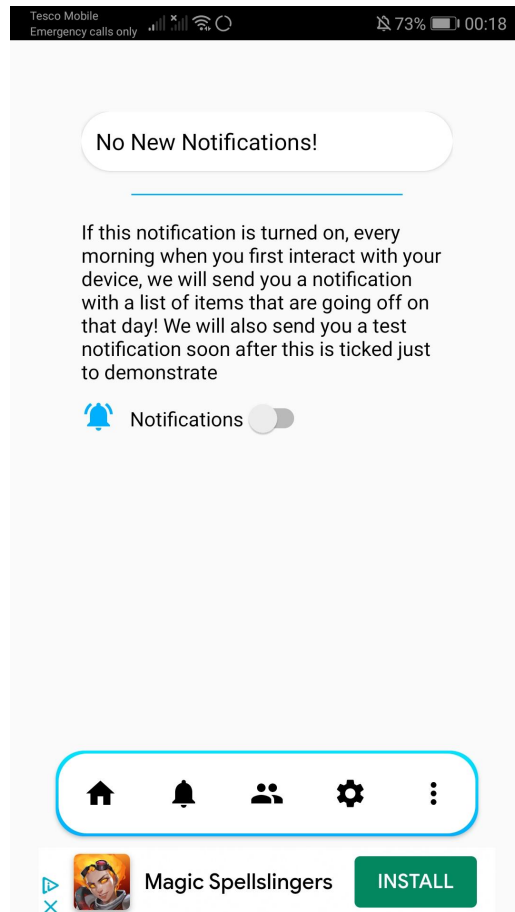**Figure 14:** Create A Group With Who You Share This List With [15]

Figure 15: Screen With Notifications About Almost Expired Food Items [15]
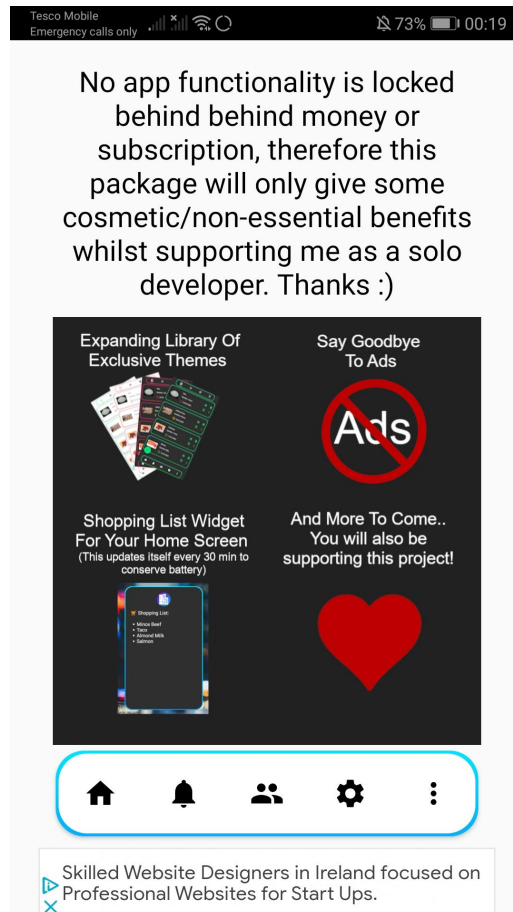
Figure 16 : Screen Requesting You To Purchase Additional Content [15]

