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Functional Specification

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1. Introduction

1.1 Overview

In this functional spec, I will be introducing the underlying concept of my project. The purpose of the project is to provide an effective and a viable solution for bicycle riders to use when they wish to navigate in an urban environment. The aim of this project is that while cycling, the cyclist is able to easily identify the directions to take to get to their desired destination. It is a navigation app that will interact with GPS as well as an LED board which would be mounted on the bicycle or could be in the form of a wearable and it will simply provide a left, right or straight-on indication as the cyclist approaches a junction. It will be an android app that runs on Google Maps servers. All you do is plug in your destination, start riding – but this time, you put your phone in your pocket.

A wireless communication module is essential in order to line the User interface (Android Application) to the control unit. It would definitely be possible to use wired technologies but this would be inconvenient as well and anti-aesthetically pleasing. Therefore, Bluetooth technology was taken into consideration. Bluetooth is primarily used to connect devices without the use of cables and it is the technology standard that is used to exchange data over short distances, usually between personal mobile devices.

The Bluetooth paired processor will use the app as GPS and will light up the LEDs mounted on the bike to tell the cyclist where to turn. Also, because the app will run with Google Maps, if the cyclist takes a wrong turn, the software will re-route. This is a very useful system for cyclists who want to get to their desired destination but don’t wish to have their phone out during the journey as this is very dangerous. As mentioned above, the system would be very easy to use as all the user has to do is enter their destination onto the app and get on their bicycle and be on their way.

1.2 Business Context

There are several possible business contexts that relates to this product. Such as:

- **Selling the Product:** This product could be sold to the Road Safety Authority (RSA). The RSA could potentially use this product as a way of helping spread safety awareness for cyclists. With this product being sold to the RSA, they could enforce that cyclists use it seeing as they would be less distracted from looking on their phones for directions. Also this product could be sold to Dublinbikes. Just Eat dublinbikes stations are distributed throughout the city centre to enable access and optimal use. They could have this product safely mounted on these bikes so for anyone who needs directions to a place they are trying to get to, they can simply pair up their phone to the product and be on their way.
- **Advertising:** This product could have extra features that could be generally advertised. This product would have a target audience of cyclists of any age once they have an Android powered smartphone.

1.3 Glossary

Java: Java is a general purpose, high-level programming language

Android Studio: Android Studio is the official Integrated Development Environment (IDE) for Android app development, based on IntelliJ IDEA.

Flora Board: "Adafruit's fully-featured wearable electronics platform. It's a round, sewable, Arduino-compatible microcontroller designed to empower amazing wearables projects." - https://www.adafruit.com/product/659

Google Maps API - "The Maps API returns helpful data about places and locations. It is called by javascript. It can cause maps to appear for the user. It can return data about a latitude/longitude location, or return data about an address." - https://github.com/RefugeRestrooms/refugerestrooms/wiki/What-is-the-Google-Maps-API%3F-How-is-it-used%3F

Arduino: "Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board." - https://learn.sparkfun.com/tutorials/what-is-an-arduino/all

Flora wearable bluefruit LE Module - Connects to the flora board and provides Bluetooth connectivity.

2. General Description

2.1 Product / System Functions

This system will be made up of an Android application working hand in hand with a customisable wearable technology called a Flora board. The user will be able to input their desired destination into the app, this will then retrieve the shortest route via Google Maps API. Once this information is retrieved, the information of the route is sent to the Flora system. This information is now used by the Flora system to send signals that will light up the correct LED for which way the cyclist has to turn.

For rerouting, if by any chance the cyclist misses a turn or meets a roadblock, since the Android application is connected to Google Maps API, the route will be automatically recalculated to give back the cyclist the shortest route.

The product could be wearable or could also be part of the bike. It would be better if it was wearable meaning that the cyclist can use the same device with different bikes. If it was to be mounted on a bike it would have to be waterproof. In addition, the alert system would have to have a relative wide range in order to be visible from a distance. It would have to be lightweight as well as comfortable. In order to eliminate any extra weight, I would have to look into making the system power efficient and that its design would be able to avoid additional weight from such things as batteries.

2.2 User Characteristics and Objectives

The intended system is designed for cyclists who have phones that can enable Bluetooth and are able to use directional based apps on their phones.

