OPSC7312

POE Documentation

Application Name: One Direction
Application ID: ONED30
Version: 1.30

Student Number: 17667327
Course: BCAD3
Subject: OPSC7312
Lecturer: Nirasha Ramckurran
Assignment: POE
Due Date: 31/08/2020

Contents

Introduction

As part of our OPSC7312 module, we were tasked with developing a mapping application for the Android platform. I chose to develop the application in Java, using the Android Studio IDE, as we were familiar with this IDE from OPSC7311 module.
We also required a maps SDK, and therefore MapBox SDK was chosen, due to it being open-source and allowing for integration within an Android application. (The Independent Institute of Education (Pty) Ltd, 2020)

The mapping application allows users to perform multiple actions, including:

- **Register and login**
  The application allows the user to register an account with their own preferences, and log in. User profiles are stored in an online server, so they can log in on any device, which will set all their preferences automatically.

- **Select a destination**
  The application allows users to either search for a location, by typing in an address, landmark name, or other phrase, and selecting the item from the dropdown list, or by dropping a pin on the map – by pressing a location on the phone screen.

- **Select preferred method of transport**
  The user can select their preferred method of transport, including driving, cycling, and walking. The route calculator will take into consideration this preference when generating a route – for example, the application will not suggest that pedestrians travel on highways, etc.

- **Select preferred units of measurement**
  The user may select either metric or imperial units, providing different localization support.

- **Find a route**
  The application allows the user to find the fastest route from the origin to destination address, with the use of MapBox SDK integration.

- **Display ETA and distance**
  The application will provide the user with trip statistics, such as travel time, estimated time of arrival, total distance travelled, distance remaining, and other such information.

- **Turn-by-turn navigation**
  The maps application will prompt the user to take the correct turns and offramps in order to follow the predetermined route – the fastest route which MapBox has determined for the user. These navigation prompts will be visually displayed on the map, and also via an audio overlay.

- **Trip history**
  All trips are recorded and viewable by only the logged in user – which keeps user information secure – they have to log in before they can access their profile and trip history.

The following sections will detail and explain all functionality of the application, including a help file, screenshots with descriptions, a use case diagram, and storage information. It aims to describe why, and how, certain features were developed in order to meet the requirements set out in our question paper.

Help File

The application provides numerous functions, which will be described in depth in the following section. The help file has been broken up into multiple sections, describing each page of the program.

Login Page

When the user first starts the application, a login page is presented. This provides the following functionality:

- Email Address Edit Text
- Password Edit Text
- Login Button
- Register Button
- Reset Password Button
- Remember Me Checkbox

The email address input allows users to enter their unique email address, and below this they can enter their account password in the password textbox. They can select the "Remember Me?" checkbox, which will remember the login details, and automatically log the user in when they open the application – making for more efficient use of the application.

Below this, three buttons are displayed:

- Login: Brings the user to the main screen (map view), where they can view their current location on the map – first-time users will be requested to allow the application to use their phone's GPS functionality.
- Register: Brings the user to a registration page, which allows the user to register a new account on the system.
- Reset Password: Displays a popup dialog which allows the user to input their email address, which will send an email with a reset-password link to the email address provided, if an account exists for the user.

Reset Password

When a user selects this button, they can enter their email address, and click "Confirm", which will send them a password reset link.

If they do not wish to reset their password, they can click "Cancel".

Register Page
When the user presses the “Register” button on the login page, a registration page is presented. This allows users to register a new account with the system, and provides the following functionality:

Account information must be entered, including the following:

- Full Name Edit Text
- Email Address Edit Text
- Password Edit Text
- Confirm Password Edit Text
- Preferred Units of Measure Switch

After they enter their user account details, and press the “Register” button, they will be sent an email verification link, which they will have to use to register a new profile with the application.
The application will prompt the user to check their email inbox for this email, and navigate the user back to the login page.

If the user does not wish to create an account, they can select the “Back to Login” button, which will navigate the user back to the login page.

Home Page
Once the user has successfully logged in to their account, they will be brought to the home page, which provides the following functionality:

- Map view of surrounding location
- Current location (blue dot)
- User heading (blue arrow)
- Start Navigation Button – disabled
- Search Button
- Menu Button (“+” symbol)

The user will be able to view a map, which they can navigate using swipe and pinch to zoom gestures. Their current location and heading will also be provided, which will be displayed as a blue dot with an arrow pointing in the user’s direction.

Menu and search buttons are shown just above the Start Navigation button.
The search button opens up a page where the user can input their desired destination, such as an address, landmark, or other phrase. A dropdown list of options is then presented, and the user can select an item. Once selected, the user will be brought back to the map view, and the route will be drawn on the map – also enabling the Start Navigation button in the process.

The user may select a location on the map by dropping a pin on a location (pressing the screen), which will draw the route and enable the Start Navigation button – another way in which the user can select a destination address.