4.5 Plume Labs: Air Quality App

This application gives you forecasts on the pollution levels in your area giving you the opportunity to change your plans if you can. The application has 3 main screens. One with the information on pollution levels, one with a map where you choose a location and the final screen is the settings screen. You also have the option to create an account. The app provides great information on pollution levels in the air and even shows the weather. However the application is a bit slow to load and a bit simple with too few features. This application would be better off to be a part of a bigger application rather than a stand alone app. For my project and Application Green Quake I would like to implement something like this that predicts pollution levels but in a different way and with messages for the user [16].
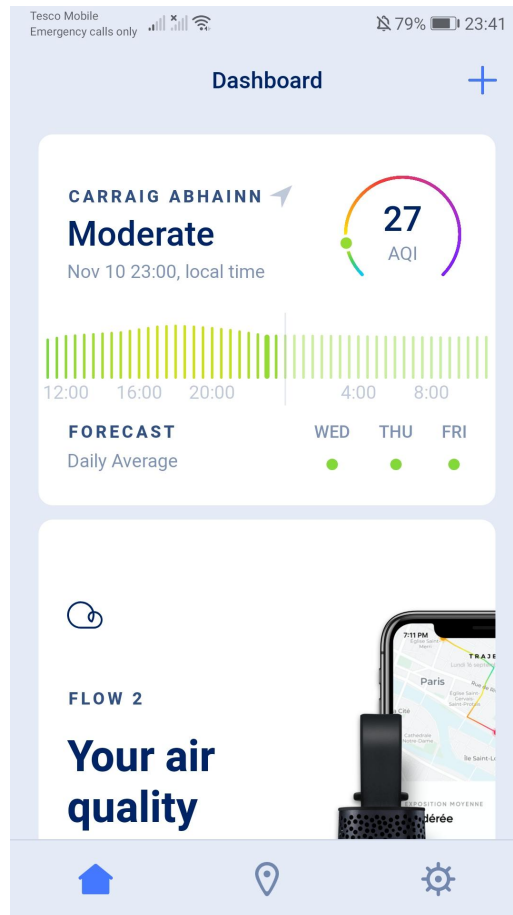
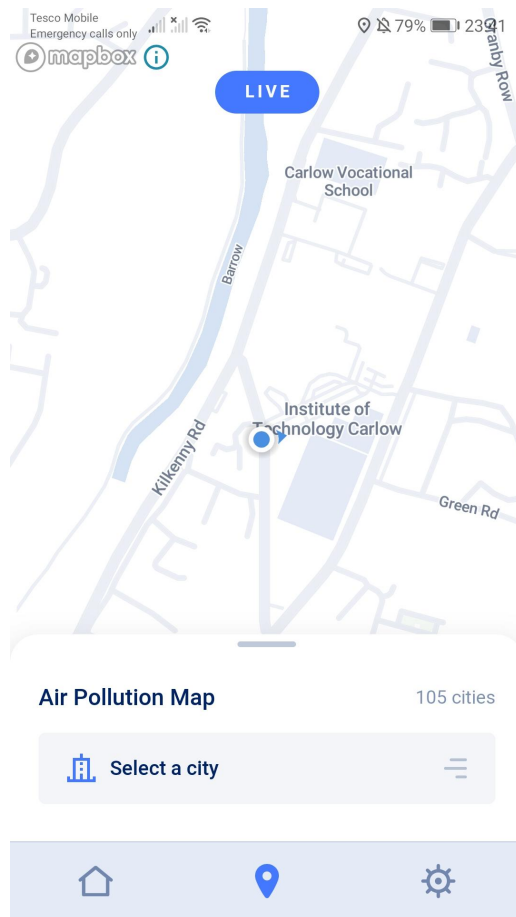**Figure 13:** Main Screen With Air Pollution Information [16]

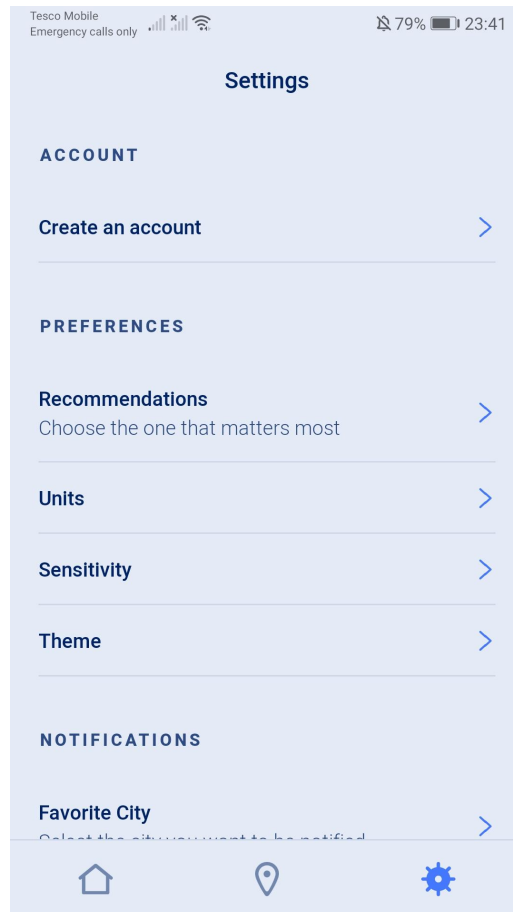**Figure14:** Map Where You Can Select A City [16]