The objective of the application is for the user to be able to input a destination that they wish to go, connect their phone to the Flora device via Bluetooth, then following the directions they there given via the LED lights. The user can make a wrong turn if they want but they still will be led back on course because the application will recalculate the new shortest distance from where they currently are to the destination they already picked.

2.3 Operational Scenarios

- **Pairing Android Application With Flora System:** Before the product can begin to do its function, the user must first pair up the device with the android application via Bluetooth. The Flora system must at first be powered on for it to be detected. Once detected for the very first time the user wishes to start using the product, a permission pop up will be shown asking if the user wants to share their location with the device. If the user clicks the yes option they will automatically be paired from then on. This means that the permission pop-up does not have to keep showing up every time the user wants to use the android application.

- **Destination Inputted By The User:** The only part the user interacts with the system is when they have to input the destination that they wish to go. The Flora system will then attain the current location of the user and display the shortest route to their destination using the Google Maps API. This information is instantly sent to the hardware and when the user is ready they can be on their way.

- **Journey:** The journey is quite straightforward. Before a certain distance between the user and a junction, an LED light would turn on to indicate what turning to take, whether left or right. The light will turn off when the user had made their turn and will turn back on before they reach another junction. If peradventure the user takes a wrong turn or somehow strays away from the original route, the route will be recalculated and the new one will be sent back to the device so that the user can continue their journey

- **Destination Arrival:** Once the user has arrived at their destination, they can confirm that they have finished their journey and they can exit the application.

2.4 Constraints

I will have to be very conscious of the time that I spend on making each component perform its functionality. If time is not spent well, I could be in danger of focusing on one thing more than I am supposed to. I need to plan out the project very well and also in a realistic way because I have other modules and exams that I have to prepare for.

I would need to ensure that the correct GPS location is given. Not that this is very critical as without it the user can still find a location to a certain degree but getting this correct would make the functionality give more precise results. I might have to use an accelerometer.

I have to make sure that the application itself is very pleasing to the eye and can be used by any user of any age. This means that I would have to make a clear and simple User Interface that would be easy to be navigated by anyone at first glance.

Where to place the hardware is also a constraint. Since I am using a wearable technology there are number of places that I could put this hardware. I could put them on clothes, on the bike itself or even on gloves if they cyclist wishes to wear gloves. I could use a helmet but then I would have to think of how the user will see the LED lights.

I also have to be able to attain the correct GPS location of the user and also the destination to give them much better results.

3. Functional Requirements

3.1 Get Route

Description: What this function is meant to do is to retrieve the shortest route between the user and their destination. It will allow the user to input their destination in the android application. The result of the input query is retrieved from Google Maps API.

Criticality: This requirement is highly critical because this is what even allows the user to input their destination and also allows the route to be retrieved.

Technical Issues: Extracting the shortest route from Google Maps API.

Dependencies: This requirement is dependent on Google Maps API and the input query.

3.2 Route Sender

Description: Once the route has been extracted the information will be sent to the Flora board by Bluetooth. The Flora board will convert the turns into a form it can use. Depending on the junctions needed to take, the Flora board will be able to indicate what colour the LEDs have to show.

Criticality: This requirement is highly critical because it is with this system the user will be able to know what turnings to take.

Technical Issues: Communicating to the Flora board using Bluetooth.

Dependencies: Flora board, Google Maps API

3.3 System Reliability

Description: The system created must perform as intended and the use of the it must also be smooth. The user should not experience a delay in how long it takes the route to show and how long it takes the route to be sent to the Flora system. The location must also be exact.

Criticality: This is highly critical because at the end of the day, the main point of the product is for users to be happy with it when it does what it is supposed to do. This would improve the user experience and would therefore want them to use it again.

Technical Issues: Making sure that the User Interface is simple to use for anyone at any age. Improving the speed of which the information is passed out by doing a lot

of testing. Creating an algorithm that would be able to correct and GPS errors from the phone if there is any.

