

Student Details (Student should fill the content)				
Name	Mushad Aadil			
Student ID	KD/BSCSD/07/01			
Scheduled unit details				
Unit code	CIS6002			
Unit title	Software Engineering Dissertation Project			
Unit enrolment details	Year	3		
	Study Period	2019		
Lecturer	Gihan Herath			
Mode of delivery	Full Time			
Assignment Details				
Nature of Assessment	Coursework (Report)			
Final Grade Weighting	Thesis: 65%			
The topic of the Case Study	Climate Change			
Learning Outcomes covered	LO1			
Word count	~ 70 to 100 Pages			
Due date/ Time	05 th Sep 2019 / 12 A.M			
Extension granted?	Yes	No	Extension Date	
Is this a resubmission?	Yes	No	Resubmission Date	
Declaration				
I certify that the attached material is my original work. No other person's work or ideas have been used without acknowledgment. Except where I have clearly stated that I have used some of this material elsewhere, I have not presented it for examination/assessment in any other course or unit at this or any other institution				
Name/Signature		Date	05/09/19	
Submission				
Return to:				
Result				
Marks by 1 st Assessor		Name & Signature of the 1 st Assessor		Agreed Mark
Marks by 2 nd Assessor		Name & Signature of the 2 nd Assessor		
Comments on the Agreed mark				

ASSIGNMENT FEEDBACK SHEET

STUDENT NAME:		STUDENT NUMBER:	
Module Number & Title:		Semester: III	
Assignment Type & Title:			
For student use: <i>Critical feedback on the individual progression towards achieving the assignment outcomes</i>			
<u>For the Assessors' feedback</u> Indicate the Task number strength and Weakness and the marks for each task			
Task No/ Question No	Strengths (1 st Assessor)	Strengths (2 nd Assessor)	

Task No / Question No	Weaknesses (1st Assessor)			Weaknesses (2nd Assessor)	
Areas for future improvement					
Comments by 1st Assessor			Comments by 2nd Assessor		
Marks					
Task /Question No	Marks by 1st Assessor	Marks by 2nd Assessor	Marks by IV (if any)	IV comments (If Any)	
Total Marks					
Name and the Signature of the 1st Assessor				Date:	
Name and the Signature of the 2nd Assessor:				Date:	
Name and the Signature of the IV: (if any)				Date:	



Cardiff
Metropolitan
University

Prifysgol
Metropolitan
Caerdydd

Cardiff Metropolitan University

Combating Climate Change

Submitted on September 2019

By

Mushad Aadil

Student ID - [st20157913] – [KD/BSCSD/07/01]

This dissertation is submitted in partial fulfillment

Of the requirements for the degree of

Bachelor of Science (Honours)

BSc (Hons) Software Engineering

DECLARATION

This work is being submitted in partial fulfillment of the requirements for the degree of

.....and
has not previously been accepted in substance for any degree and is not being
concurrently submitted in candidature for any degree.

Signed - (Candidate)

Date -

SUPERVISOR'S DECLARATION STATEMENT

Student Name -

Supervisor's Name -

I acknowledge that the above-named student has regularly attended the meeting,
and actively engaged in the dissertation supervision process.

Signed - (Supervisor)

Date -

ABSTRACT

This is the dissertation project for Bachelor's Degree in Software Engineering. In this paper, I discuss the effects of climate change and the consequences we will face in the nearby future. There are various ways to combat this issue and I have adopted a unique approach that isn't talked about considerably. This method involves combating climate change by focusing on individuals. I develop an application that aims to change the behavior of individuals. Various psychological tactics are employed to create this product. I have talked about the causes of climate change and its consequences in the introduction subdivision. In the literature review, I talk about the different psychological strategies that can be employed to influence different behaviors in humans. I compare different strategies and select the most effective one. Then this tactic is used to develop the application which is detailed in a Software Development Lifecycle approach which includes planning, design, implementation, and testing & deployment. All the resources used have been referenced in the respective fields.

ACKNOWLEDGMENT

This is a final dissertation which is a combination of all the modules taught in the degree program. I acknowledge Mr. Gihan Herath – Computational Intelligence and overlooking the Dissertation Project, Mr. Prabu Premakumar – Advanced Programming, Mr. Induranga De Silva – Analytics & Business Intelligence, and Professional & Ethical Issues in IT. And all the other staff at the International College for Business and Technology Kandy.

TABLE OF CONTENTS

Abstract.....	1
Acknowledgment.....	1
Table of Contents.....	2
List of Figures.....	4
List of Tables.....	5
1.0 Introduction.....	6
1.1 Causes.....	6
1.2 Transforming Entities.....	7
1.3 Who benefits?.....	9
1.4 How can you help?.....	9
1.5 Current situation leading to problem identification	10
2.0 Literature Review.....	11
2.1 Habit Development	11
2.1.1 The Process of Habit Formation	11
2.1.2 Can Habit be Changed or Replaced?	14
2.1.3 The Habit loop can change how we think.....	14
2.2 Actions are taken by the government and organizations to influence the behavior of the individual consumer	15
2.2.1 Types of thinking	16
2.3 Similar apps/ IT solutions. Feature/weaknesses/strengths	17
3.0 Planning	22
3.1 Requirement Analysis and Specification	22
3.1.1 Purpose of the document.....	22
3.1.2 Scope.....	22
3.1.3 Functional Requirements	22
3.1.4 Non-Functional Requirements	23
3.2 PESTLE Analysis.....	23
3.2.1 Political	23
3.2.2 Economical	24
3.2.3 Social.....	24
3.2.4 Technological.....	24
3.2.5 Legal	24
3.2.6 Environmental.....	25

3.3 SWOT Analysis.....	25
3.4 Risk Assessment.....	27
3.5 Data Collection.....	29
3.5.1 Questionnaire	29
3.6 Product Description.....	30
3.7 Feasibility Study.....	32
3.7.1 Cost Feasibility	32
3.7.2 Time Feasibility	32
3.7.3 Technical Feasibility	33
3.8 Project Timeline	34
3.9 Required Resources.....	34
3.9.1 Hardware.....	34
3.9.2 Software	34
3.9.3 Developer.....	35
3.10 Expected Output and Outcome	35
3.11 Limitations	36
3.12 Ethical Deliberations	36
4.0 Design	37
4.1 Entity Relationship Diagrams (ERD).....	37
4.1.1 ERD for Product Scanning.....	37
4.1.2 ERD for Earning Rewards	38
4.1.3 ERD for EV Charger.....	39
4.1.4 ERD for Social Media.....	39
4.2 Use Case Diagram.....	40
4.2.1 Use Case Diagram for Calculation Process/Algorithm	40
4.2.2 Use Case Diagram for Product Scanning.....	42
4.2.3 Use Case Diagram for EV Charger.....	43
4.2.4 Use Case Diagram for Social Media.....	45
4.3 Sequence Diagram.....	46
4.4 Class Diagram	48
4.5 Wireframe.....	50
4.6 Calculation Algorithm Flowchart.....	52
5.0 Implementation	53
5.1 Code Samples.....	53
5.1.1 Flutter app frame.....	53

5.1.2 Scaffold & App bar	53
5.1.3 Navigation Bar	54
5.1.4 Calculation Algorithm	55
5.1.4 Viewing Statuses.....	55
5.2 Working Application Interfaces	56
5.2.1 Home Page	56
5.2.2 Login Page	56
5.2.3 Calculation Page	57
5.2.4 Finding EV Chargers	57
5.2.5 Sharing Achievements	58
6.0 Testing and Deployment	59
6.1 Test Plan.....	59
6.2 User and Technical Documentation	III
6.2.1 Registration	III
6.2.2 Calculation Page	V
5.2.6 Sharing onto social media	V
7.0 Conclusion	VI
Works Cited and Bibliography	VII

LIST OF FIGURES

Figure 1 - CO2 Emissions.....	6
Figure 2 - Deforestation	6
Figure 3 - Plastic Disposal in Ocean.....	7
Figure 4 - Chemical Run-off into river	7
Figure 5 - Shoes made from plastic	8
Figure 6 - Bhutan Mountains	8
Figure 7 - GBRF	9
Figure 8 - The Habit Loop	12
Figure 9 - Click Sound. Phase 1.....	13
Figure 10 - Click Sound. Phase 2.....	13
Figure 11 - Habit Loop for Pepsodent	14
Figure 12 - Brain Waves. Phase 1.....	14
Figure 13 - Brain Waves. Phase 2.....	15
Figure 14 - Visual Marketing.....	17
Figure 15 - GoodGuide rating system.....	17
Figure 16 - iRecycle app	18
Figure 17 - Leaffully Trends Page	19
Figure 18 - Leaffully Overview Page.....	19
Figure 19 - PlugsShare app	19

Figure 20 - PaperKarma app	20
Figure 21 - greenMeter app.....	20
Figure 22 - Air Visual app	21
Figure 23 - Joulebug app.....	21
Figure 24 - Questionnaire. QR Code	29
Figure 25 - Questionnaire. Page 1.....	29
Figure 26 - Questionnaire. Page 2.....	30
Figure 27 - Questionnaire. Page 3.....	30
Figure 28 - Green Travel Choice	31
Figure 29 - Rewards System 1	32
Figure 30 - Rewards System 2	32
Figure 31 - Firebase	33
Figure 32 - Project Timeline	34
Figure 33 - Flutter	35
Figure 34 - ERD Cardinality.....	37
Figure 35 - ERD Product Scanning	38
Figure 36 - ERD Earning Rewards	38
Figure 37 - ERD EV Charger.....	39
Figure 38 - ERD Social Media.....	40
Figure 39 - Use Case Diagram. Calculation System.....	41
Figure 40 - Use Case Diagram. Product Scanning	42
Figure 41 - Use Case Diagram. EV Charger.....	43
Figure 42 - Use Case Diagram. Social Media.....	45
Figure 43- Types of Multiplicity.....	49
Figure 44 - Wireframe. Page 1.....	50
Figure 45 - Wireframe. Page 2.....	50
Figure 46 - Wireframe. Page 3.....	51
Figure 47 – Code for Flutter app frame	53
Figure 48 – Code for Scaffold and app bar.....	54
Figure 49 – Code Navigation bar.....	54
Figure 50 - Code for Calculation Algorithm.....	55
Figure 51 - Code for Viewing Statuses.....	55
Figure 52 - Home Page Interface	56
Figure 53 - Login Page Interface	56
Figure 54 - Calculation Page Interface	57
Figure 55 - EV Chargers Interface.....	57
Figure 56 - Achievements Page Interface.....	58
Figure 57 - German activists standing on ice.....	VI

LIST OF TABLES

Table 1 - Required Specifications.....	23
Table 2 - SWOT Analysis.....	26
Table 3 - Risk Assessment.....	28
Table 4 - Cost Feasibility.....	32
Table 5 - Test Cases.....	65

1.0 INTRODUCTION

One of the most pressing issues faced by humanity in this modern world is Climate Change. Global Warming in simple terms is the rise of the average temperature on the surface of the earth. The rise in global temperatures is caused by both natural and man-made factors. This is called the greenhouse effect. The earth is covered by an ozone layer that protects it from the sun's radiation. Molecules of greenhouse gasses in the air and clouds absorb the sun's radiation and reflect it back into the earth's atmosphere. This causes the surface temperature to increase. The primary greenhouse gasses are Water Vapor, Carbon Dioxide, Methane, and Nitrous Oxide.

1.1 Causes

The emissions of greenhouse gasses are caused by a varying number of factors triggered by different entities:

Overpopulation & Lifestyle – Overpopulation is the driving factor in the increase in greenhouse emissions.

- Some may argue that **Carbon Dioxide** emissions are released through natural processes such as respiration and increasing evidence point that the burning of **fossil fuels** for generating electricity and petroleum for cars release vast amounts of Carbon Dioxide (CO₂) into the air.
- Large amounts of **Methane** are released by livestock, predominantly cows. As the population grows, higher **livestock** demands need to be met. On average cows release between 70 to 120 kg of Methane per year. (TimeForChange, 2008) Decomposition of landfills.
- This is one of the most debated topics among scientists. As the earth's population is rising faster than ever before, tropical land is being cleared out for agriculture. Moreover, **deforestation** has increased to make space for homes and expanding cities. With habitat transformation on the increase, there aren't enough trees to absorb the rainwater causing more **Water Vapor** to stay in the air. While only 30% of oxygen is produced by trees on the land, running out of **oxygen** could be considered a factor in the long run. (News, 2019)
- **Nitrous Oxide** is primarily found in fertilizers and pesticides used for agricultural and beautification farming.



Figure 1 - CO₂ Emissions



Figure 2 - Deforestation

Another main contributor to climate change that isn't widely discussed is the pollution of our oceans. 70% of the world's oxygen is produced by the oceans. Just like above the ground, the tiny plant at the surface of the oceans called phytoplankton use sunlight and carbon dioxide to produce food, and a by-product of photosynthesis is oxygen. Coral reefs also protect coastlines from waves, storms, and floods. The sad truth is that coral reefs are being destroyed at an alarming rate. At the current rate in 30 years all the coral reef in the world is estimated to be dead. This is due to several factors:

- **Nuclear waste** – There are about 450 commercial nuclear power plants in 31 countries. In 2010 about 10.4% of the world's electricity was generated from nuclear power. All this comes at a great cost which is nuclear waste. Nuclear waste emits high levels of radiation which could kill humans in seconds. Companies needed a safe place to dispose of this waste, a place where there wouldn't be human contact and the best option was the deep ocean. The increase in the disposal of nuclear waste has contributed to the death of coral reefs which produce oxygen.
- **Plastic disposal** – Another reason why coral reefs are dying is the increasing use of plastic by humans. In 2017 there were 381 tonnes of plastic produced with only 9% of them being recycled. All the plastic waste is being disposed in the deep seas. A great example of this is the great Pacific garbage patch. Experts say that by 2050 there could be a number of plastics as there are fish in the oceans. Millions of tonnes of garbage are dumped every year on the Pacific Ocean. This causes the coral reefs to develop diseases like any living organisms and not be able to produce oxygen and function as it would if it were in full health. Another consequence of plastics in the oceans is that fish get tangled and swallow plastics. Reports claim at least 70% of all fish have ingested plastic and about 1 million animals are killed each year due to entanglement and ingestion. This destroys marine life. Fish and coral reefs need each other to survive.
- **Runoff from factories and farms** – Factories and farms located in urban areas runoff their wastage into close by rivers and reservoirs. This can vary from chemical waste to toilet water.
- **Sunscreen** – With the increase of tourists visiting beautiful coral reefs comes great damage. Sunscreens contain two types of toxins called Oxybenzone and Octinoxate. These chemicals which are used to absorb ultra-violet lights are harmful and can kill coral reefs. 14,000 tons of sunscreen are thought to wash into the oceans each year. (Zachos, 2018)



Figure 3 - Plastic Disposal in Ocean



Figure 4 - Chemical Run-off into river

1.2 Transforming Entities

All these problems seem to have solutions that are suggested by scientists and environmentalists. Most of them include simply changing our lifestyles. Various

governments, multinational companies have adapted to many changes that are helping the environment. This increases awareness and in turn, an increasing number of individuals are making changes.

- In terms of carbon dioxide emissions – We need to fly less, upgrade to more modern cars which have better fuel efficiency providing higher range and cars with lower emissions. Better yet buy electric cars. Electric car manufacturers such as Tesla have received a lot of praise in recent years. This is mainly due to their outstanding achievements in battery technology and electric car expertise. Customers praise Tesla for the quickest production car with 0 to 60 mph in 3.2 seconds. (Motors, 2019) They are quiet and vibration-free and need very little maintenance such as oil change. Most consumers in Europe and North America are buying electric cars. Norway has become the world's EV capital because the Norwegian government provides subsidies such as prioritized parking and free charging to its citizens in an effort to promote this market trend.
- In terms of electricity consumption. It is estimated that 80% of the world's energy is generated by burning fossil fuels. People can stop climate change by upgrading their home energy source to solar panels. They could use materials such as Fiberglass which provides better insulation. This means it keeps the cold and hot weather out while maintaining the temperature inside the home. Fiberglass is cheap to produce and is eco-friendly. Most modern architectures are inspired by large open panes of glass. This includes houses and commercial businesses alike. Fiberglass is the material consumers opt for due to its numerous advantages.
- People can consume less meat reducing the demand for livestock production. This promotes healthier options and improves lifestyle. WeWork the workplace sharing company has put a ban on employees eating meat inside the workplace to reduce their carbon footprint. (Hub, 2018)
- Adidas and Levi Strauss have taken a different approach. They are minimizing the damage rather than try to control it. Both have taken the approach to reuse plastic bottles in a special edition to produce jeans and shoes. A similar approach is adopted by Starbucks and McDonalds to replace plastic straws with paper straws.
- It is argued by environmentalists and scientists that enough agricultural food can be produced to feed the entire population without the need for habitat transformation.
- One of the most unspoken governments that are contributing vastly to help conserve the environment is the government of Bhutan. In one of the Ted talks by Tshering Tobgay. He mentions how a third-world country that isn't wealthy is making major efforts to not leave a Carbon Footprint. The Bhutan King Jigme Khesar enforced a constitution that demands that at least 60% of the country remains under forest cover. Bhutan's development is based on Gross National Happiness (GNH) rather than Gross National Product (GDP). Bhutan is



Figure 5 - Shoes made from plastic



Figure 6 - Bhutan Mountains

conserving the environment in ways such as: providing free renewable electricity to farmers. The idea behind this that they will not have to use firewood. Investing in sustainable transport and subsidizing the purchase of electronic vehicles. The entire government aims to go paperless. All of this is covered by the national program Green Bhutan. (Tobgay, 2016)

- A new company in British Columbia called Carbon Engineering uses a process called Direct Air Capture to remove carbon dioxide from the air. It claims that one plant could do the work of 40 million trees. It is even backed by Bill Gates. (CNBC, 2019)
- Apart from major corporations, there are many small non-profit Foundations and Campaigns that have devoted their mission to protect coral reefs and the environment. A good example is Save The Reef and the World Wildlife Fund for Nature (WWF).



Figure 7 - GBRF

1.3 Who benefits?

Does anyone benefit from global warming?

Northern countries like Canada and Russia have the vast majority of their land covered in ice. If the earth's temperature increases some of this ice may melt resulting in economic benefits for these countries. Land previously uninhabitable can now be used for various projects like agriculture and commercialized industries.