Figure 15: Settings Page [16]

4.6 Conclusion

In Conclusion all these applications have something to offer but all have flaws which could be fixed. In addition to that some of these applications are too lightweight with too few features for someone to bother to download them or keep them. When a person looks for an application they look for an application that can do all that they want or many things that they want as opposed to having many apps on their phones. My solution is to create an application that focuses on gamification of eco friendly actions and also implements some of the features of the other applications in improved ways. With nicer design and better user experience. Application Green Quake will have most of the things you need to become environmentally friendly and will make it easy to stay so.

From the similar applications I have learnt how to implement a user interface and how not to. For example Green Me's user interface is too green, JouleBugs interface is too overwhelming and the points system isn't great. All of these aspects can be improved in Application Green Quake to make the application attractive, easy to use and use gamification like Joulebug to make being eco friendly fun and rewarding. From this research I have also acquired ideas and inspirations on how to implement certain features. When it comes to Air Plume it shows air pollution levels in areas that you search for but that is it. Application Green Quake would show pollution areas over the world to give the user interesting facts and

put them off pollution instead. My Kitchen and Refill can also be improved and some similar features will be applied to Application Green Quake.

5 Software Technologies

5.1 Front End Technologies

5.1.1 Xamarin Forms

Xamarin Forms is an open source mobile development framework used for User Interfaces. It allows developers to develop an application for Android, iOS and Windows simultaneously using a shared code base. It works by creating interfaces in XAML with code-behind in C#. [22]

Figure 16: Xamarin Forms Architecture

This framework is really smooth and easy to use. Thanks to microsoft docs this framework is also very well documented and straightforward to follow. To add to this this framework has high performance and is not difficult to maintain.

5.1.2 React Native

React Native is a framework that combines native app development with ReactJS. React is an open-source, front end, JavaScript library for building user interfaces or UI components. As a result React Native is used for cross platform mobile Development. React primitives render to native platform UI, meaning your app uses the same native platform APIs other apps do. This makes it possible for developers to use a single code for multiple platforms [20].

Figure 16: React Native Architecture [21]

5.1.3 Ionic

Ionic is a popular Framework used to build cross platform applications based on AngularJS. It is an open source UI toolkit for building high performance and quality mobile and desktop applications using languages such as HTML, JavaScript and CSS with integrations of frameworks such as Angular, React and VueJS [17].

The Ionic Framework focuses on the front end of mobile applications. It can integrate with other frameworks such as Angular, React or Vue but it can also work alone without any frontend framework with just using a simple script include. It allows developers to develop and build apps for all major app stores from a single codebase [17.] Ionic apps are built with Cordova. Cordova is a means of packaging html/css/js into apps that can run on mobile and desktop devices and provides a plugin architecture for accessing native functionality beyond the reach of JS run from a web browser. As such, Ionic apps have the Cordova file structure [18].

Figure 17: Ionic Architecture [19]

5.1.4 Conclusion

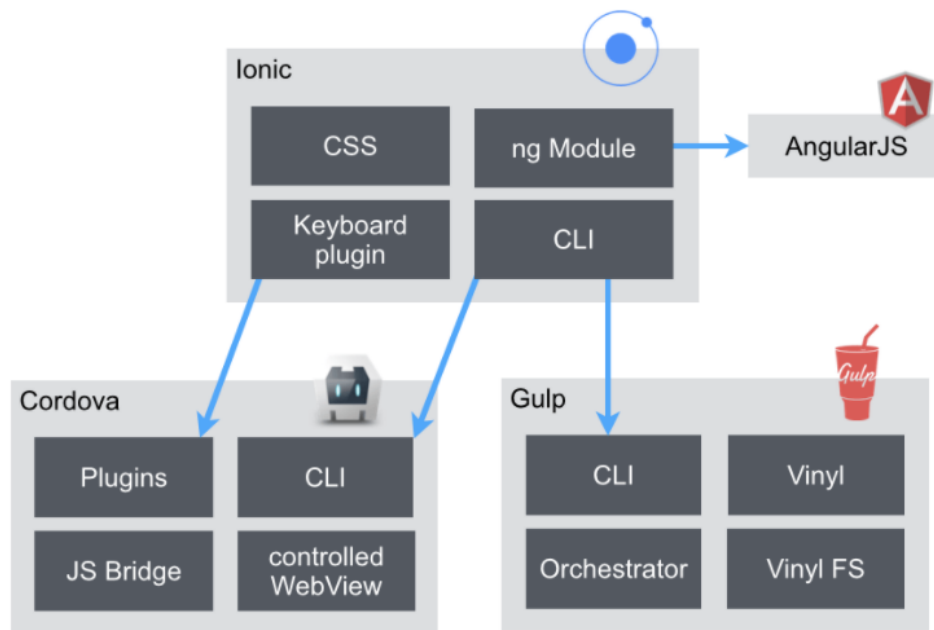After much deliberation even though all three frameworks are suitable to develop this application Xamarin Forms was chosen due to Microsoft's extensive range of documentation and tutorials. As a sole developer on this project it is important to choose a framework that is powerful but also easy and accessible to learn. In addition Xamarin Forms has a broad range of compatible libraries and APIs. Due to these factors it is a leader in the selection process of picking a framework for Application Green Quake.