Dependencies: Creator, Flora, GPS, Bluetooth

3.4 Getting User to Destination

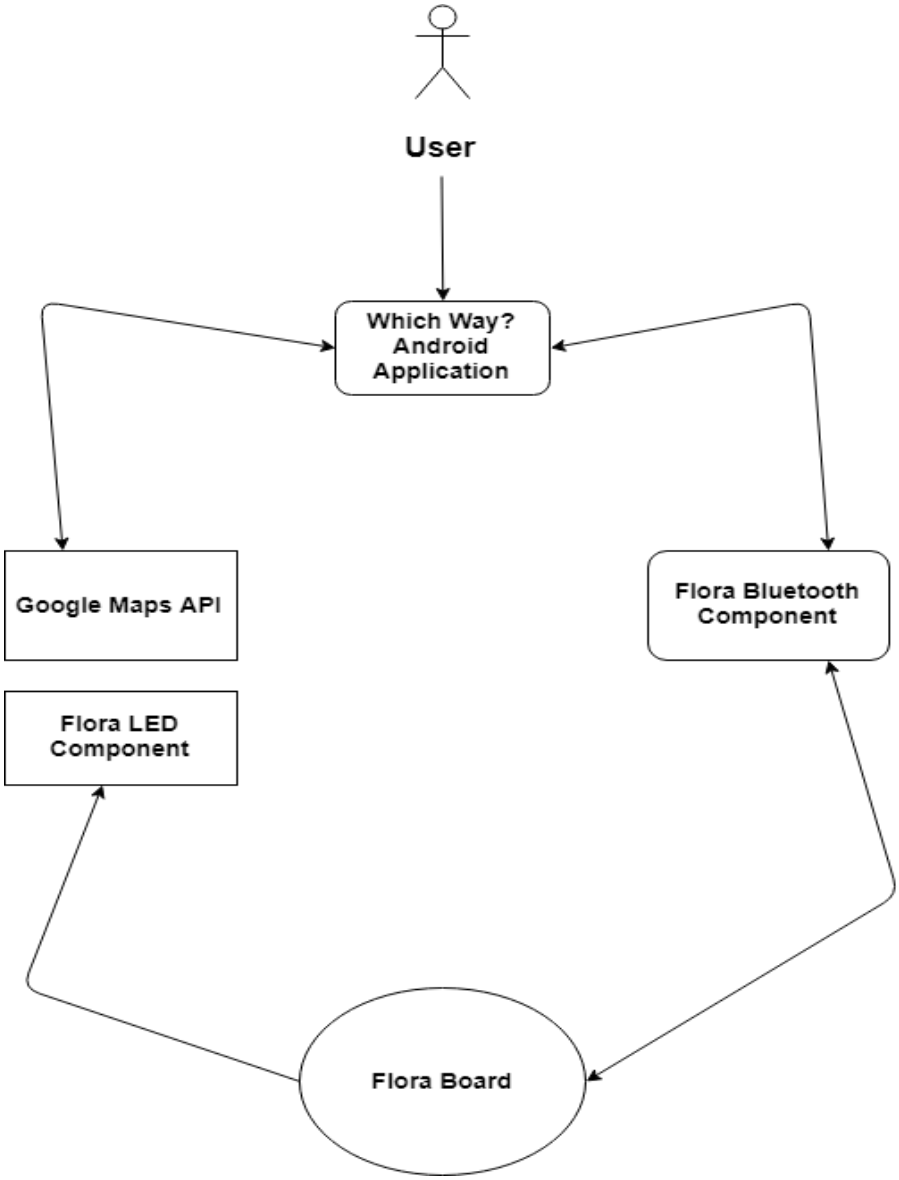
Description: This requirement is how the user gets from point A to B in the shortest route. This would require the LED lights which will direct the user just before they reach a junction on what way to go. It will also require the Flora board as this is what sends interacts with the LED lights telling them which one and when they should turn on. This may or may not use an accelerometer. The accelerometer will try to ensure that the user is at the correct location that they are. It could also indicate prior to a user getting to a junction how far away they are from the junction.

Criticality: This is highly critical because this is what the system is all about. It is all about getting the user to their desired destination.

Technical Issues: How to calculate how far the user has before they can turn and how to make the flora board send signals to the LED lights telling them when exactly to turn.

Dependencies: Bluetooth, Accelerometer, GPS, Flora Board.