1.4 How can you help?

Collectively individuals can make a huge impact on helping to fight climate change. Below are some ways in which we can do that:

- **Get charged up with renewables** – Use renewable energy. The most common and practical solution for individuals would be to install solar panels on their roofs. This is especially helpful when your electricity supplier doesn't use renewable sources. Companies like Sunrun and Tesla provide products to cater to this.
- **Green your commute** – Using public transport and services like ride-sharing can reduce the carbon emissions released into the atmosphere. Uber is a popular ridesharing app. People are encouraged to fly less and use alternatives like video conferencing to attend meetings.
- **Use less energy** – This is self-explanatory. Turn off the lights when you leave the room and water when brushing your teeth. Dry your clothes in the sun instead of using a dryer. Use Energy Star certified electronics and appliances. Adopting this approach could save you money as well.
- **Eat climate stable food** – Try to go Vegan is possible and reduce your meat consumption.
- **Waste and consume less** – 1.3 billion metric tonnes of food is thrown or lost every year. The main contributor to this is restaurants and consumers in first world countries while people may be starving in some parts of the world. (David, 2018)

- Finally, and most importantly, **increase awareness** on the subject – Educate your friends and family how important an issue this is.

In my proposal to develop a product where these solutions are implemented.

1.5 Current situation leading to problem identification

Currently, the increase in greenhouse gasses is leading to an increase in temperature of the earth's atmosphere at an alarming rate. Between 1980 and now the surface temperature has increased by 1.7 F. This may not seem much but considering the heat humans combinedly emit (400,000 atomic bombs) this has drastic consequences. Future generations are in trouble with storms and hurricanes growing larger with longer periods of dryness in between. The climate disaster will be severe that it may destabilize entire nations and cause problems such as:

- Sending millions of **refugees** across the border to countries such as Canada and Russia as other countries become too hot to be habitable. People may have to live in slums and unhygienic conditions.
- **Mass Extinction** of most species that require cold weather for survival. (News, 2019)
- Melting of polar ice glaciers will cause a **rise in sea levels**. This may be troublesome to coastal cities which will eventually sink. A great example of this is the city of Jakarta in Indonesia. About 45% of the city is already underwater and is continuing to sink at 10 inches per year. Some may argue that this is due to partly the bad infrastructure of the city, but climate change also plays a major role. (Conversation, 2015)
- All the reasons mentioned above would take centuries to take effect but a collapse in agriculture would cause immediate chaos. This is caused by longer periods of dryness. With no rainwater farmers fail to keep crops alive, thereby limiting supply and increased prices. People may die of starvation. Longer periods of dryness were observed in Sri Lanka in the first months of 2019. Headlines emerged that the Ministry of Power, Energy, and Business Development imitated a program to create artificial rain to combat this problem in the future. This was tested successfully with a pilot over the Maussakele Reservoir. (Derena, 2019)
- Another immediate effect on humans would be that since fish are ingesting large amounts of plastics, it ultimately means that we humans are consuming them. About 3 billion people rely on seafood for day to day survival.

So, you may be wondering, how does this all affect humanity since the global temperatures have only risen by 2 degrees in the past 30 years. And humans are the smartest species and can adapt to extreme conditions.

The changes that we are causing will not directly affect humans as yet and will take decades to be in full effect but as of now, it'll drive us to wars and human conflict. This will be the plausible extinction of humans.

2.0 LITERATURE REVIEW

For a person to be environment-friendly and reduce their carbon footprint they need to make certain changes to their lifestyle. This will influence the way they travel, foods they eat and other consumer products they use. All this depends on changing their way of thinking and mentality on how they perceive certain things. They may need to prioritize some actions over others.

And after certain actions have been implemented, they need to be sustained to make a positive impact. This is where **Habit Development** comes in. A habit in simple terms is a settled or regular tendency and practice that is hard to give up. Due to repetition the behavior gradually becomes progressive subconsciously.

A great understanding of how habits work and are formed is necessary to apply the concept of being environment-friendly to communities and individuals. Techniques on influencing behavior are also important.

2.1 Habit Development

Essentially for an action to become a habit, it needs to:

- **Occur regularly**
- **Efficiency**
- **Uncontrollability**
- **Cued by an entity in the environment.** This can be represented in any way, shape, or form
- **Triggered without thought of the action itself.** An example we can relate to is breathing. Though it is encoded into our DNA and is essential to how our body functions, this process is automatic and repetitive. Which classifies it as a habit.

2.1.1 The Process of Habit Formation

Forming habits and making them stick is a complicated task. It involves a study of how the complex human brain works and reacts to certain tasks under different circumstances. Fortunately, there have been various studies and clinical tests done on both humans and animals (lab rats (Duhigg, 2012)) which prove various methods that are successful in developing habits.

American Journalist Charles Duhigg talks in his book, “The power of habit” that habits are formed by a continuous process called the Habit Loop. (Duhigg, 2012)The Habit Loop consists of three components. These are linked in a continuous cycle. Namely:

- **The Cue** – A trigger in the environment that jumpstarts the action subconsciously
- **Routine** – When the brain recognizes the trigger it starts to perform the routine tasks.

- **Reward** – We perform routine tasks because at the end of it we receive a reward which may be satisfactory to our needs and wants. This can also be the prize telling us if this loop is worth the hassle. If a positive response is received, we are more likely to do continue this loop in the future.

And this is the simple process of how a habit is formed. An action should result in any form of reward such as satisfaction.

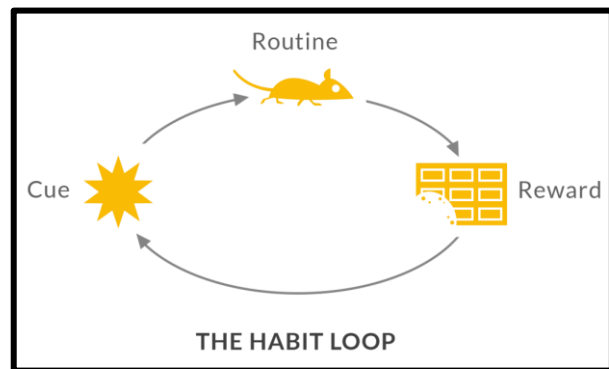


Figure 8 - The Habit Loop

A great example of the habit loop in which many people can relate is when laying around at home with absolutely nothing to do, we may walk up to the fridge to find snacks to consume. The Cue will be boredom. The Routine will be the task of checking the refrigerator or cabinet for the availability of snacks. Finally, the Reward will be the satisfaction we get from the wonderful flavors in the snacks. Different flavors can be used to satisfy diverse moods. Similarly, when entering the cinema, the first thing we notice is the smell of fresh popcorn. The smell is strong and generally pleasing.

According to the time of the day, we may crave sugary, salty or sour foods. Nanette Steinle, a Professor at the University of Maryland claims that genetics plays an important role in taste preferences. Hormones, Body Mass Index (BMI), and metabolism all contribute. (Steinle, 2011)

An interesting experiment was done in 1993 on a patient named Eugene who was brain-damaged in the central medial lobe due to a virus. Eugene was previously diagnosed with arthritis. Moreover, he happens to catch a virus called encephalitis. He went into a coma for a week and when he comes out don't remember any names of the family member including his wife Becky, form sentences or barely breathe. Later the doctors discovered that Eugene has lost his short-term memory resulting in him only remembering something to up to 20 seconds.

A professor named Larry Squire introduced himself to Eugene at the time he was in the hospital. Squire has spent the last three decades studying the neuroanatomy of memory. Squire conducted some experiments that later led to amazing discoveries within the scientific community. Some of those are discussed below.

Even though Eugene, had short term memory loss over time habits were formed that were tightly engraved into his brain. When asked about it he wouldn't remember it, but he would perform it from time to time. One of those events was when he was asked where the kitchen in his home was. He would simply reply "I am not sure". But afterward, he would walk up to the refrigerator to grab something to eat.

Similarly, Squire recommended Becky to take Eugene out for walks as it would be good for his health. This eventually led to another similar event. One evening his wife Becky noticed that Eugene wasn't on his sofa in front of the television. As Eugene roams from room to room Becky hadn't given in much thought. However, when looking for him to go for a walk she noticed the front door open and Eugene missing. She sprinted out in search of Eugene

and couldn't find him anywhere. Upon her return, she saw him sitting in the chair in front of the television. When asked where he went his answer again was simply "I am not sure". But this is again another habit that was formed and tightly embedded into his brain.

In conclusion, Squire stated that habits are powerful but delicate. They form over time without the need for consciousness or permission. They shape our lives more than we realize and they are strong – they cause our minds to cling to them even when nothing else works.

Another experiment conducted by researchers at MIT in the 1990s was done on rats with damaged basal ganglia. Rats with damaged basal ganglia have trouble navigating a maze. Tiny sensors were placed inside the rats' brains to measure brain activity.

The experiment was that a click sound would send with the first section of the maze to open and when the rats have completed navigating the first section a second click sound would be sent with the second section opening with a path to the reward which is the Chocolate. Below the image demonstrates the brain activity of a rat during the first phases of the experiment. You can notice that there are high levels of activity throughout the whole process.

However, as the experiment was repeated over and over the brain activity changed. This is because a habit is being formed due to repetitive activity. The brain works much less now compared to before.

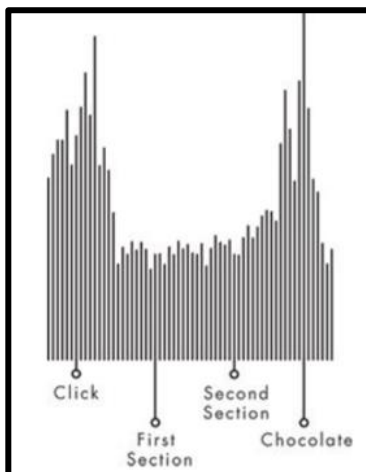


Figure 10 - Click Sound. Phase 2

Spikes are still seen before a partition to a section is open because the rat doesn't know if it's a familiar maze or a new one. But as the 'First Section' partition of the maze is open, and the rat realizes that the maze is the same the activity falls as the habit has taken over.

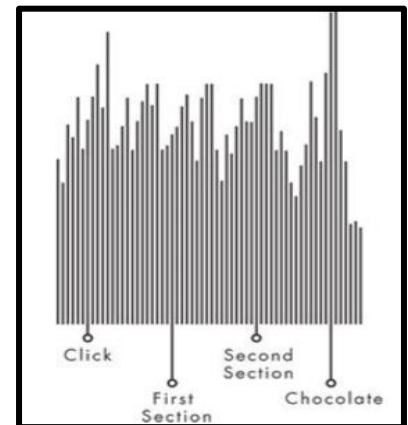


Figure 9 - Click Sound. Phase 1

In the early 1900's advertising pioneer Claude C. Hopkins was approached by a friend regarding a new product. This product now is known as Pepsodent. Hopkins was at the top of his game. He had convinced millions of Americans on using unpopular brands such as Quaker Oats, Goodyear Tires, Palmolive Soap, etcetera. He was extremely successful and well known at his time. Even now many CEOs, public health professionals, and marketers follow the rules of Hopkins.

During the 1900s brushing wasn't much popular. People weren't educated about the risks of bad dental hygiene. However, with Hopkin's marketing skills in about 5 years, more than half the American population had toothpaste tubes in their cabinets. This was a rise from 7% before Pepsodent to 65% after Hopkins. By 1930, Pepsodent was sold in all the continents of the world.

Later, in his autobiography, Hopkins told how he achieved one of his greatest milestones ever. He just found a Cue and informed of the rewards. The Cue was that the film-forming above the teeth was bacteria and prone to tooth decay. Even though various dental researchers proved that this is natural and would form even if you brushed with Pepsodent, Hopkins managed to persuade millions. The Reward was a great pretty smile.

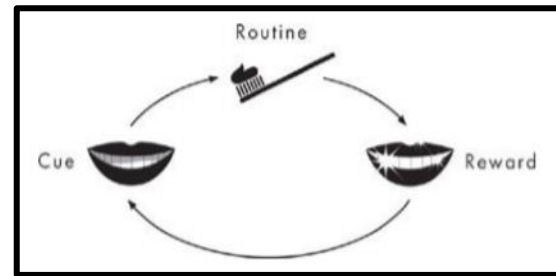


Figure 11 - Habit Loop for Pepsodent

Hopkins can be the first to discover the Habit Loop. A simple and obvious Cue with a clearly defined Reward has been used throughout the world by many people. Such as in exercise routines and workout plans.

2.1.2 Can Habit be Changed or Replaced?

This is a question that researchers argued about a lot. Recent studies show that old habits cannot be replaced due to how tightly they are imbedded with our brain, but they can be modified or altered.

In his book, Charles Duhigg states that the **Golden Rule of Habit Change** suggests that in the habit loop the components that change are not the Cue or the Reward but the Routine. Say, suppose due to frustration at work a person smokes a cigarette. The soothing effects of nicotine release dopamine in the brain. The chemical is responsible for happiness in the reward center. Instead of smoking the said person could have a cup of coffee in which the caffeine provides a similar reaction. This may take a long time to implement. And if it's a bad habit it's worth the time.

2.1.3 The Habit loop can change how we think

Wolfram Schultz, A professor of neuroscience at the University of Cambridge conducted a series of tests on monkeys. His experiments found out that the habit loop we are used may change order, which will result in how we think. These have revolutionized and

The base was a monkey whose brain waves were measured using a thin electrode inserted into the macaque's brain. The macaque was named Julio.

Julio was placed in front of a television screen in a dimly lit room. When colored shapes and figures appeared on the screen Julio was supposed to touch a lever which in turn outputs blackberry juice from a straw into Julio's mouth. Equally, as in the previous examples, the subject was resistant at first, but the habit was eventually formed. The habit loop seemed to work fine in normal order. The image below shows the brain waves.

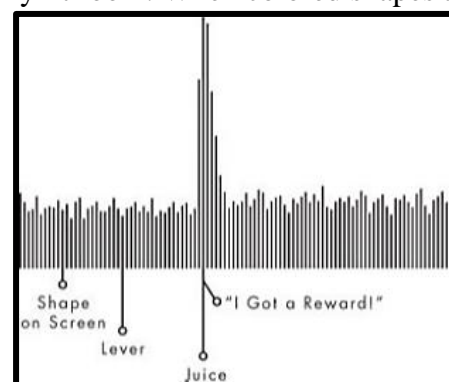


Figure 12 - Brain Waves. Phase I

However, this began to change after the continuous repetition of the experiment. The change was initially noticed by observing the brain waves. As seen on the image the brain waves spikes before the routine which is pulling the lever. This spike is the excitement of receiving blackberry juice. This is because Julio thinks of getting the reward as soon as it sees the shapes on the screen, even before performing the routine. In other words, the shapes have become a Cue not just for pulling the lever but also for just seeing the shapes on the screen.

In conclusion of this experiment, it can be said that once we develop strong habits, we can expect a reward even before the routine. This can be applied in many real-world situations and often will lead to disappointment, as not every cycle will later produce a successful reward leading to frustration, anger or depression.

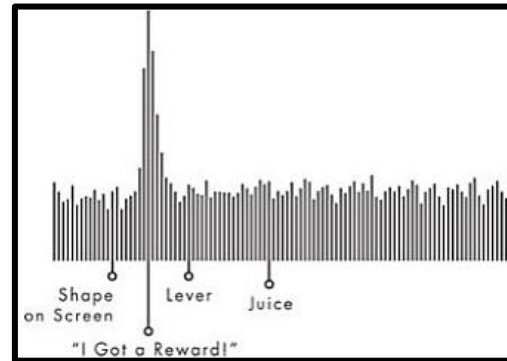


Figure 13 - Brain Waves. Phase 2

2.2 Actions are taken by the government and organizations to influence the behavior of the individual consumer

Aside from the theoretical knowledge of habit formation and development, there are various other methods used by governments and organizations to influence the behavior of individuals.

Financial Provision – Money is a great factor in motivation. It is widely known that salary increments or other commissions have widely increased productivity in the workplace.

A similar method was used by the Norwegian government to encourage its citizens to use environmentally friendly means of transport. The Norwegian government provides subsidies such as free and prioritized parking, and free charging. There are high investments in financial incentives and charging infrastructure. In 2001, about 25% of sales tax was scrapped for EV. Other forms of provisions provided by the government are low road taxes, tolls for roads and ferries were completely eradicated. In 2005 EV's were legally allowed to drive on bus lanes.

This proved to be a very successful campaign with the government meeting its target three years earlier of 50000 zero-emission on the road. (Nikel, 2019)

Another successful campaign the Chinese government schemed was when it partnered with Internet giant Baidu to launch an app that shows recycle points near a user. The user may then drop off e-waste at these points which are run by third part recycling companies. The latest stats show that 5900 components are recycled every month. (Rohaidi, n.d.)

As I mentioned before that money is a great factor for motivation. It can work the other way around. Around the world, governments can control public nuisance by imposing fines. There's fine for almost every public safety law you break. Such as speeding, not wearing seatbelts, and parking in a no-parking zone, etcetera.

However, a new finding suggests that Nudges are more effective at changing people's behavior than the traditional methods used. Nudges in behavioral science are subtle, slight or indirect proposals that influence the decisions made by individuals.

Nudges are proven to be 40 times more effective, efficient and cheaper than traditional methods of behavioral change used by governments such as advertisements. It only requires changing the form traditional methods are presented in. (Blanding, 2017)

Instead of governments using billboards to remind people to simply "Wear seatbelts", they can use declarative or exclamatory sentences that state some facts about road safety accidents or express strong emotion. Any information that can reach a person's heart is likely to make a change.

One example of using nudges to influence behavior is when a person starts a new job. Paperwork may roll in like a bullet train. Along with that, an application form for retirement savings may come in. But this form is likely to be ignored as there will be no deadline and there "is time". People are more likely to finish the paperwork that should be submitted by the end of the week. The retirement form will be pushed back as they procrastinate. A simple solution of adding a deadline on this form could get it filled much faster. Though it doesn't have any legal implications, no harm comes from this and gets the work done.

People were sent electricity usage of neighbors. This was an effective method to control emissions from power plants. Patients were able to schedule flu shots and reminders were sent out. More people got vaccinated.

An Australian hospital found out that they lose A\$66000 a year by patients not showing up to their appointments. They solved this issue by sending out text messages to patients noting that "We will not lose \$125 when you show up".

However, it was also discovered that nudges weren't always effective. When money was involved nudges failed to make a difference.