5.2 Back End Technologies

5.2.1 Firebase

The Firebase Realtime Database is a cloud-hosted NoSQL database that lets you store and sync data between your users in real time. Thanks to the real time aspect it allows collaboration across all devices easily and thanks to it's API's it can be set up to be cross platform with minimal effort. Further to this Firebase is optimized for offline use. This means that when users log off or go offline, the real time SDK's use the local cache to save and store changes. When the device comes back online the local data is automatically synchronised. This database also provides a good level of security which is essential in developing mobile applications and as a google product is very well documented. [23]. For a student. This option is also great because it is free for up to 1 GB of storage.

5.2.2 Realm

Real was designed as a local database for applications that are offline and also as a database for real-time mobile applications. Instead of the traditional object-oriented mapping it was built on top of SQLite with its own database engine. This made it an

object-oriented database rather than a relational database. It provides high performance on cross platform mobile applications with high amounts of data [24]. One negative of this database is that it does not support the auto increment function.

5.2.3 Local Database

A completely different option would be to use a local database. This can be done using the SQLite database engine. It saves data objects in shared code. The problem with this solution is that each device has a separate database and if one device's data updates another ones would not. This is a major issue for Application Green Quake.

5.2.4 Conclusion

In conclusion, after much deliberation Firebase was chosen as the database for this project. The decision was made to use Firebase because overall it is the best application to use. As a product of Google it comes with great documentation which helps with the development and learning of how to use it. It is a suitable database for cross platform applications and different devices and works really well with Xamarin Forms which is our chosen framework. In addition to this Firebase is free to use for up to 1GB of data which is great for a college project and the data is also kept safe thanks to firebase security.

6 Application Design

6.1 Colors

In order to be successful Application Green Quake must be appealing and attractive to the target audience so it gets downloaded and used. In order to achieve this the correct color must be selected. Colors must be selected that also convey the message that this is an environmentally friendly app. To achieve this research on environmentally friendly colours had to be carried out.

After some time researching colors, Green and Blue are seen as the most environmentally friendly colors [27]. Some argue which is more eco-friendly between the two but it is definite that they are the top two. Green is associated with being environmentally friendly due to its connection with nature and the phrase "Going Green" which refers to someone or something going eco-friendly. Blue is also seen as an eco-friendly color and according to a study published in the Journal of Business Ethics, researchers from the University of Oregon and University of Cincinnati some view it to be more eco friendly than others. Below you can see images of examples of environmentally friendly colours and brands that try to present themselves as being eco-friendly.
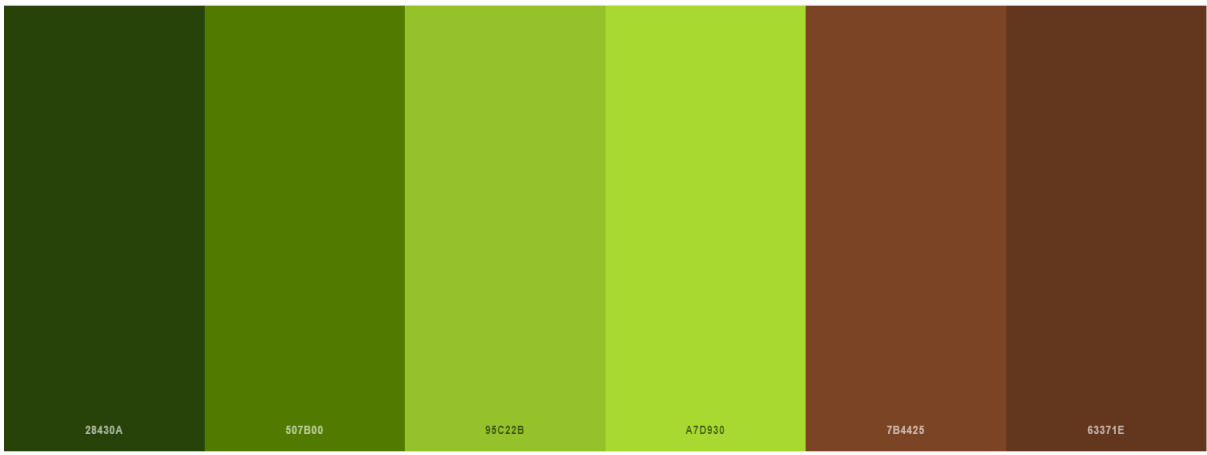
Figure 18: Example of a Eco-Friendly color palette [28]