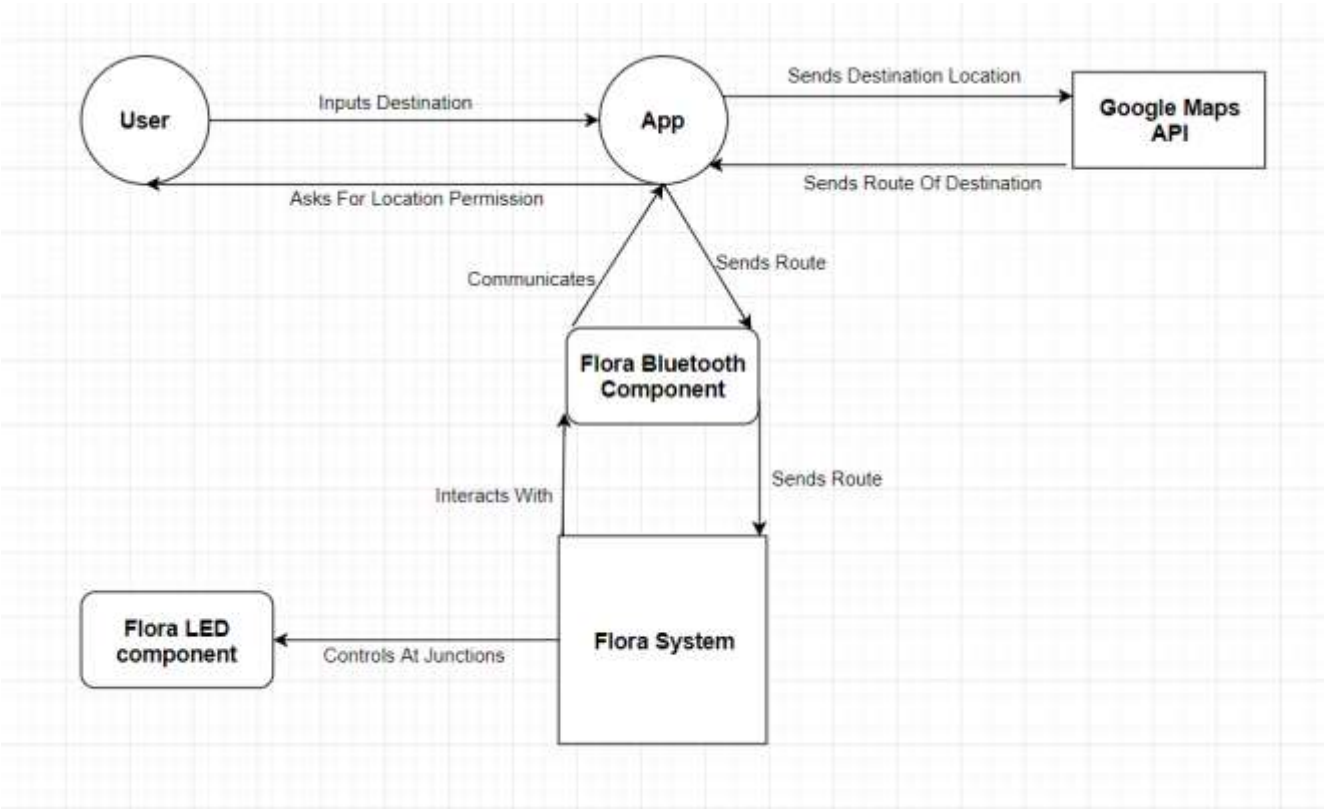
4. System Architecture



As we can see from this diagram, the system architecture of the product is; 1. There is a user. 2. The user used the Android Application. 3. The application interacts with Google Maps API and also interacts with the Bluetooth component of Flora. 3. Google Maps API interacts with the Android Application. 4. The Bluetooth component sends signals back and forth with the Android Application as well as the Flora Board. 5. The Flora boards interacts with the Bluetooth component and well as with the LED components.