2.2.1 Types of thinking

Psychologist Daniel Kahneman says there are two types of thinking known as System 1 and System 2. Decision making in System 1 is quick and spontaneous while in System 2 it's slow and leisured. (Kahneman, 2011) Humans spend most of their time using System 1 thinking mainly to save cerebral resources. Nudges are more likely to work with System 1 thinking.

So, in enforcing pollution regulations nudges aren't going to work. Because the whole process of building a factory or coal-fired power plants uses System 2 thinking.

However, in the case of enforcing road safety regulations, these can be successful. As a driver sees a billboard with a declarative statement they will follow the rules. This will also work with littering in public places, speeding, drunk driving, and piracy.

Companies have deployed tricky ways to manipulate how the average consumer spends. All in favor of them of course. And we unintentionally fall into this trap.

One of these is Cinnabon Stores. This can easily be noticed by how they are always located away from food courts at malls. These are decisions made by executives so that the smell of cinnamon rolls would freely roll down hallways without mixing with the smell of other restaurants in the food court. So, hungry shoppers will start craving for cinnamon rolls inside

their heads. These cravings are what keeps the habit loop going. The smell of cinnamon rolls is the Cue. And this Cue triggers a craving which in turn becomes a habit automatically. When they eventually turn a corner and see the Cinnabon store they unknowingly reach for their wallets. This is one of the general techniques used by the food industry.

Another important method of how organizations influence customer behavior is by **Aroma Marketing**. This is a large market, especially in retail and aviation. Aroma marketing is basically when stores buy specially engineered scents to suit their market and use them in stores. These scents improve customer experience and increase spending. In aviation, scents are used to make the flyer more comfortable in the flight.

Similarly, like the smell, another sense which is targeted by the retail industry is the vision. **Color** can have a strong psychological impact on customers' behaviors. A survey revealed that 93% of buyers had been influenced by the visual presentation of a product or service. Take this image of popular fast-food chains. A common theme seen around is the use of red and yellow colors. Red is used to grab the attention of the customer while also representing hunger. Yellow, on the other hand, is a more welcoming color. It displays happiness and friendliness.



Figure 14 - Visual Marketing

2.3 Similar apps/ IT solutions. Feature/weaknesses/strengths

1. GoodGuide

- **Description** – Environmentally friendly shopping
- **Features**
 - Scan barcode to see more information on the product such as ingredients used.
 - Provides rating calculated on health, social, environmental impact and company policies.
- **Price** – Free
- **Availability** – ☒ App Store ☐ Play Store ☒ Web

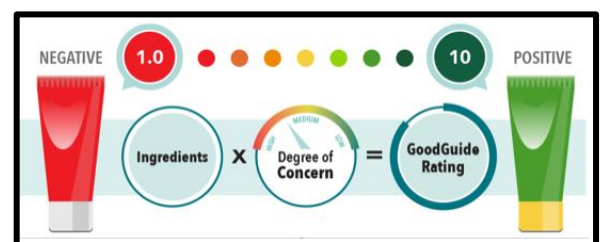


Figure 15 - GoodGuide rating system

In general, a great app that can tackle the problem right from the source. This improves the purchasing behavior of the consumer and promotes environmentally-friendly shopping. However, the product portfolio could be expanded.

2. Commute Greener

- **Description** – Low - emission commute. App designed by Volvo.
- **Features**
 - Ridesharing suggestions
 - An efficient route to the destination
 - Personal CO₂ calculator
 - Calculate emission saved and earn badges and rewards
- **Price** – Free
- **Availability** – ☒ App Store ☐ Play Store ☐ Web
- **More** - Data from the app is used by urban planners to manage traffic better.

The lack of availability on various platforms creates a disadvantage. The data collected daily about the user's commute could raise privacy concerns. This app will become redundant due to popular taxi services such as Uber integrating ridesharing into their apps.

3. iRecycle

- **Description** – Displays the nearest recycling points.
- **Features**
 - Locations of the nearest recycling facility for all kind of items
 - Supports 350 different materials and 110000 programs
 - Provides contact information and limits of these facilities
 - Can filter the search by specific product
 - FAQ section
- **Price** – Free
- **Availability** – ☒ App Store ☒ Play Store ☐ Web

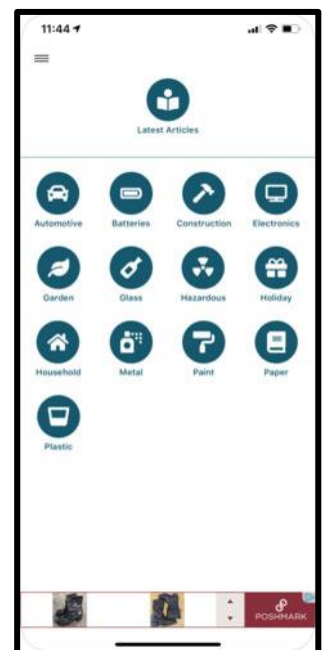


Figure 16 - iRecycle app

4. Leaffully

- **Description** – Help maintain energy consumption.
- **Features**
 - Measures electricity, gas and petrol consumption by linking to your provider
 - Breaks down consumption units (kWh) into understandable information such as charts and trends
 - Look at the energy sources. E.g.- hydro, nuclear
 - Set goals and provides tips on how to save energy
 - Calculator
 - Tips on saving. Compare with friends
- **Price** – Free
- **Availability** – ☒ App Store ☒ Play Store ☒ Web

This app is great as it helps show how our actions impact the world around us. It takes our energy consumption from providers and turns them into meaningful information such as how many trees it takes to offset the energy used. Great selection of platform availability.



Figure 18 - Leaffully Overview Page

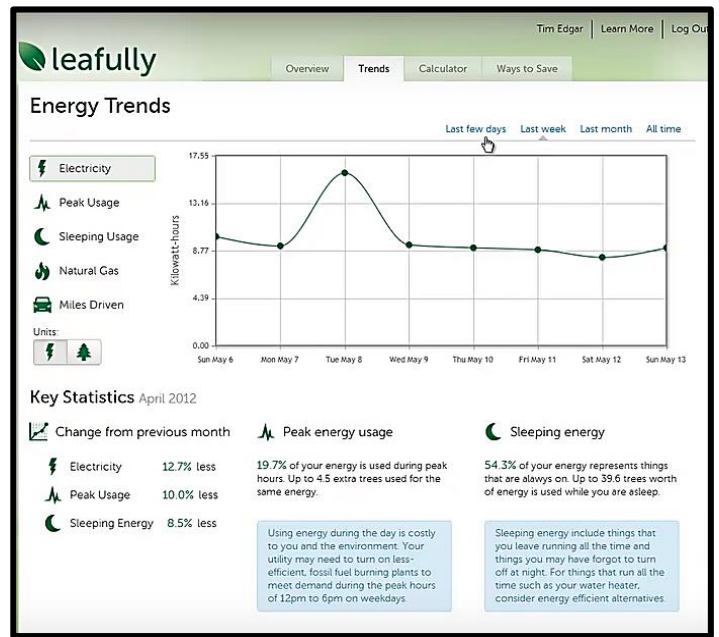


Figure 17 - Leaffully Trends Page

5. Plugshare

- **Description** – Maps EV charging stations
- **Features**
 - Find EV chargers
 - View stations, ratings, availability, and photos
 - Pay directly from within the app
 - Travel Planner – Find stations along the route to the destination
 - Charging tips
- **Price** – Free
- **Availability** – ☒ App Store ☒ Play Store ☒ Web

The leading app in the market. Filters chargers based on the supported car models/type, fast chargers, plug type, availability, networks, and location.



Figure 19 - PlugShare app

6. Climate Counts

- **Description** – Details large corporations' carbon footprint.
- **Features**
 - Ranks the companies on their contribution to climate change
 - Details on the CSR and production methods
- **Price** – Free

- **Availability** – ☒ App Store ☐ Play Store ☐ Web

7. PaperKarma

- **Description** – Stop postal junk mail
- **Features**
 - Stop junk mail with a single photo of the mail and the sender's address
 - The wrangling is done by the company itself
- **Price** – Free/Subscription
- **Availability** – ☒ App Store ☒ Play Store ☐ Web

An excellent app that detects the sender automatically using artificial intelligence. Boasts a 90% success rate. It can stop magazines, coupon books, catalogs, flyers, credit card offers, and white and yellow pages. However, users have to pay a subscription fee after a certain number of uses. And legally PaperKarma can't unsubscribe on your behalf and senders may refuse. So, it may be considered a rip-off.

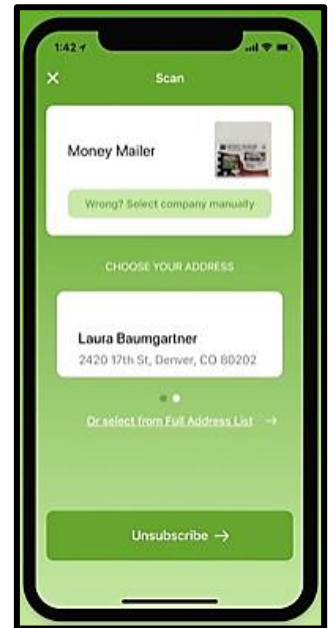


Figure 20 - PaperKarma app

8. greenMeter

- **Description** – Driving efficiency gauge using the data from the accelerometer on the phone.
- **Features**
 - Can compute fuel consumption by cost, carbon emissions, and power
 - Detailed information on aerodynamic drag and rolling resistance.
- **Price** – \$5.99 (One-time purchase)
- **Availability** – ☒ App Store ☐ Play Store ☐ Web

This is an excellent app as it provides various calculations all from a data collected from a single accelerometer. Users may need to set some pre-sets before using the app like vehicle type/model.



Figure 21 - greenMeter app

9. Air Quality | Air Visual

- **Description** – Live air quality updates
- **Features**
 - Check the air quality in over 10000 cities and 80 countries
 - 7-day forecast
 - Live monitoring of 6 crucial pollutants
- **Price** – Free

- **Availability** – ☒ App Store ☒ Play Store ☒ Web

A great package provided all for free. Details are available in thematic maps and scores. Live monitoring is available for Carbon dioxide/monoxide, nitrogen dioxide and sulfur.



Figure 22 - Air Visual app

10. Joulebug

- **Description** – Encourages eco-friendly actions and rewards points and badges
- **Features**
 - Explore new ways to be sustainable
 - Compete with friends and earn points
 - Social media. Share and like your progress of being sustainable
 - Join the local community for events and meetups
 - Track your carbon footprint trends
- **Price** – Free
- **Availability** – ☒ App Store ☒ Play Store ☐ Web

While completing the suggested sustainable activities you can save money. Connects to your utility bills to show savings. This app aims to turn actions into habits and when it does it can be a very successful and powerful tool in helping the environment.

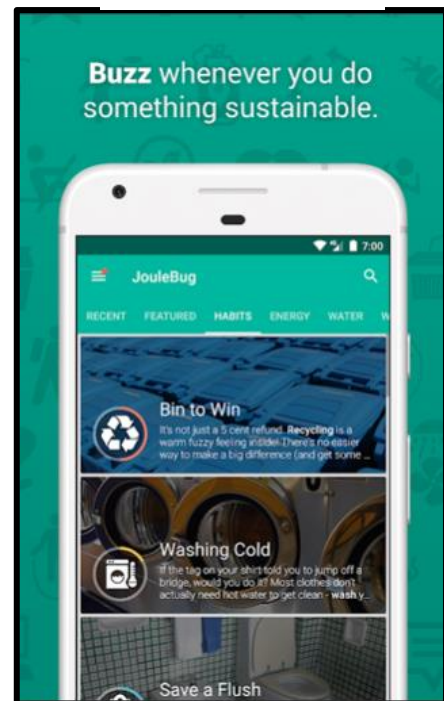


Figure 23 - Joulebug app

3.0 PLANNING

There are many entities contributing to climate change. Such as governments, corporations, and communities/individuals. My product will be focused on minimizing the damage caused to communities or individuals.

When put together individuals can make a huge positive impact on the prevailing situation than all the government and corporations combined.

It is important to note that with the advancement of technology and social media platforms, increasing awareness about a subject has become more prevalent.

My product will be focused on improving the mentality of individuals, so they will change their lifestyle which ultimately results in a positive impact on the environment.

I have aimed at designing a platform for all the solutions I mentioned above. A sort of visual aid that gives individuals the accessibility to make changes to their lifestyle.

3.1 Requirement Analysis and Specification

3.1.1 Purpose of the document

This report explains in detail the development and evaluation of Empreinte Carbone. A web app that tries to combat the issue of climate change, this encourages users to change their lifestyle to more eco-friendly options. Users may input activities done by them which can be considered eco-friendly and the app calculates the carbon emissions saved. Users then receive a badge as a reward as a form of motivation. They can unlock achievements and share them on social media. This can be then shared among friends who use the same app. These friends can like and comment on those posts forming a module like social media. Extra features include searching for EV charging stations, recycling points, and environmentally friendly shopping.

The web app is a hybrid version that runs in an android app frame which is developed under the flutter framework. The target audience would be individuals or communities.

3.1.2 Scope

Project Goals – Development and maintenance of a Carbon Emissions Calculator

Deliverables – Carbon Emissions Calculator Web App

3.1.3 Functional Requirements

- **User Accounts**– While on the start page of the app users can register themselves. When done so the details recorded will be stored in the Wix database. Details such as first/last names, email addresses, phone numbers, and passwords will be encrypted and sent to the Wix server. If users opt to use social media for login, only names and email addresses will be requested.
- **Storing Information with Security** – After recording personal information security measures will be taken. Passwords that have been stored in the Wix database will be encrypted so that even admins cannot access them.

- **Data Protection and Availability** – Users can access their data anytime by requesting to download it. This is in accordance with privacy and protection laws such as the Data Protection Act of 1998.
- **Panels** – Two different accounts with different authority will be used. The users will have the common and basic privileges whereas the admins will have heightened privileges where they may moderate for fraudulent activities, manually update user details upon request.

3.1.4 Non-Functional Requirements

- **Usability** – An intuitive interface will be established. The application will be developed with ease of access in mind. In modern operating systems features such as text-to-sound and high contrast are already natively integrated.
- **Performance** – Since the system is going to be web-based it requires a powerful server with a high band with internet access. The server should be able to handle multiple users at a time while performing several operations simultaneously. Higher simultaneous users could be handled.
- **Access Security** – When data is stored it will be encrypted and when retrieved it is decrypted. So not even moderators will be able to access passwords.
- **Portability** – The application is a hybrid version of flutter and a web-page. This will be extremely lightweight and be able to run on mobile phones with even with the lowest specifications. The minimum hardware requirements are:

Version	Android v4.0 and up
RAM	100 MB free (required)
Disk Space	50 MB (upon download)

Table 1 - Required Specifications

- **Accessibility** – The application will be online all year round and will only be taken down under special circumstances such as during maintenance.
- **Principle** – Users can update their information at any time through the system or by contacting the support team through twitter. Users are notified to update their login credentials after a certain time has passed. If they choose to delete their account from our servers, no residue will be kept upon complete deletion. They will also be able to delete the data from our servers if they choose to.
- **Integrity** – Usage patterns and other information won't be marketed to third party advertising agencies.

3.2 PESTLE Analysis

PESTEL analysis helps map out the external environments that affect the business of Empreinte Carbone.

3.2.1 Political

One important factor that could impact the business is environmental law. Policies by governments such as Bhutan could help exponentially. Such as the whole premise of the Bhutan government is to remain a carbon-free country and they have taken up certain measures to ensure that. This means that the Bhutanese are in a mindset of helping the

environment, this shows a large potential user base in the country. Similarly, the Norwegian government provides subsidies such as free parking and charging to owners of EV's.

But there is also a negative side to this. Politicians such as Donald Trump campaign and strongly argue against the climate change movement. There are various incidents where Trump has withdrawn such as the Paris Pact and 2015 UN Climate Agreement.

As soon as Trump took office the administration worked hard on removing safeguards set by the previous president, Barak Obama. The reason for this was to boost the output by businesses by businesses using cheaper energy such as fossil fuels. A former coal lobbyist Andrew Wheeler was elected to be the head to the Environmental Protection Agency (EPA). (SustainabilityX, 2018)

3.2.2 Economical

Certain macroeconomic factors can help expand and fund the business. Governments of countries with the highest pollution rates such as India and China would provide subsidies in exchange for our services. This could include free prioritized advertising, operating tax incentives, paid overhead costs, and technical and legal support.

3.2.3 Social

People have different viewpoints or a collective belief that climate change isn't real. This is inspired by some political factors.

3.2.4 Technological

There may be a possibility that the flutter framework is likely to go obsolete. This raises concerns about migrating to a different platform.

Securing a consumer base will be a big concern. With the number of apps that perform great in a similar field out in the market, it will require great efforts to lock a consumer base.

With an increasing number of smart accessories such as smartwatches, bands, and glasses there will be a need to develop an extension app for these devices.

3.2.5 Legal

During the start-up, there aren't many laws and regulations the effect the business, but during expansion, we may have to come in accordance with minimum wage requirements.

Another important regulation to adhere to is the Data Protection Acts of the respective countries the application is launched. This will require a platform for users to access,

download and modify all the data that has been collected. As the application collects personal information, legally we are required to provide a privacy policy.

Copyright and Patent violations – As a similar idea is being used by our competitors there is a small possibility that it could become a patent violation.

3.2.6 Environmental

With increasing natural disasters more, people are coming to their senses about the drastic effects of climate change. News outlets are reporting cities having the highest temperatures ever in summer, the worst hurricanes, longer and bigger forest fires, and rising sea levels.

This raises the conscience of people. And most of them are trying to make an effort to be eco-friendlier.

3.3 SWOT Analysis

SWOT analysis is performed to better help understand the business strategy of Empreinte Carbone.

Strengths (Internal)	Opportunities (External)
<ul style="list-style-type: none"> • Unique Calculation and motivation strategy. Targeting individuals specifically. • The psychological approach taken by the app is an exclusive idea which can greatly help in the success of the application. • The framework, Flutter is cross-platform. This gives an advantage with time and cost-saving while testing and deploying on multiple platforms from a single code base at a single time, • Location – A physical location (office) will not be required until a certain point of expansion as most of the business is conducted online. This will reduce overhead costs. 	<ul style="list-style-type: none"> • Increasing concerns and awareness about climate change by media outlets and social media will largen the consumer base. • Policies and subsidies by certain governments such as Bhutan and Norway greatly help the app gain more public interest.
Weaknesses (Internal)	Threats (External)
<ul style="list-style-type: none"> • The uniqueness of the calculation mechanism needs to improve, as this is the key feature of the app. 	<ul style="list-style-type: none"> • Competitors have a similar concept that was designed and perfected over the years. Example – Leaffully app.