Figure 19: Example of a Eco-Friendly color palette #2 [29]

Figure 20: Example of Green Environmentally Friendly Logos [27]

Figure 21: Example of Blue Environmentally Friendly Logos [27]

In conclusion as Green Quake is an environmentally friendly application either Blue or Green will be primarily used to help brand it as an eco-friendly application. The logo of the application will be mostly green or/and blue and the app itself will also be a version of blue or green but other colors will be used also in an aesthetically pleasing way. As this application will have three main sections 3 main colours will be used for each section to visualise to the user that they have entered a new section.

6.2 Design

To create an attractive looking app that will catch the users eye and be visually appealing to them we must use the right tools, images and icons to do so. In order to do this we must research and find the best tools and sources of images and icons that we can use for this project. In addition we need some tools to help us with ideas and brainstorming when creating this application.

6.2.1 Tools

Every mobile application needs an attractive, memorable app icon. In Order to create such an icon the correct design tool has to be used such as Gravit Designer. Gravit Designer is a graphic design app that works on all platforms [30]. This tool possesses all the features that will be needed to create an appealing app icon.

Figure 22: User Interface of Gravit Designer [30].

Since the Green Quake application is an application that focuses on gamification and will possess achievements, badges and trophies, a tool is needed for their creation. After careful research a perfect tool was found. The name of this tool is Badge Builder [31]. Badge Builder allows a user to create beautiful badges and ribbons which will be used in this project.

Figure 23: User Interface of Badge Builder [31].

Since Images will be used in this application a good design tool must also be found to be used for editing images and two tools were found which are perfect for the job. The first tool was found very quickly as it is Microsoft's Paint 3D product that comes with Windows. The

second tool was more time consuming to be discovered. Its name is Befunky [32]. This tool has all that is needed for image editing for this mobile application.

Figure 24: User Interface of Befunky [32].
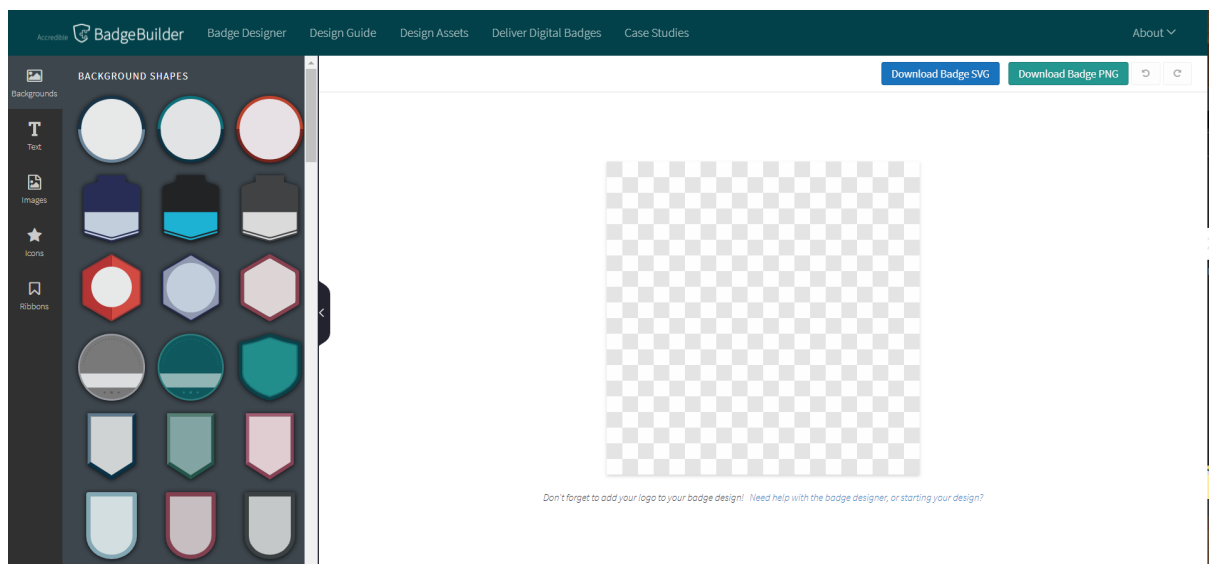
Last but not least a good tool for brainstorming and planning must be seeked out. After some choosing and testing of tools Miro was chosen to be the planning tool for this project [32]. Miro is an online infinite whiteboard with many features.