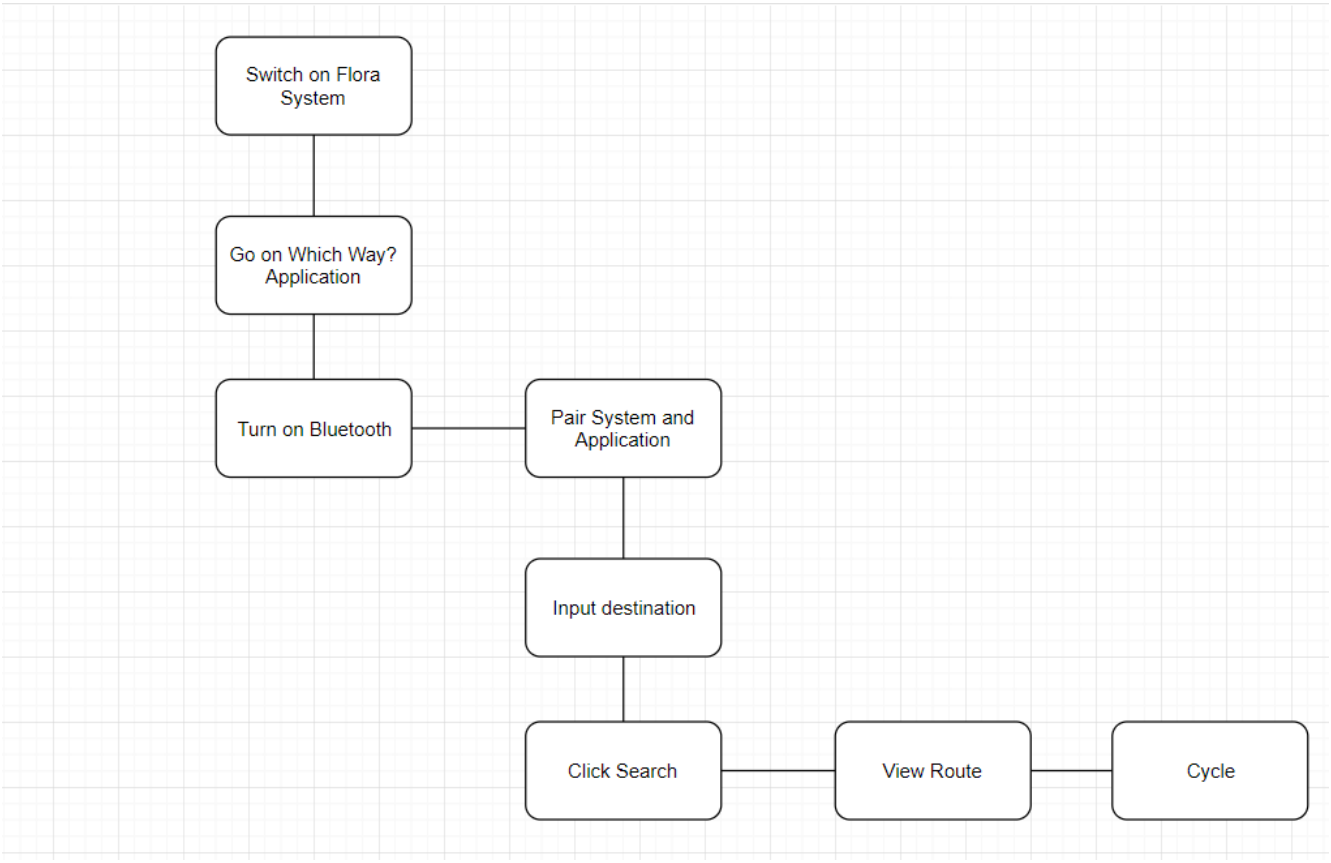
5. High-Level Design

5.1 Context Diagram



From the diagram above we can see a context diagram of how the system is. 1. The Applications asks the user if they want to allow their location to be used by the app. If the user agrees then we move on to step 2. 2. The user inputs the destination into the Application. 3. The App sends this destination to Google Maps API in real time. 4. Google Maps API takes this information and sends the route back to the Android app which then, 5. Sends this route to the Bluetooth component which would now pass this information to the 6. Flora System. The Flora System takes this information and converts it into data that it can process and understand then it converts all the junctions into lefts and rights. Then this message is liaised with the 7. LED component to blink the correct LED when there is a direction up ahead.

5.2 High Level Design



Step 1: Switch on Flora system
Switch on the Flora system to begin the process.