<ul style="list-style-type: none"> • People are not likely to download an app for just carbon emission calculations. I.e. – target market in uncertain • An expert on the field is required to develop an exceptional product • Funding - All funding related to marketing and the maintenance of the webpage and databases will have to be supported by the sole owner and developer of this application. 	<ul style="list-style-type: none"> • Different consumer attitudes - There is a certain perception by the public that climate change isn't real and just a myth. This may affect marketing and public relations. • Big politicians such as Donald Trump, the president of the United States of America doesn't believe in climate change. This can affect the perception of his followers.
---	---

Table 2 - SWOT Analysis

3.4 Risk Assessment

<u>Risk</u>	<u>Priority Level (1-5 with 1 being riskiest)</u>	<u>Liabilities/Consequences</u>	<u>Mitigation Strategy</u>
Planning			
The possibility of not being able to capture the market. Uncertain market and variations in consumer attitudes/perceptions towards the product and idea. Some parts of the public may think climate change is a myth and this may affect the product directly as its focus is to combat climate change.	2 – Posses higher risk as the success of the product depends on it	Diminishes the whole idea the product is based on. Everything depends on the users downloading the application	Clearer advertising. Stating facts that climate change is real and happening, immediate action is needed.
Competition – Certain competitors such as Leafully have created and perfected a similar concept over years	1 – Posses extremely higher risk as the whole idea may be in jeopardy	Nothing drastic. Lower market share and monetary costs for a certain period.	Competition is healthy and promotes innovation but to overcome this we need to spend more time on research and planning to find a more unique element to develop on. This will create a stronger product and climate competition
The planned timeframe is inadequate. If the allocated timeframe is deficient, the deployment of the application would be	4 – Less likely threat.	The launch of the application would be delayed	As the launch of the application can be pushed by requesting an extension on the dissertation.

delayed. Optimistic schedule rather than accurate.			
As paid third-party services are used to host the database, plausible changes to financial projections	4	Would delay the launch of the application	Seek for outside investors. This process shouldn't be hard as the finance required seems to be a small amount.
Design			
The W3C design requirements must be met to provide accessibility for people with disabilities.	4	The only consequence would be the user base would slightly become smaller as disabled people wouldn't be able to use it.	These requirements are minimal with the basic design satisfying requirements. 'A' is the minimum prerequisite and will be used in the design process. With modern operating systems having various native built-in tools available for the disabled, this would be ample to cater to their needs.
Implementation			
Possibility of the Flutter framework going obsolete in the future	5	The application would be offline for a period until it is being migrated to a new platform	Develop the application on the React Native framework. This is the closest to the Flutter framework.
Testing & Deployment			
Technical – Software bugs are common among all software when first deployed to the public	5 – This is a common threat. Sort of natural. You should be more concerned if there aren't any errors.	-	Extensive troubleshooting and testing would solve a problem. Push alpha and beta releases to select a group of users.

Table 3 - Risk Assessment

3.5 Data Collection

3.5.1 Questionnaire

A questionnaire was used to collect data which was used to identify variables such as the target market and their interest. A questionnaire was prepared to collect only relevant information and presented as google docs. This could be accessed by entering a URL or scanning a QR code.

bit.do/aadil




Figure 24 -
Questionnaire. QR
Code

The questions are as follows:

1. Answers which features should be included in the web app

Climate Change Survey (Draft) -
Respondent Copy

1. Look at the environmental issues mentioned below. Select
THREE that concerns you the most

 <input type="checkbox"/> Air Pollution	 <input type="checkbox"/> Pollution of rivers / oceans (BY PLASTIC DISPOSAL)
 <input type="checkbox"/> Poor Waste Management / Recycling	 <input type="checkbox"/> Traffic / Congestion

Page 2 of 4

Never submit passwords through Google Forms.

Figure 25 - Questionnaire. Page 1

2. Specific details on the features and how the respondents are using it

Climate Change Survey (Draft) - Respondent Copy

* Required

2. Are you contributing in anyway to reduce the effects of Climate Change *

☐ YES

☐ NO

CONTD>>>If you selected YES, briefly list the reforms you are making

Your answer

BACK NEXT

Page 3 of 4

Never submit passwords through Google Forms.

Figure 26 - Questionnaire. Page 2

3.

Climate Change Survey (Draft) - Respondent Copy

* Required

3. Would you be interested in a platform that aims to help the earth *

☐ Yes

☐ No

BACK SUBMIT

Page 4 of 4

Never submit passwords through Google Forms.

Figure 27 - Questionnaire. Page 3

3.6 Product Description

I will be developing an application that measures and continually monitor the carbon footprint of an individual person. The app will have features such as:

- **Environmentally Friendly Shopping** – Guide to safe products that do not use chemicals. This may include organic produce that does not include the use of pesticides. Users can scan the barcode of a product to get details such as harmful chemicals present. Users will then see a rating scheme. This tells if the overall outcome of the product on the environment is positive or negative, helping the

customer decide whether to choose this product. If it were negative the app may suggest environmentally friendly alternatives.

- **Recycle Points** – Nearby recycle stations for most non – renewable products will be highlighted in a map. This makes it easier to recycle products such as/containing batteries, glass, metal, and paper.
- **EV chargers** – Displays available Electronic Vehicle chargers nearby.
- **Commute Greener** – Provides greener options for travel while promoting health. Features include calories burned during travel.
- **Sharing Platform** – In which users can share their achievements and progress.
- Finally, provide a weekly summary of the carbon footprint of the user with tips on how to further improve their lifestyle. An awareness feature will inform the users of the current situation supported by shocking facts. This will be used as a form of motivation.

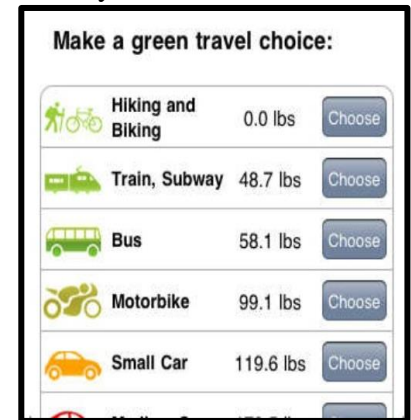


Figure 28 - Green Travel Choice

However, there are downsides to my proposed product being successful in the real market. Even though an awareness feature will be used as a factor of motivation and reminder to the individual, human psychology can be complex. People could simply fall out of the behavior of maintaining practices that help our planet. On average it takes 66 days before a new behavior which is the act of being eco-friendly to become a habit. (Clear, 2018)

It can be a challenge to make consumers keep using my app. I will implement various techniques that are used by social media which lead to addiction. Dopamine is the chemical released by the brain's reward center when you feel happy. Most popular drugs such as alcohol, nicotine, and cocaine trigger the release of dopamine. It is clear that humans are motivated by the reward system.

A visual reward system will be integrated into my app. Users may receive badges for each

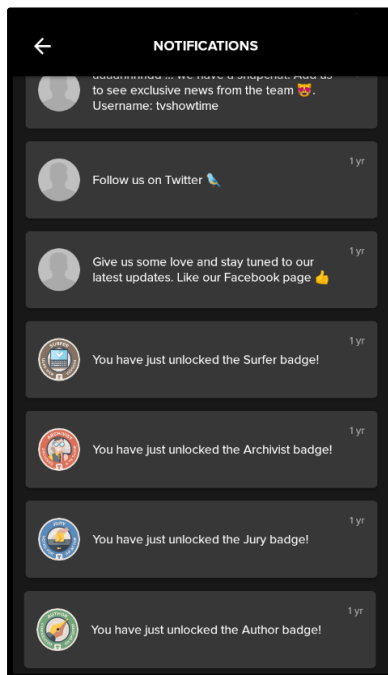


Figure 29 - Rewards System 1

negative impact they offset. Another important method used by social media is “likes” and “popularity”. It is widely known that people are obsessed with becoming popular on social media. Mainly since they love the attention which in turn makes them happy. For this specifically, a separate page will be created in which users can post their progress/badges they’ve earned. Users may like and share their posts. Similar to most social media platforms.

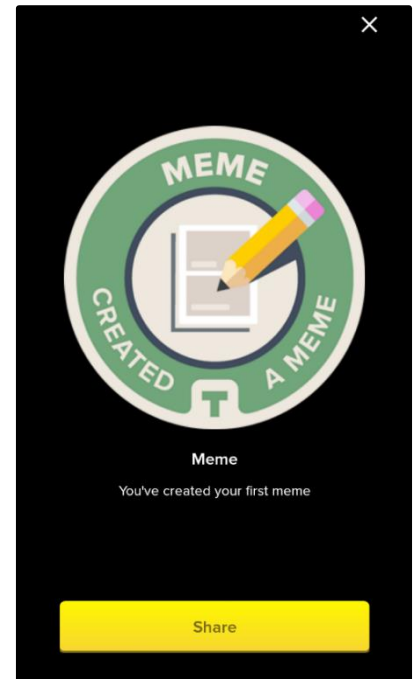


Figure 30 - Rewards System 2

3.7 Feasibility Study

The feasibility study document is used to conduct an objective and rational analysis of the strengths and weaknesses of the proposed project.

3.7.1 Cost Feasibility

Proposed Cost for building and maintains the application.

Description	Estimated Cost
Google Play Store Release	\$25 (One-time)
Apple App Store Release	\$99/Year
Backend Support (Firebase)	FREE up to 10,000 users
Backend Support (Wix)	FREE trial – Variable pricing

Table 4 - Cost Feasibility

Firebase backend is provided for free up to 10,000 users. And then applicable plans upon usage are available at [Firebase Pricing](#).

More information can be found at [Wix Pricing](#). Additional charges for add-ons upon usage.

3.7.2 Time Feasibility

The time allocated for system development is estimated to be around 1.5 months (45 days). Developing an app with such impeccable features will require more time, even when working fulltime. Extensive time will be spent on:

- Learning the new Flutter framework which has a new programming language called Dart.
- Implementing the Firebase backend to configure and run smoothly with the application.

- Installing necessary software on the device.

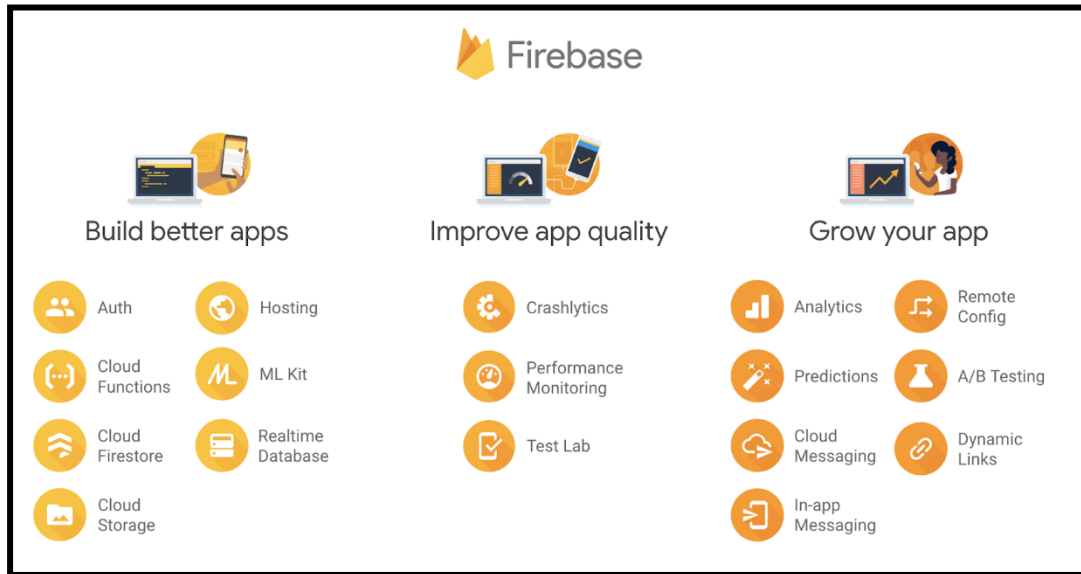


Figure 31 - Firebase

3.7.3 Technical Feasibility

The carbon footprint calculator will be developed with ease of use in mind. The UI will use a minimalistic design. Another important factor that will be considered is accessibility. The app will have accessibility features such as magnifier, dark contrast theme, and audio output at selected pages to aid users with vision and hearing impairment.



3.8 Project Timeline

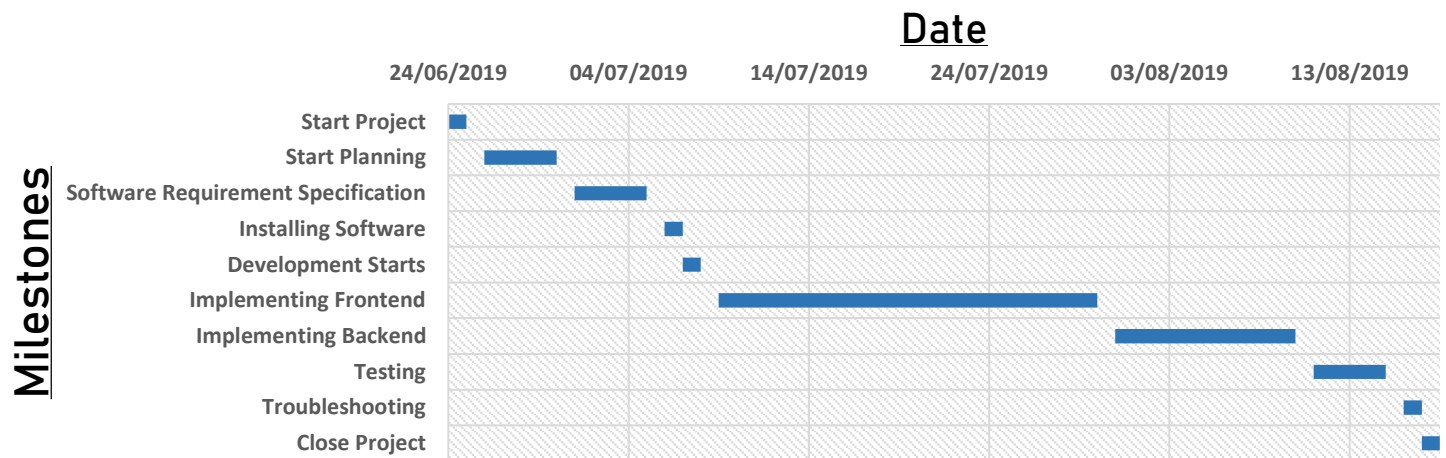


Figure 32 - Project Timeline

- Installing Software
 - Firebase
 - Flutter
 - Android Studio
- Implementing Frontend
 - Flutter coding in Dart Language
- Implementing Backend
 - Firebase Google Authentication
 - Hosting
 - Cloud Storage
- Testing
 - Usability
 - Performance
 - Ease of access
- Troubleshooting
 - Bugs

3.9 Required Resources

3.9.1 Hardware

Hardware requirements would be:

- Android – Any compatible Android device running Android 5.0 and up
- iOS (Apple) – Any compatible iOS device running iOS version 9.0 and up
- PC – Website application compatible with any PC with an internet connection and a compatible browser. Chrome v50 and up recommended.

3.9.2 Software

- Frontend

- IDE – Android Studio and Visual Studio Code
- Debugger – Visual Studio Code
- Framework – Flutter
 - Programming Language – Dart
- Backend (Storage & Database)
 - Wix
- Other
 - Image editing – [Adobe Photoshop](#)
 - ERD and UML diagrams – [Lucid Chart](#)
 - Wireframe diagram – [MockFlow](#)
 - Version Control System – [Git](#)

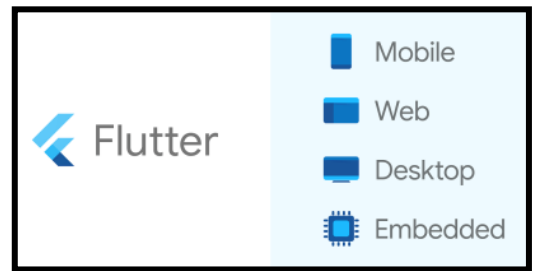


Figure 33 - Flutter

3.9.3 Developer

The developer is knowledgeable in all mentioned prerequisites mentioned above in software requirements.

3.10 Expected Output and Outcome

Listed below are sample applications that perform some of the tasks I am going to integrate.

Recycle Products





Find EV charges

3.11 Limitations

- **Reach of Audience** – Reaching an audience will be out of my reach. Advertising and marketing costs for the app can be huge. Increasing awareness about the topic plays an important role in reaching an audience.
- **Funding** – Funding for publishing and maintenance of the application for commercial use.

3.12 Ethical Deliberations

Ethical behavior can in most cases display the image of a company more clearly. Companies that have great ethical behavior and follow practices are talked about good. Customers are likely to stay loyal to a company that respects their privacy. Ethics can be used when designing a system.

Privacy – This would be one of the most important considerations. Privacy would be taken seriously. Security discusses how information is put away and dealt with by programming programs. Programming engineers need to consider the Data Protection Act of 2018 and its principles when structuring software and how it handles information. The information must

be shielded from outsiders. This implies the framework created must be secure and inclined to hacking. The product must not gather the site of a client if redundant.

Web Technologies – Internet advances assume a noteworthy job in programming improvement. Old advancements, for example, Flash which is extremely inclined to hacking must not be utilized.

Language and culture – The language and culture used to in which an inquiry is spoken can enormously influence the info. If the language utilized is excessively dubious, information that may not be required will be gathered and this could be an infringement of the Data Privacy Act.

Accessibility – Accessibility options ought to be created on the market for users with difficulties. This can be an elementary right of somebody.

Expertise Level - Software projects ought to be anything but difficult to utilize notwithstanding for individuals with the most reduced proficiency rates.

4.0 DESIGN

4.1 Entity Relationship Diagrams (ERD)

An entity-relationship diagram describes the relationship between two or more entities.

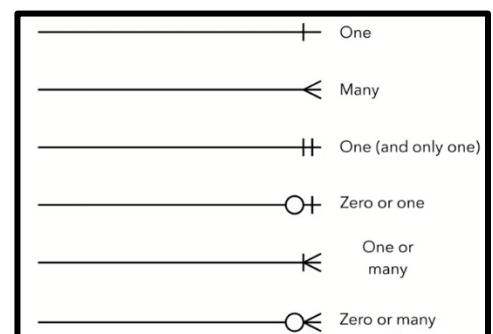


Figure 34 - ERD Cardinality

4.1.1 ERD for Product Scanning

The entity-relationship diagram below shows the relationship between entities when a product is scanned using the barcode to check if it's environmentally friendly.