Figure 25: User Interface of Miro [33].

6.2.2 Images

Since images will be used in this application, images that are free and free to use for commercial use with no attribution have to be found. After extensive research and browsing three websites were found who fulfil said criteria. These websites are Pixabay [34], Pexels [35] and Unsplash [36].

6.2.3 Icons

Every application uses and needs icons. Some icons will be designed and some will be taken from the internet. The icons whose source is the internet must also be free to use like the aforementioned images. After some research and browsing the web three websites were found who fulfil said criteria. These websites are Flaticon [37], Iconfinder[38] and Icons8 [39].

6.3 Conclusion

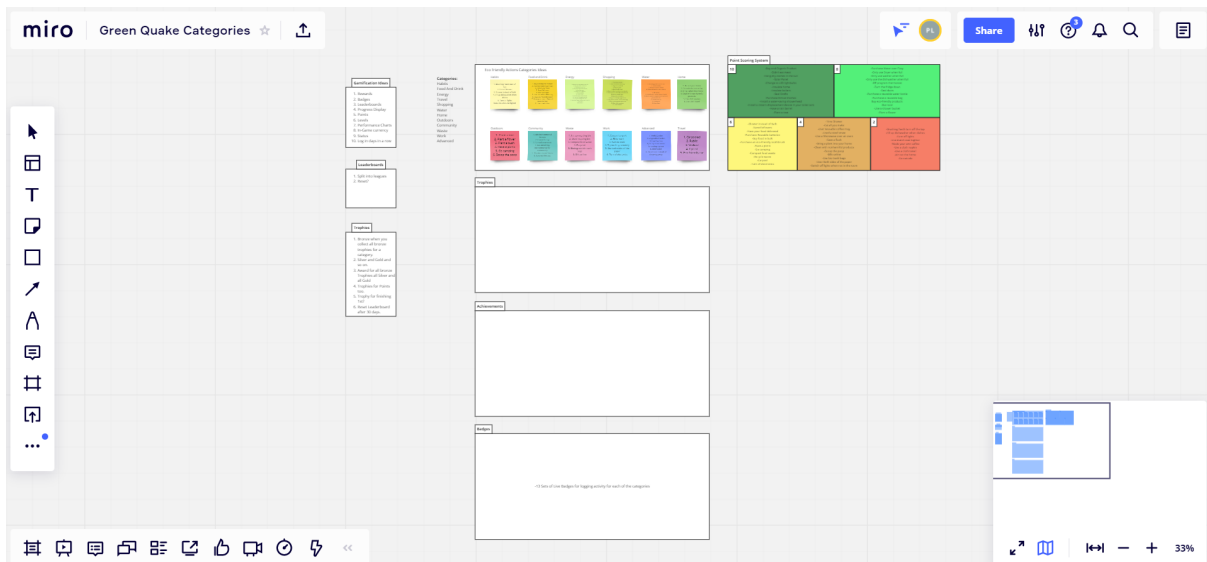After extensive research an idea of how such an application as Green Quake should be designed was found. It was discovered that colours like green and blue are the best to appear friendly to the users and therefore it was decided that Green Quake will be an application themed around shades of green. It was clear that icons and images will be needed for this project and the sources for these have also been found. Finally for the UI and UX design tools were needed that would enable the design of the app, the badges, the achievements, the trophies and allow the editing of images and icons. These tools have also been found as can be read in the content above.