Step 2: Go on Which Way? Application
Go on the android application

Step 3: Turn on Bluetooth
Switch on the Bluetooth on your mobile device

Step 4: Pair system and application
Pair the Flora system and the android application on your phone so that they can start communicating

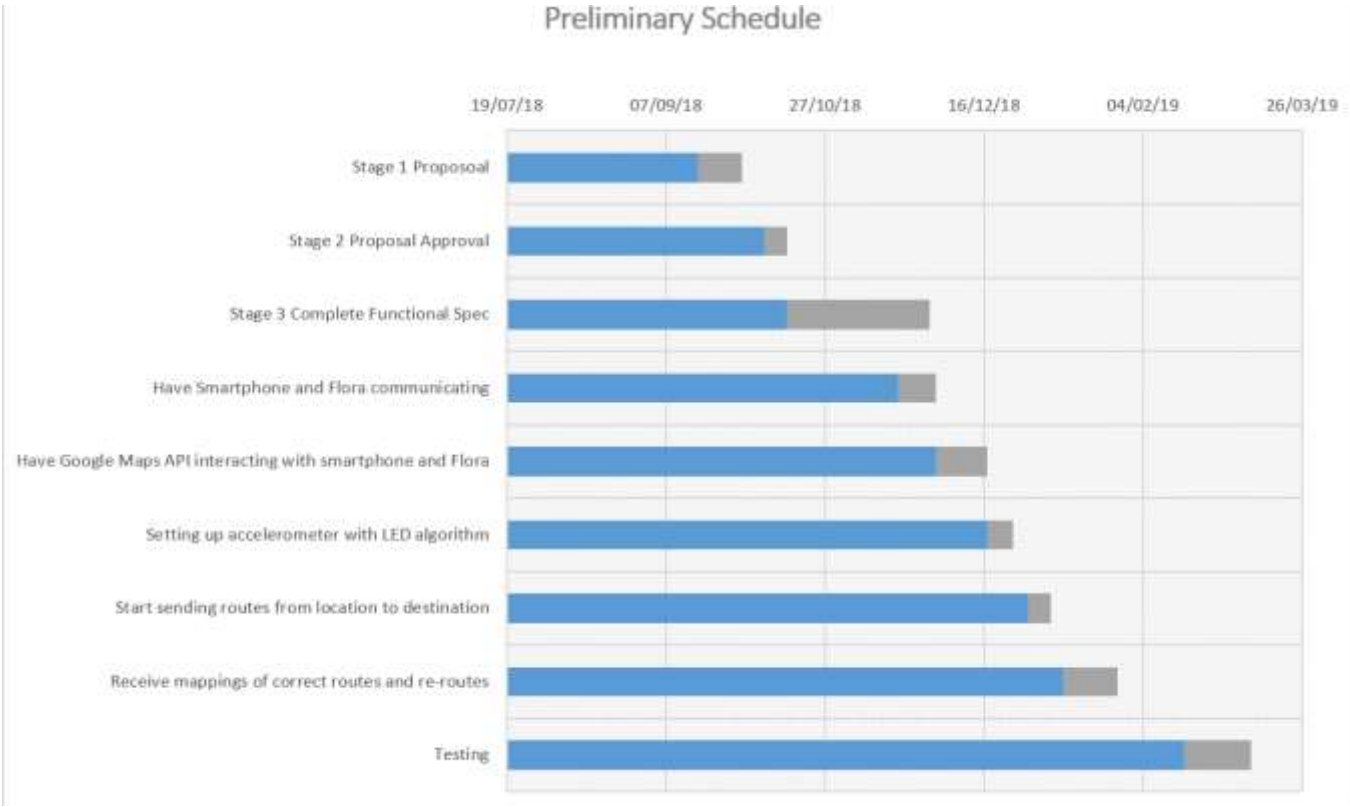
Step 5: Input destination
Input the destination that you want to go in the search query bar

Step 6: Click search
Click search after inputting the destination

Step 7: View route
View the route that is displayed on the application of where to go to reach your destination

Step 8: Cycle
Get on your bicycle and start cycling

6. Preliminary Schedule



7. Appendices

www.google.com
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https://developer.android.com/studio/
www.stackoverflow.com