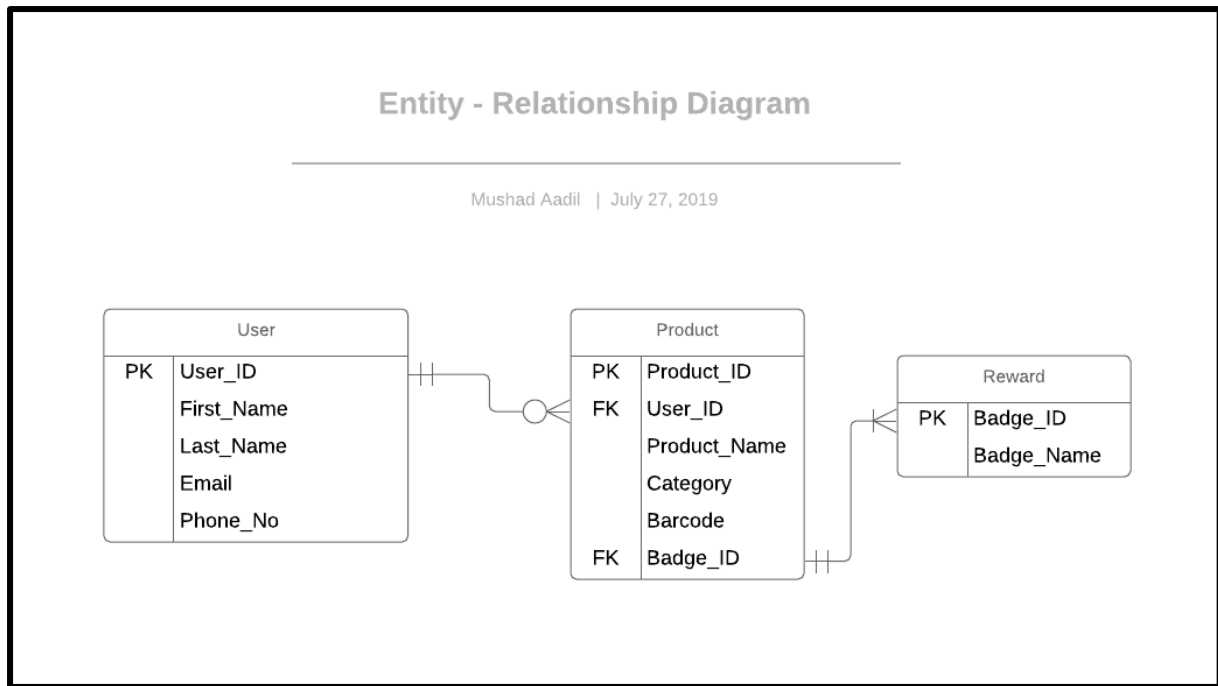


Figure 35 - ERD Product Scanning

Users can scan if products use ingredients that are harmful to the environment by using the name or barcode.

4.1.2 ERD for Earning Rewards

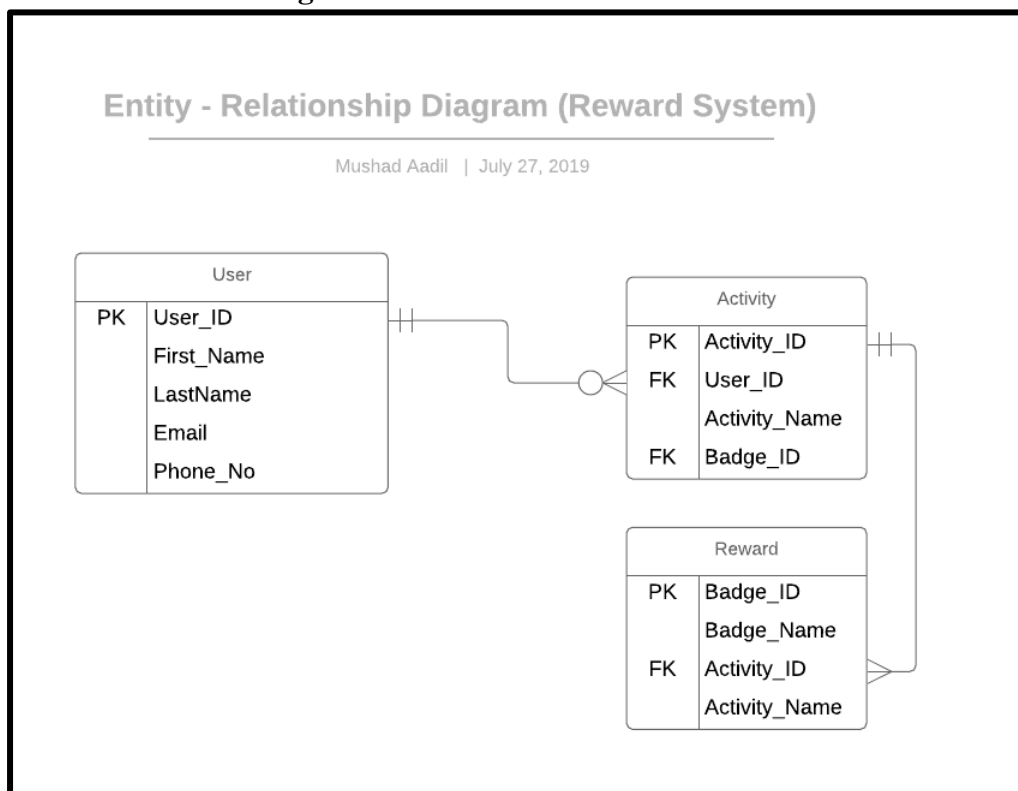


Figure 36 - ERD Earning Rewards

As a user completes an activity that is environmentally friendly such as ride-sharing, or recycling cardboard boxes they can log this into the system and unlock an achievement. This can then be shared onto external social media platforms.

4.1.3 ERD for EV Charger

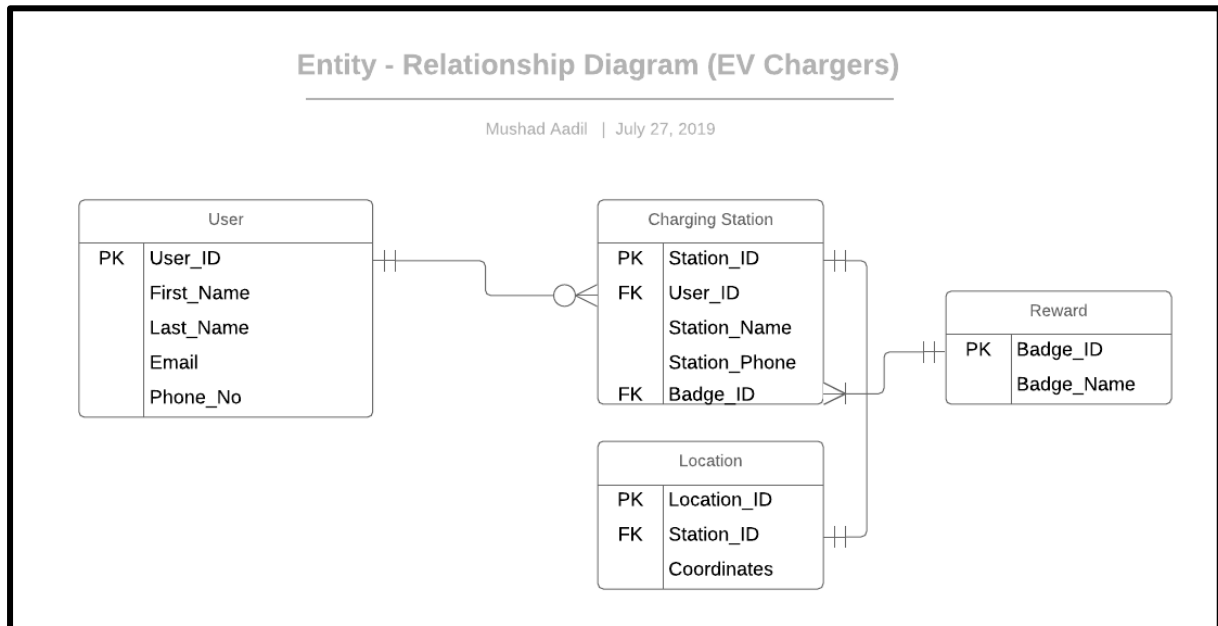


Figure 37 - ERD EV Charger

As an ecofriendly mode of transport users can find Electronic Vehicle chargers that are in close proximity to them by entering their location or searching for one and apply certain filters such as chargers with certain plugs or stations with bathroom and cafeteria facilities.

4.1.4 ERD for Social Media

The entity-relationship depicts the relationship needed between entities when sharing badges, progress or achievements they have achieved into the platform integrated.

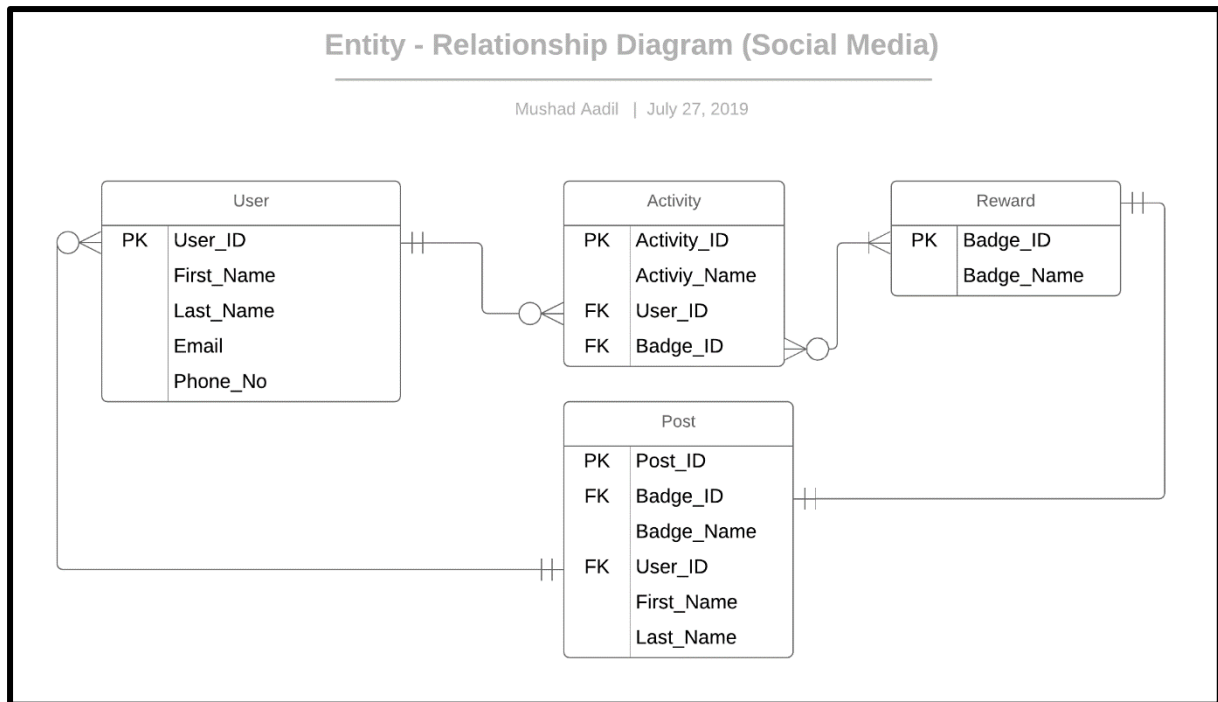


Figure 38 - ERD Social Media

4.2 Use Case Diagram

4.2.1 Use Case Diagram for Calculation Process/Algorithm

The Use Case diagram below explains the interaction of the user when details about carbon emissions are entered and the system provides feedback based on the results. This could be tips on how to improve the lifestyle or congratulate with a badge that they can share.

Use Case Diagram

Mushad Aadil | August 8, 2019

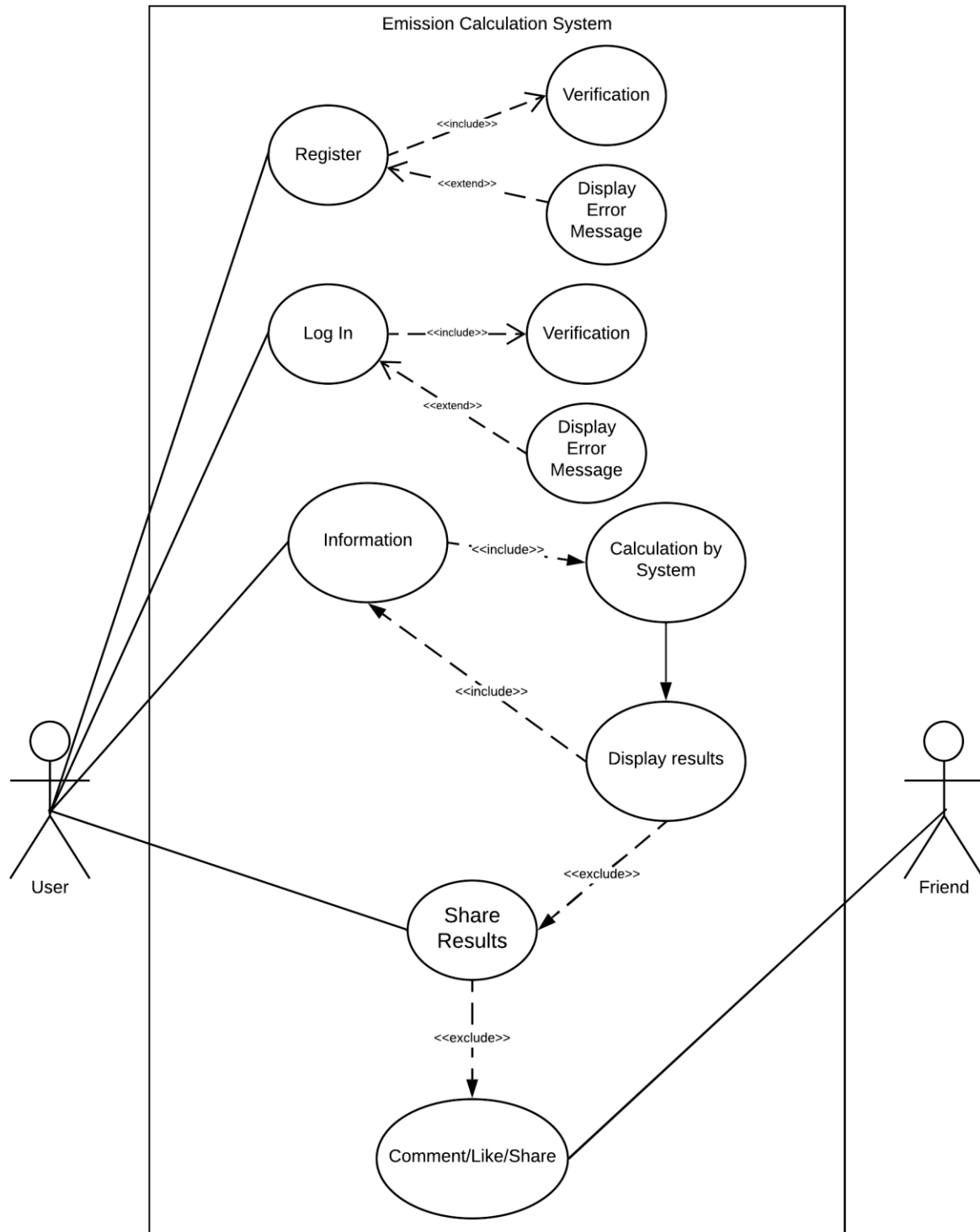


Figure 39 - Use Case Diagram. Calculation System

4.2.2 Use Case Diagram for Product Scanning

The Use Diagram below shows the interaction of the user when a product is scanned to check if it is environmentally friendly. It may be scanned by a barcode or name and checked against a database.

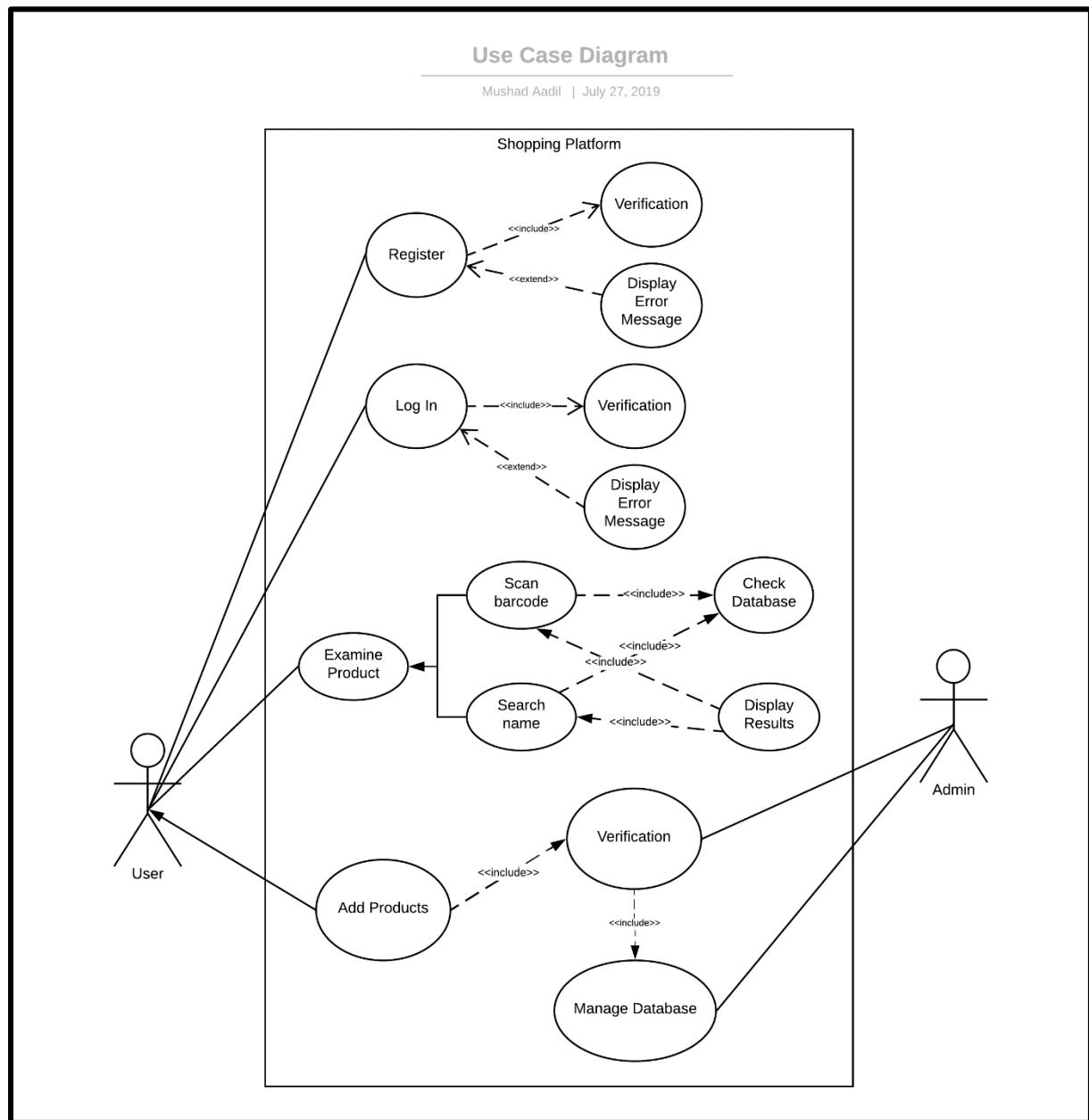


Figure 40 - Use Case Diagram. Product Scanning

- The User may Register or Login (Base Use Case). This relationship is called association since it just shows basic communication. The Base Use Case has a dependency on Verification from the server (Included Use Case) so it is an 'include' relationship. This means Verification is vital for the User to log in or register.
- **Generalization** - After the user has logged in he/she may find if a product's manufacturing process and contents are environment-friendly by scanning the barcode or manually entering its name. This will again similarly check the database and return the results. Examine Product is the **Parent** class while Search by barcode or name are

Children. Each child shares the common features of the parent which but adds something of their own.