7 Firebase Authentication

Figure 26: Image representing Firebase [40].

Every application needs a way of performing CRUD operations for user data. Firebase Authentication allows us to do just that and simplifies the process. Firebase Authentication provides backend services, easy-to-use SDKs, and ready-made UI libraries to authenticate users to the app [40]. This is why this approach will be taken for user authentication in the Green Quake Application.

8 Gamification In Mobile Applications

The Green Quake Application will be a mobile application and therefore gamification in mobile applications must be researched.

8.1 Why Achievements, Trophies, and Badges Work

It has been proven that Achievements, Trophies, and Badges Work do indeed truly work and we will inspect the reasons for why they work below.

8.1.1 They Set The Bar For Our Expectations

One of the reasons for why they are so effective is that they set the bar for our expectations [41]. When a person sees a high score this sets the person's expectation of what a good score is and what they could shoot for. When a person sees an achievement they will know what achievements they want to earn.

8.1.2 They Empower Us

Achievements empower us. They make us strive towards them and once the achievement is earned a great sense of pride is felt which makes the person want more [41]. They empower us as they set us a goal which we assume we must be able to reach otherwise there would be no such achievement.

8.1.3 Satisfaction

No one can deny that earning achievements is not satisfying. Especially when it comes to something that a person is passionate about [41].

8.1.4 Progress Motivates Us

When a person is in the process of completing or earning an award they see the progress that they have made and the progress that is left to do [41]. Then they are more likely to persist and keep going until that Achievement is unlocked. We all know that if progress is at 99% almost everyone will go on until they hit 100% and progress.

8.1.5 Social Comparison

Social Comparison is one of the driving factors of society and gamification is no different [41]. When a friend shows that they possess more achievements than their other friend. The friend with less achievements is more likely to be motivated to catch up or beat their friend. This is especially evident in teenagers where friends compete for the amounts of followers and likes they get.

8.2 How To Make Them Work

8.2.1 Variety

Incorporating all types or as many types of badges/achievements in an application helps the users feel motivated for every single effort they make [42]. If they are all the same then

earring them will feel boring and pointless. Simple colour or shape changes are enough to have a high impact on the desirability of their accomplishment.

8.2.2 Meaningfulness

It is important to attach a meaning to them [42]. For example when earring a badge for scoring a goal the badge should somehow visually represent scoring a goal which makes it meaningful.

8.2.3 Visual Appeal

The most important aspect is to make them visually appealing [42]. It is a fact that people overpay for items just because they look good or make themselves look good. When it comes to Badges, Trophies and Achievements it is no different. If it looks good the user will want to get it.

8.3 Most Popular Gamification Features

8.3.1 A Progress Bar

A progress bar does exactly what it says [43]. It shows the user how much progress they have made and as mentioned before this motivates a person to keep going. The impact of knowing where a person is in terms of progress in any situation is immeasurable on motivation. If a person is close to the end but does not know it than they are much more likely to give up than if the person knew that they were at 95%.

8.3.2 Achievements

People like rewards and being recognised or praised and achievements do just that [43]. A simple colorful award on a mobile application is enough and certainly better than nothing to encourage someone to keep going.

8.3.3 In Game Currency

A huge feature in gamification is in game currency [43]. This allows users to purchase otherwise unavailable items or levels and the alike. This is a very good feature as it makes the game addictive. A user wants to earn currency so that they can purchase things.

8.3.4 A Leaderboard

Adding a competitive aspect to an app will make your users work hard to outdo one another [43]. Leaderboards do just this and can make the app addictive.

8.4 Conclusion

In this section it has been discovered and documentation what features should be implemented into applications for their gamification element to work to the desired effect on it's users. As such these gamification elements will be incorporated into the Green Quake Application to make it's gamification successful.

9 Final Conclusion

In conclusion this document has provided the research to acquire all the knowledge that was needed in order to design and build this application. Thanks to this research it was concluded what should and what should not be incorporated into the final application. This research has also aided in finalizing the UI-UX design for the application. This research can therefore be concluded as a success.

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