- In addition to searching for products, users can contribute by entering information about products through a panel. This includes a verification that is monitored by an admin or expert and then added to the database.

4.2.3 Use Case Diagram for EV Charger

The diagram below shows the process of a user searching for an EV charging station.

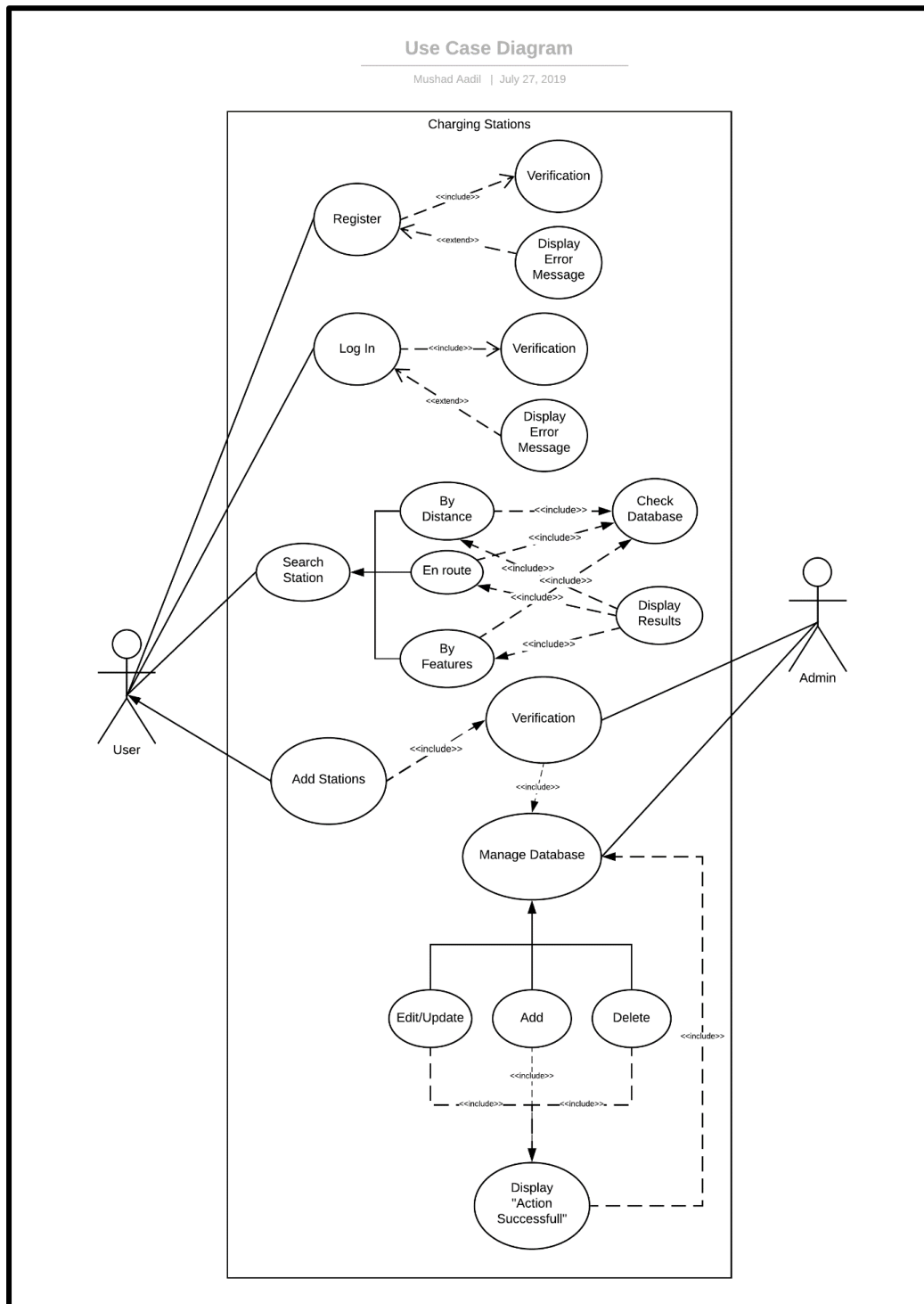


Figure 41 - Use Case Diagram. EV Charger

- After the login process, the user opens the map to search for EV stations. This can be done by the nearest station, en route to the destination or by specific facilities available. When each of these filters is applied and searched, the system checks the database and returns directions for the specified station. Stations with specific facilities may include but not limited to certain types of charging plugs, fast chargers for newer car models, cafes and restrooms.
- To enlarge the database, I've implemented a feature where users can contribute by adding stations they discover on their own. This will include providing the location, name and phone number of the station. They may also provide other details such as which facilities are available such as wheelchair accessibility.

4.2.4 Use Case Diagram for Social Media

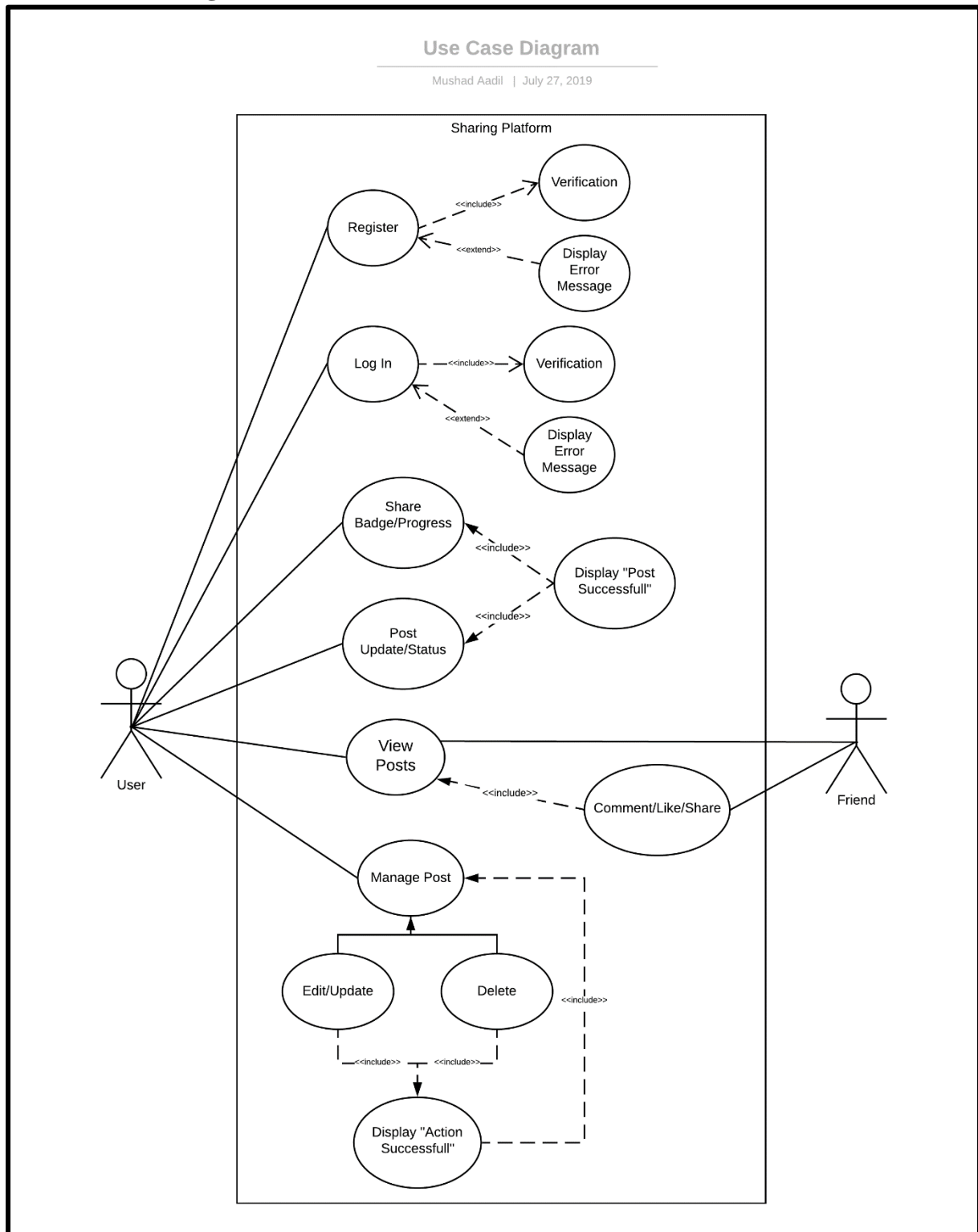
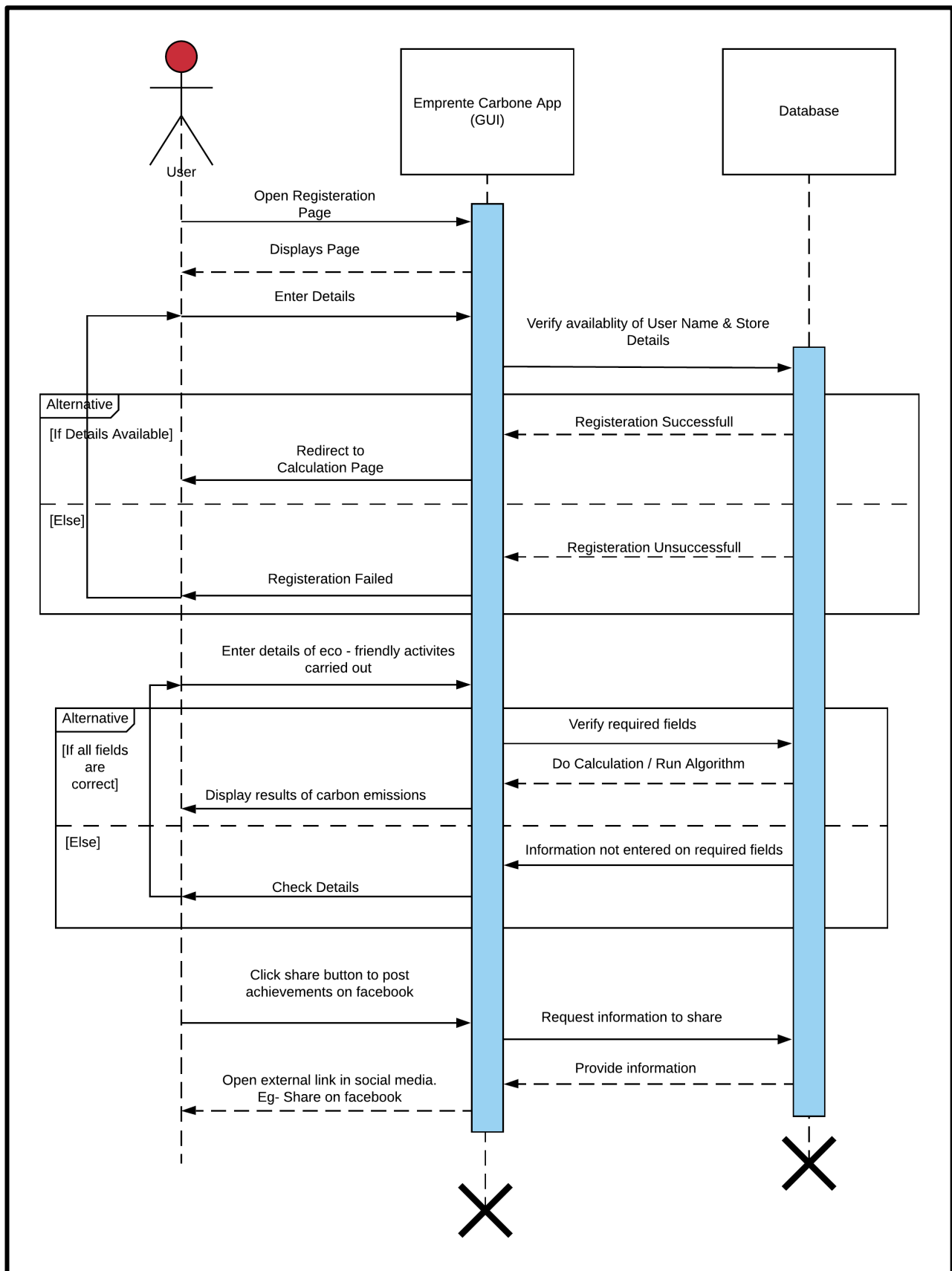


Figure 42 - Use Case Diagram. Social Media

4.3 Sequence Diagram



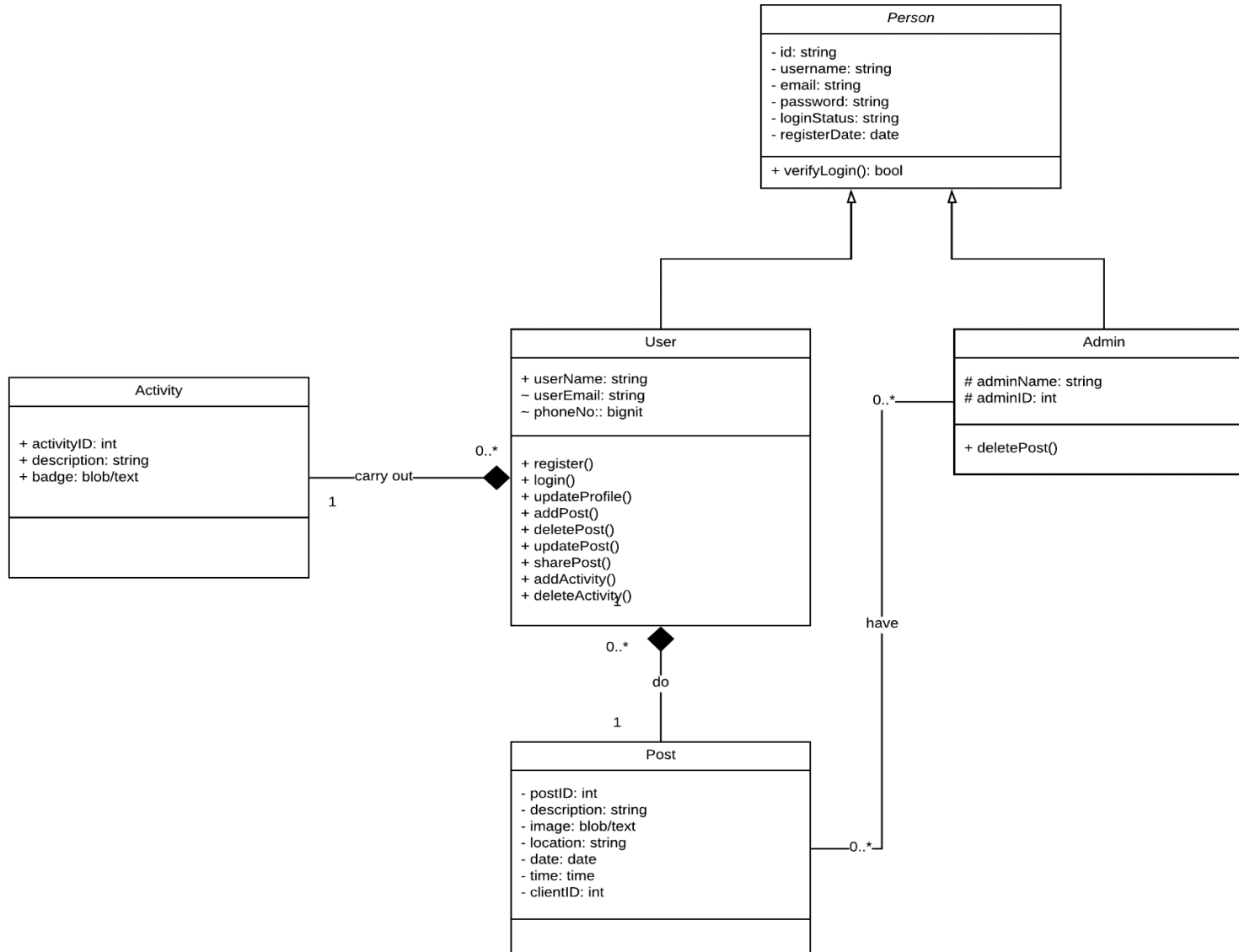
The sequence diagram shows the sequence of events of a user registering, unlocking an achievement and sharing that on social media.

- The first **message** is the **interaction** between the User and the Application. The User opens application which loads the registration page. This is marked by an arrow from the User that points straight towards the GUI.
- **Return Response**– The Application in return displays the Registration Page. This is a return response and is presented by a bolt arrow that moves from left to right.
- **Alternative Frame** – After the user enters the information into the application, it goes into the Wix Server to verify the obtainability of the credentials. The server has two options. It can either return a message that says “Registration Successful” which means credentials are available or “registration Unsuccessful” which means credentials are unavailable. In this case, an alternative frame would be used. The top section of the frame shows the outcome if there is availability for the credentials whereas the bottom section shows the outcome if the credentials are unavailable.
- **Activation boxes** – The activation box which is denoted in blue indicates how long an object is running. The Graphical User Interface of the application has a longer process compared to the Database.

4.4 Class Diagram

Emprente Carbone - Class Diagram

Mushad Aadil | August 31, 2019



- Admin details will be only recorded once when they are hired for the job, so these details do not need to change, hence the attributes in the Admin Class are protected (#).
- The User and Admin are subclasses of the Person class and this type of relationship is called an Inheritance relationship. They inherit all the attributes of the Person class and have a few extra of their own.
- **Abstraction** – The person is an abstract class. In the event that we need to instantiate a class in our framework, it going to be either the User or Admin. We wouldn't start the Person class itself. The User class is to keep the code DRY. (DON'T REPEAT YOURSELF) hence the name of the class is in italics.
- **Association** – The Post class and the Admin class have an association relationship. They have no dependencies between them.
- **Composition** – The User, Activity, and Post classes have a composite relationship. The Activity and Post classes wouldn't exist without the User Class. Because there should be a user to post or complete an activity.
- **Multiplicity** – Permits setting numerical requirements on the connections. For example, a User could register and not do any eco-friendly activities. Hence the Zero to Many relationships. Moreover, an Activity could only belong to one user.

0..1	zero to one (optional)
n	specific number
0..*	zero to many
1..*	one to many
m..n	specific number range

Figure 43- Types of Multiplicity

4.5 Wireframe

A wireframe is a crucial part of the design process. It is the designer's impression of the final outcome of the product. It may give a basic idea of what the product represents. A wireframe may change throughout the software development lifecycle as new features are implemented or existing ones are removed. Below is the wireframe for the home page:



Figure 44 - Wireframe. Page 1

The calculation page is a crucial page in the app. This is where certain questions will be answered by the user. These are needed to calculate carbon emissions and provide tips. Simple selections and long answers will be used. The calculate button will return an answer which can then be shared for friends to see.

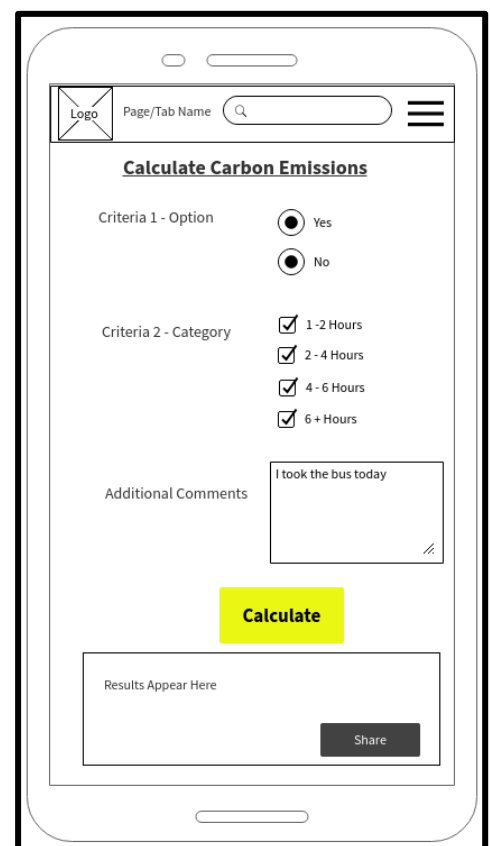
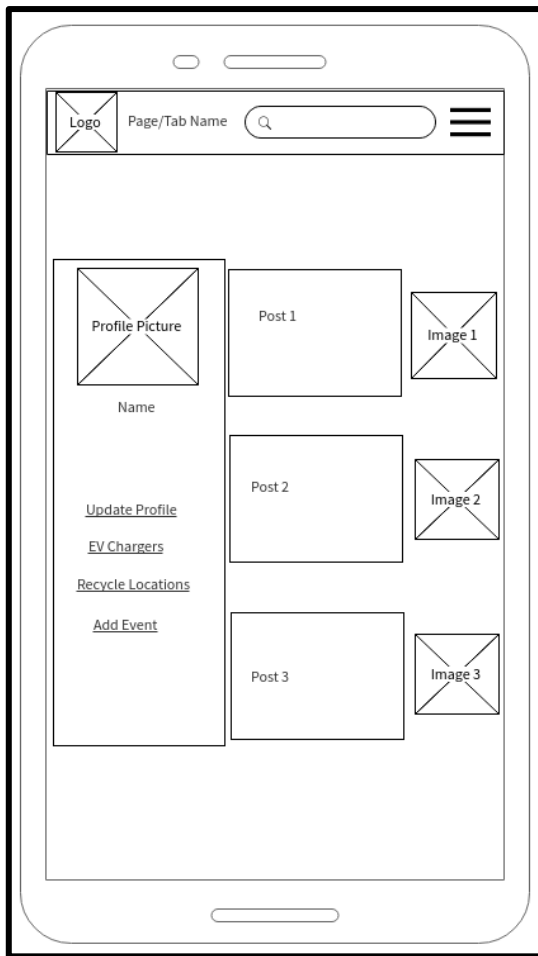


Figure 45 - Wireframe. Page 2



This is the profile page. On the left side, there is a panel detailing the details about the User. Below are hyperlinks to edit the profile with access to other parts of the app.

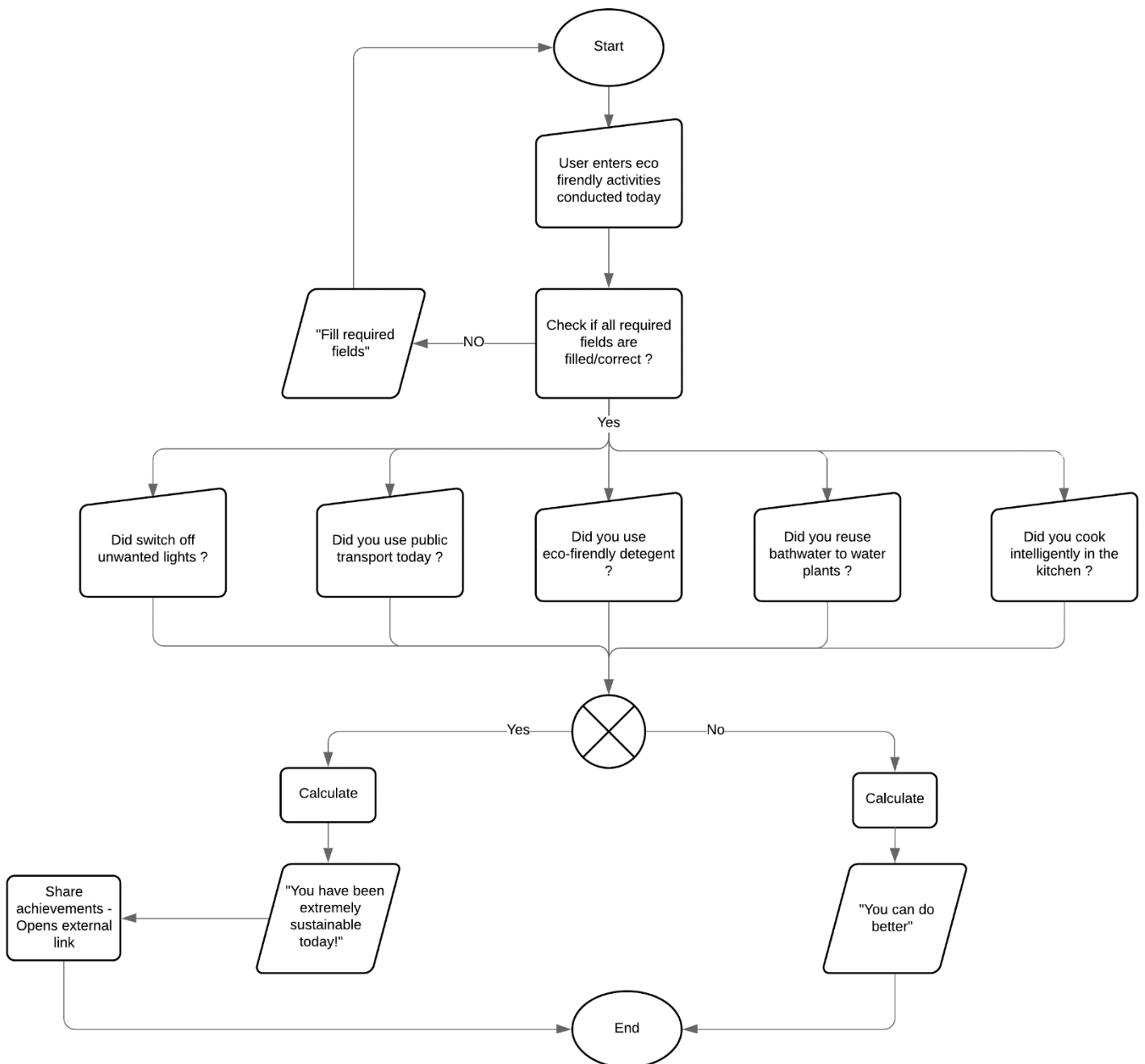
On the left side, you can see posts correspondingly placed with pictures. These will display in the form of a repeater.

Figure 46 - Wireframe. Page 3

4.6 Calculation Algorithm Flowchart

Calculation Algorithm Flowchart

Mushad Aadil | September 2, 2019



The flowchart above shows the process that happens in the back-end when a user fills in the details and hits the calculate button to see their achievement.

5.0 IMPLEMENTATION

5.1 Code Samples

Below are code snippets of a simple web app developed in the flutter framework using the Dart programming language. Each page contains a widget that accesses the website in real-time while having a navigation bar at the bottom which respectively connects to the other pages of the website.

5.1.1 Flutter app frame

Creating Flutter frame in which web app will run on

```
void main() => runApp(new MyApp());

class MyApp extends StatefulWidget {
  |  MyAppState createState() => MyAppState();
}

// This widget is the root of your application.
//List<Widget> _tabList = [];
class MyAppState extends State<MyApp> {
  |  int _currentIndex = 0;
  |  Widget callPage(int currentIndex) {
  |    |  switch (currentIndex) {
  |    |    case 0:
  |    |    |  return Pageone();
  |    |    case 1:
  |    |    |  return Pagetwo();
  |    |    case 2:
  |    |    |  return Pagethree();
  |    |    case 3:
  |    |    |  return Pagefour();
  |    |    |  break;
  |    |    default:
  |    |  }
  |  }
}
```

Figure 47 – Code for Flutter app frame

5.1.2 Scaffold & App bar

WebView scaffold which will access the URL of the website and the app bar with the logo and title within a Stateful widget

```

class Pageone extends StatefulWidget{
  PageoneState createState()=> PageoneState();
}

class PageoneState extends State<Pageone>{
  @override
  Widget build(BuildContext context){
    return new Scaffold(

      appBar: PreferredSize(
        preferredSize: Size.fromHeight(30.0), // here the desired height
        child: AppBar(title: Text('Stats', style:TextStyle(fontSize: 15, fontFamily: 'Saira')  ))

      ), // PreferredSize
      body: WebviewScaffold(

        url: "https://maadilpm.wixsite.com/mysite",
        withZoom: false,
        withJavascript: true,
        scrollBar: false
      )
    );
  }
}

```

Figure 48 – Code for Scaffold and app bar

5.1.3 Navigation Bar

The bottom navigation bar which can access the important pages

```

items: [
  BottomNavigationBarItem(
    title: Text('Stats',
      style: TextStyle(
        color: Colors.white, fontWeight: FontWeight.bold)), // TextStyle // Text
    icon: Icon(Icons.data_usage, color: Colors.redAccent)), // BottomNavigationBarItem
  BottomNavigationBarItem(
    title: Text('EV',
      style: TextStyle(
        color: Colors.white, fontWeight: FontWeight.bold)), // TextStyle // Text
    icon: Icon(Icons.power, color: Colors.green)), // BottomNavigationBarItem
  BottomNavigationBarItem(
    title: Text('Products',
      style: TextStyle(
        color: Colors.white, fontWeight: FontWeight.bold)), // TextStyle // Text
    icon: Icon(Icons.scanner, color: Colors.yellowAccent)), // BottomNavigationBarItem
  BottomNavigationBarItem(
    title: Text('Account',
      style: TextStyle(
        color: Colors.white, fontWeight: FontWeight.bold)), // TextStyle // Text
    icon: Icon(Icons.person, color: Colors.blue)), // BottomNavigationBarItem
],

```

Figure 49 – Code Navigation bar

5.1.4 Calculation Algorithm

```
import wixUsers from 'wix-users';
import wixData from 'wix-data';
import wixLocation from 'wix-location';

$w.onReady(function () {
  $w('#calculate').onClick(function(){
    console.log("button has been pressed")
    if ($w('#publicTransport').value === 'Yes' && $w('#lights').value === 'Yes' ) {

      $w('#result').value = "You have been extremely Sustainable today !";
    } else {

      $w('#result').value = "You could do better. Keep on trying";
    }
    // $w('#result').value = $w('#publicTransport').value + $w('#lights').value
    console.log("calculation finished")
  })
})
```

Figure 50 - Code for Calculation Algorithm

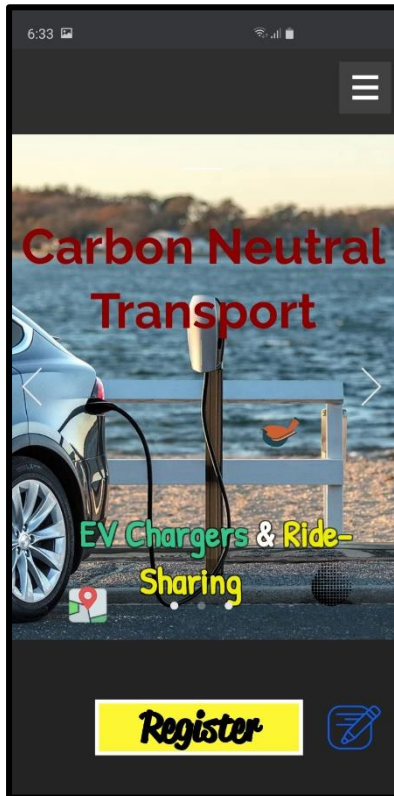
5.1.4 Viewing Statuses

```
1  import wixUsers from 'wix-users';
2  import wixData from 'wix-data';
3  import wixLocation from 'wix-location';
4
5  $w.onReady( () => {
6    if(wixUsers.currentUser.loggedIn) {
7      $w("#like").show();
8    }
9    else {
10     $w("#like").hide();
11   }
12 });
13
14 export function like_click(event) {
15   wixData.insert('Likes',
16     {likedContent: $w('#UserStatuses').getCurrentItem()._id});
17   $w('#contentLiked').show(),
18   $w('#like').hide();
19 }
```

Figure 51 - Code for Viewing Statuses

5.2 Working Application Interfaces

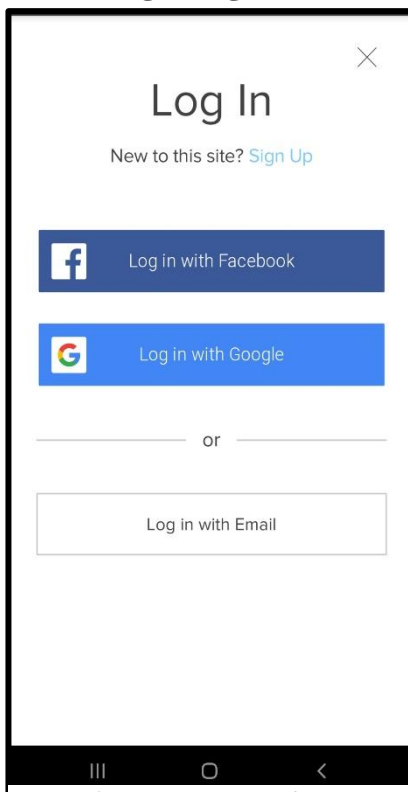
5.2.1 Home Page



This is the page users will see when they open the application.

Figure 52 - Home Page Interface

5.2.2 Login Page



The login page provides the option to log in with popular socials or by email.

Figure 53 - Login Page Interface

5.2.3 Calculation Page

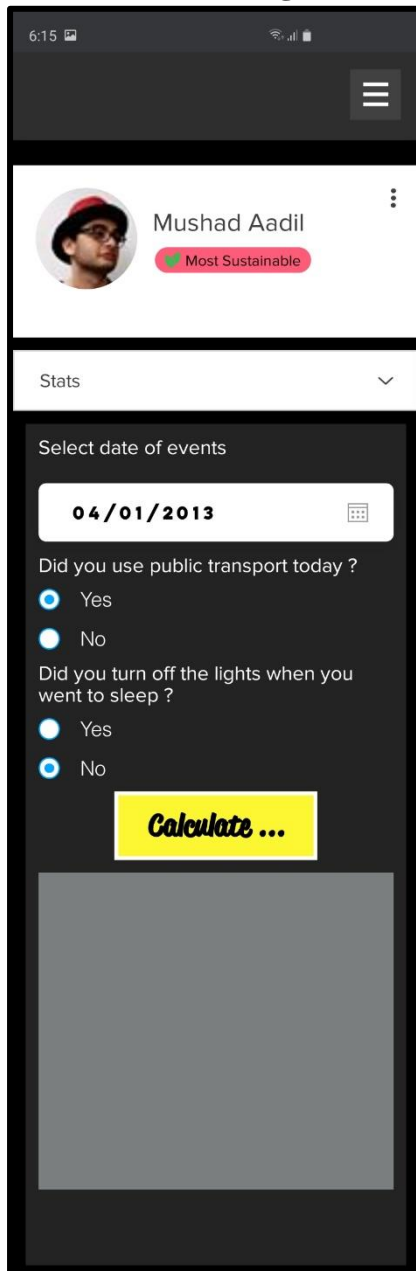


Figure 54 - Calculation Page Interface

5.2.4 Finding EV Chargers

This is a publicly available database that shows registered EV chargers throughout the world. Users can enter their location or auto-detect and filter by features.

This page allows the user to calculate carbon emissions by entering a few details such as the date of the event they are recording. The user will select answers to the premade questions and when hit 'calculate' and the answer will appear at the bottom on the grey rectangle. This could be then shared into the social media platform of the user's choice.

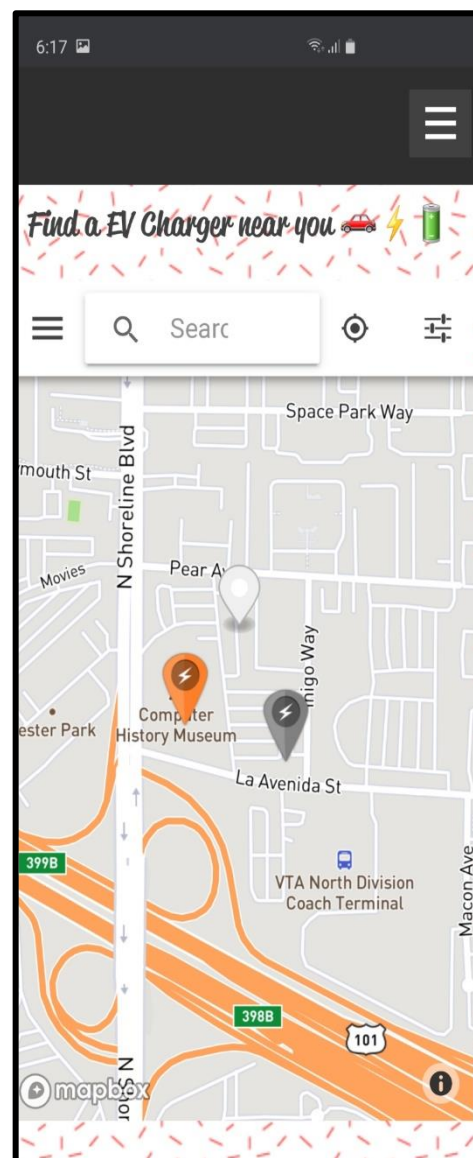
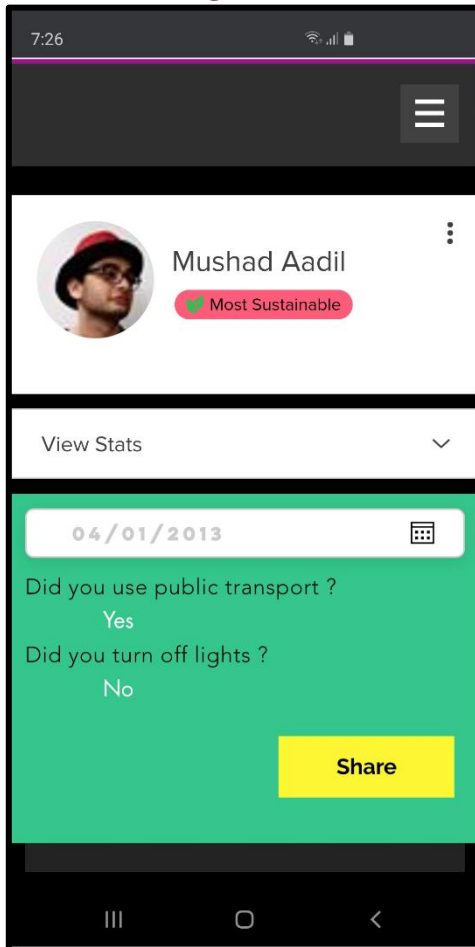


Figure 55 - EV Chargers Interface

5.2.5 Sharing Achievements



Users can come into the page where they can view all their achievements, and statistics on how sustainable they were. From this page, they could share their achievements for the day which can be liked and commented by other users.

Figure 56 - Achievements Page Interface

6.0 TESTING AND DEPLOYMENT

6.1 Test Plan

1.0 INTRODUCTION

The product that is going to be tested is the Carbon footprint calculator.

The functions of the product are:

- Register Users and Store User Information
- Calculate carbon emissions
- Share achievements
- Like and comment on other's achievements
- EV chargers, recycle programs

2.0 SCOPE

The test will run from the registration to the calculation stage.

3.0 TESTING STRATEGY

- Product Background
- Features tested
- Test Approach

4.0 HARDWARE REQUIREMENTS

Computer

Mobile Phone/ Emulator

Modems

5.0 ENVIRONMENT REQUIREMENTS

6.1 Main Frame:

Hardware – Computer and Mobile Phone/ Emulator

Software – Visual Studio Code running on Windows 10

Framework – Flutter

6.0 FEATURES TO BE TESTED

- Login
- Calculating Carbon Emissions and share the results
- Update User Details from the profile page

- Like a post
- View EV Chargers
- View Recycle Points

7.0 FEATURES NOT TO BE TESTED

All features are tested

8.0 RESOURCES/ROLES & RESPONSIBILITIES

Mushad Aadil – Conducting all testing

9.0 SCHEDULES

Major Deliverables:

Test Plan

- Test Cases

Test Case ID	Test Case	Description	Test Step	Step Description	Expected Result	Actual Result	Status
TC01	Validate Login Credentials	Test the login functionality of the site to check whether the user can log in	Prerequisites	Make sure the application is available and testable Make sure the required data for login is available			
			Step 1	Launch the website	Application launching properly	Launch Success	Pass
			Step 2	Navigate to the login page	The login page is displayed properly	Display Success	Pass
			Step 3	Enter valid username and password	Fields are editable	Username and password accepted	Pass
			Step 4	Click on the login button	User should log in and navigate to the	User navigated to the Appointment Page	Pass

					Appointments page		
TC02	Calculate Carbon Emissions	Check the calculation functionality	Prerequisites	<p>Make sure the application is available and testable</p> <p>Make sure the required data for calculation is available</p>			
			Step 1	Open the Stats Page	Page loading properly	Loading success	Pass
			Step 2	Enter details into field	Make sure the drop-down lists, checkboxes and the calendar option are working	Submission Success	Pass
TC03	Share Achievements	Share the achievements unlocked	Prerequisites	<p>Make sure the application is available and testable</p> <p>Make sure the achievements are accessible</p>			

			Step 1	Open the Achievements Page	Page loading properly	Loading success	Pass
			Step 2	Click on the Share button next to the preferred achievements	External Social media link opens	Posting success	Pass
TC04	Update User Profile	Update client details from the admin panel	Prerequisites	Make sure the application is available and testable Confirm that the User Details are shown in the respective fields			
			Step 1	Log In to the admin panel	Log in to the panel Successfully	Log In Success	Pass
			Step 2	Navigate to Client Information Page	Navigation successful	Page Opened	Pass
			Step 3	Search for client	Search with details	Search Successful	Pass
			Step 4	Modify Information	Details to be successful changes	“Success” message appeared	Pass

TC04	Liking System	Like a post of a User from the Statuses Page	Prerequisites				
			Step 1	Log In to the account	Log in to the panel Successfully	Log in Success	Pass
			Step 2	Navigate Statuses Page	Navigation successful	Page Opened	Pass
			Step 3	Like Post	Red Heart indicates, liking successful	Search Successful	Pass
TC05	EV Chargers	Go to the EV Chargers page and get directions to the nearest one	Prerequisites				
			Step 1	Click on the more items menus and click EV Chargers	Accessing page successful	Page opens	Pass
			Step 2	Enter a location or click location detector	Search results appear	Search Successful	Pass
			Step 3	Click directions	Opens google maps to get directions	Navigation Successful	Pass

				next to search results			
TC06	Recycle Centers	Go to the Recycle Centers page and get directions to the nearest one	Prerequisites				
			Step 1	Click on the more items menus and click Recycle Points	Accessing page successful	Page opens	Pass
			Step 2	Enter a location or click location detector	Search results appear	Search Successful	Pass
			Step 3	Insert certain filters if needed	Filter Results appear	-	Pass
			Step 4	Click directions next to search results	Opens google maps to get directions	Navigation Successful	Pass

Table 5 - Test Cases

10.0 TOOLS

Testing is done in Visual Studio Code. Visual Studio Code – Editor and Debugger

11.0 APPROVALS

Approved by Myself

6.2 User and Technical Documentation

Title: Empreinte Carbone – Carbon Emissions Calculator

Subtitle: The application encourages people to take eco-friendly actions in order to lead a sustainable life.

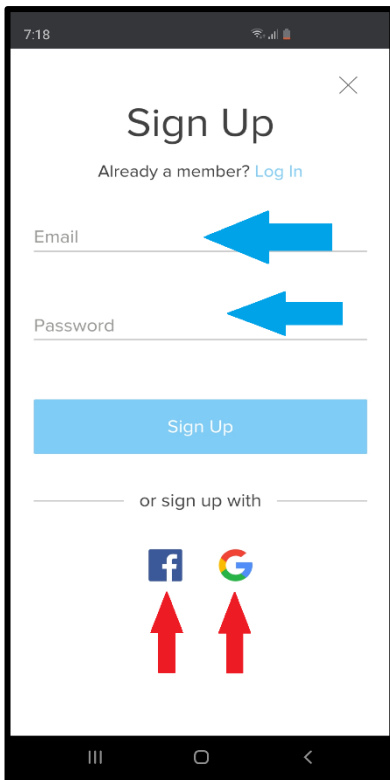
Objectives: Users can log the activities they carry out and in turn, they unlock an achievement. This can then be shared onto different social media platforms.

Overview: The pursuers of this report will figure out how to utilize the item referenced above and its highlights that are useful. They will in detail figure out how to enroll and finish an action and share the accomplishments.

6.2.1 Registration

Registration is a simple and straight forward step. When the users open the application for the first time they will be greeted at the home page which will look like this. Users can click on the **Yellow** Register button or the menu button which will open an overlay to sign up.





In this overlay, the user has two different options to sign up. They sign up by email address. Or by using social media.

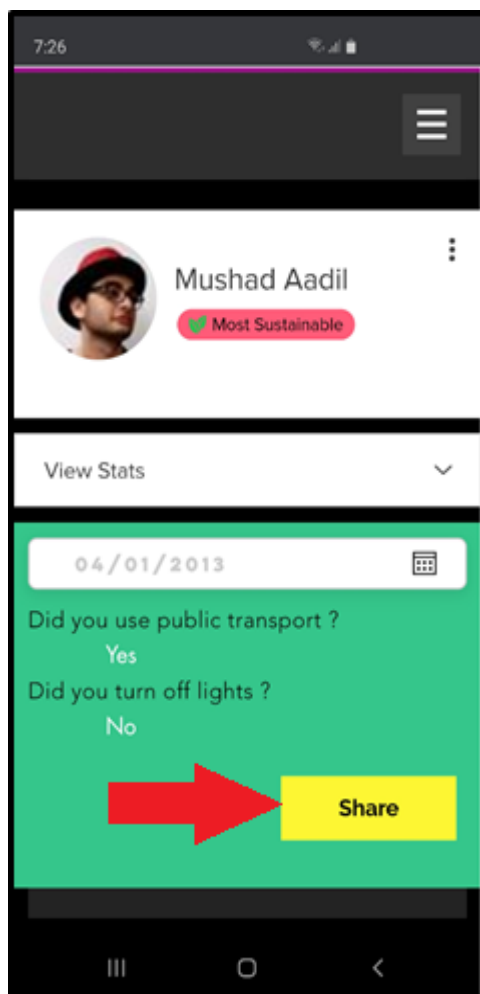
6.2.2 Calculation Page

After registration, the user will be logged in automatically. Then he/she will be redirected to the Calculation Page. This page is where the user logs in all the eco-friendly activities he/she has carried out today. Ultimately, they unlock an achievement that can be shared onto social media.

- First users select the **date** of the activity.
- Then, they answer common **questions** about each activity. If they have completed such and such.
- When finally hit the **calculate** button, the algorithm runs in the background to bring their achievements which can be shared on social media.

5.2.6 Sharing onto social media

With the panel above users can access the View Stats page whereby clicking on the yellow share button they can **share** their achievements onto social media.



7.0 CONCLUSION

Climate change is real and is increasing at a rapid rate

One of the most pressing issues faced by humanity in this modern world is Climate Change. Climate change is a broad subject where several parties play important roles and there are various contributions. But if we move our focus to individuals rather than focusing on large corporations and multinationals, we could accomplish great change. In view of recent events, we can see more people are aware of the dangers of the earth warming up. The ultimate consequence will be the extinction of our species by our species itself, which is the sad truth.

The most recent event was when the Amazon rainforest caught fire. This has caused an increase in the rate of the earth's temperature rising and now we have very little time to make changes than ever before. Social media was stormed by environmentalists demanding change from political leaders. We as a united group can make a great impact. But to do that we must be willing to change ourselves first. The Amazon rainforest story though popular on social media didn't grab the attention of the media or get contributions as when the Notre-Dam caught on fire. People are more focused on tourist attraction that what merely helps us breathe.

People need to be educated on the subject and awareness should be increased. My application takes a psychological approach by focusing on individuals and aiming to change their mindset about climate change and the drastic consequences that come with it. With the research, I have done about **behavior change** and **habit development** I am able to implement a motivation strategy into my application. This way little by little people will develop habits that help the planet. They are also likely to destroy old habits that are eco-unfriendly.



Figure 57 - German activists standing on ice

Together, let's save the planet. One step at a time.

WORKS CITED AND BIBIOLGRAPHY

- Blanding, M. (2017, July 19). *Harvard Business School Working Knowledge*. Retrieved from Why Government 'Nudges' Motivate Good Citizen Behavior: <https://hbswk.hbs.edu/item/why-government-nudges-motivate-good-behavior-by-citizens>
- Clear, J. (2018). *How Long Does it Actually Take to Form a New Habit? (Backed by Science)*. Retrieved from James Clear: <https://jamesclear.com/new-habit>
- CNBC. (2019, June 22). *Carbon Capture Plant Does The Work Of 40 Million Trees*. Retrieved from Youtube: https://www.youtube.com/watch?v=XHX9pmQ6m_s&list=WL&index=21&t=1s
- Conversation, T. D. (2015, December 2). *Climate Change Explained*. Retrieved from Climate Change Explained: <https://www.youtube.com/watch?v=ifrHogDujXw&t=61s>
- David. (2018, July 3). *Top 10 things you can do about climate change*. Retrieved from David Suzuki Foundation: <https://davidsuzuki.org/what-you-can-do/top-10-ways-can-stop-climate-change/>
- Derena, A. (2019, March 22). *Ada Derena*. Retrieved from <http://www.adaderana.lk/news/53944/sri-lanka-successfully-tests-artificial-rain-for-first-time>
- Duhigg, C. (2012). *The Power of Habit*. New York: Random House.
- Hub, I. (2018, August 1). *Impact Hub*. Retrieved from Impact Hub: <https://impacthub.net/5-big-companies-reducing-their-carbon-footprints/>
- Kahneman, D. (2011). *Thinking, Fast and Slow*. New York: Farrar, Straus and Giroux.
- Motors, T. (2019). *Tesla*. Retrieved from Tesla: <https://www.quora.com/Why-Tesla-cars-are-gaining-so-much-popularity>
- News, B. (2019, June 17). *Youtube*. Retrieved from Climate Change: <https://www.youtube.com/watch?v=nho73BtDQtE>
- Nikel, D. (2019, June 18). *Forbes*. Retrieved from Electric Cars: Why Little Norway Leads The World In EV Usage: <https://www.forbes.com/sites/davidnikel/2019/06/18/electric-cars-why-little-norway-leads-the-world-in-ev-usage/#4e95032213e3>
- Rohaidi, N. (n.d.). *Six ways governments are 'nudging' citizens*. Retrieved from Gov Insider: <https://govinsider.asia/innovation/six-ways-governments-nudging-citizens/>
- Steinle, N. (2011). *Genetics of Eating Behavior: Established and Emerging Concepts*. Maryland: University of Maryland.
- SustainabilityX. (2018, November 30). *Once Upon A Time, There Was A President That Didn't Believe In Climate Change*. Retrieved from Medium:

<https://sustainabilityx.co/once-upon-a-time-there-was-a-president-that-didnt-believe-in-climate-change-21414c69e829>

TimeForChange. (2008). *Time For Change*. Retrieved from Time For Change:
timeforchange.org/are-cows-cause-of-global-warming-meat-methane-CO2

Tobgay, T. (2016, February). *Ted Talk*. Retrieved from Ted Talks:
https://www.ted.com/talks/tshering_tobgay_this_country_isn_t_just_carbon_neutral_i_t_s_carbon_negative?language=en

Zachos, E. (2018, April 20). *National Geographic*. Retrieved from National Geographic:
<https://www.nationalgeographic.com/travel/features/sunscreen-destroying-coral-reefs-alternatives-travel-spd/>

Plagiarism Report

Dissertation Project - CardiffMoodle.pdf

ORIGINALITY REPORT

8%

SIMILARITY INDEX

1%

INTERNET SOURCES

0%

PUBLICATIONS

7%

STUDENT PAPERS

PRIMARY SOURCES

1

Submitted to University of Wales Institute,
Cardiff

Student Paper

6%

2

www.slideshare.net

Internet Source

<1%

3

Submitted to Taylor's Education Group

Student Paper

<1%

4

melbourne-classifieds.info

Internet Source

<1%

5

Submitted to Rancho Santiago Community
College District

Student Paper

<1%

6

Submitted to El Camino Community College

Student Paper

<1%

7

www.scienceinschool.org

Internet Source

<1%

8

Submitted to University of Wales Swansea

Student Paper

<1%

9	Submitted to Upper Iowa University Student Paper	<1 %
10	Submitted to University of Southampton Student Paper	<1 %
11	Submitted to Trident University International Student Paper	<1 %
12	Submitted to CSU, San Jose State University Student Paper	<1 %
13	link.springer.com Internet Source	<1 %
14	www.psyfitec.com Internet Source	<1 %
15	Submitted to University of Cambridge Student Paper	<1 %
16	www.davistownmuseum.org Internet Source	<1 %
17	essay.utwente.nl Internet Source	<1 %
18	Submitted to Coastline Community College Student Paper	<1 %
19	waikato.researchgateway.ac.nz Internet Source	<1 %
20	Submitted to Nyenrode Business Universiteit Student Paper	

<1%

21

www.rapidsharedownloader.com

Internet Source

<1%

22

Submitted to University of Greenwich

Student Paper

<1%

23

Submitted to KMD Computer Center

Student Paper

<1%

Exclude quotes Off

Exclude matches Off

Exclude bibliography Off