Menu
When the user selects the "+" menu floating action button (FAB), a menu will be expanded, which will include the following functions and information:

- About – a page describing the application.
- Preferences – allows the user to edit their user preferences.
- Route History – displays all previous trips (ordered by date added)
- Share Current Location – allows the user to send their location via SMS
- Refresh Map – refreshes the map and finds the user using GPS
- Logout – logs the user out of the application

These functions will be explained in more depth in the following pages.

About
Once the user selects this button, a page with application information such it's functionality and version number is presented, along with a "We Still Love Your Music" link.
This page also displays the application name and icon.

Preferences
Once clicked, a modal popup will be displayed with the following functionality:

- Full Name Edit Text
- Mode of Transport Spinner
- Preferred Units of Measure
- Delete Account Button
- Delete History Button
- Save Button

The user may update their account preferences, including selecting their preferred mode of transport and units of measure.
In addition to this, the user can delete their profile (which includes trip history, preferences, and login details), or just delete their history by using the Delete Account or Delete History buttons respectively. Confirmation popups are presented with both actions, so the user cannot accidentally delete their account or history.

Route History
Once clicked, the trip history will be presented, which will include the following information:

- Date / Time of the start of the trip
- Transit method – Driving, Cycling, or Walking
- "From" address line 1.
- "To" address line 1.

These trip records are ordered by date added, so the most recent trips will be displayed first.

If a user clicks a route, the route will be displayed on the map, with the use of Directions Route JSON objects.

Share Current Location
Once clicked, the Start Navigation button text will change to “Send my Location”, and an input field will appear in the middle of the screen requesting the user to “Enter a Phone Number”.
The user can cancel the action by pressing the pink X button, or send the message by pressing the “Send my Location” button (at the bottom of the page).

The user’s location is sent as a link to google maps, where it adds a pin with the latitude and longitude of the user’s current location – overlaying on a map.

Refresh Map
This action refreshes the map, be completing the following actions:

- Removes any current navigation routes
- Moves the map location back to the current user’s location
- Disables the “Start Navigation” button
- Prepares the application for the next navigation or other user action

Logout
Logs the user out, and clears shared preferences, so they will not be automatically signed in again if they open the application again – they will be brought to the login page.

Search
There is a search button on the home screen, which looks like a magnifying glass. Once clicked, a page will appear where the user can enter a phrase, address, or landmark name. Once this is input, results will appear, which the user can select.

When a location is selected from the dropdown list, the fastest route will be calculated from the origin position (the user’s current location), and the destination location.

Readme

Project Title: One Direction

Welcome to One Direction. An innovative maps application, with an even more innovative name. This maps application allows you to easily navigate to locations, through the use of searching for a landmark or address, or dropping a pin on the map.
Your profile is synced with an online database, so you can sign in on any device and obtain access to your profile.
Features include, but are not limited to, turn-by-turn navigation, trip history, selecting from a variety of different transport methods, and many more features.

Getting Started
The following steps are required to get One Direction application running in the development environment:

- Open the application source code in Android Studio
- Build the application
- Run the application to a phone or emulator on API level 23 or greater

Prerequisites
There are a few prerequisites required to run the application, including:

- Install the *latest Android Studio
- Set physical device to development mode (USB) or set up emulator environment.
- Ensure device is using Android API 23 or above

*latest Android Studio as of when the application was developed is: Android Studio 4.0

More detailed specifications are included below

Build #AI-193.6911.18.40.6514223, built on May 20, 2020
Runtime version: 1.8.0_242-release-1644-b01 amd64
VM: OpenJDK 64-Bit Server VM by JetBrains s.r.o
Windows 10 10.0
GC: ParNew, ConcurrentMarkSweep
Memory: 32716M
Cores: 12
Registry: ide.new.welcome.screen.force=true

Installing

- Open the application source code in Android Studio
- Build the application
- Run the application to a phone or emulator on API level 23 or above

*The development test system has been detailed on the following page.

Test System
Development PC

OS Name	Microsoft Windows 10 Pro
Version	10.0.18363 Build 18363
Other OS Description	Not Available
OS Manufacturer	Microsoft Corporation
System Name	KARL
System Manufacturer	System manufacturer
System Model	System Product Name
System Type	x64-based PC
System SKU	SKU
Processor	Intel(R) Core(TM) i7-8700K CPU @ 3.70GHz, 3696 Mhz, 6 Core(s), 12 Logical Processor(s)
BIOS Version/Date	American Megatrends Inc. 2301, 2020/02/25
SMBIOS Version	3.0
Embedded Controller Version	255.255
BIOS Mode	Legacy
BaseBoard Manufacturer	ASUSTeK COMPUTER INC.
BaseBoard Product	ROG MAXIMUS X HERO
BaseBoard Version	Rev 1.xx
Platform Role	Desktop
Secure Boot State	Unsupported
PCR7 Configuration	Binding Not Possible
Windows Directory	C:\WINDOWS
System Directory	C:\WINDOWS\system32
Boot Device	\Device\HarddiskVolume5
Locale	South Africa
Hardware Abstraction Layer	Version = "10.0.18362.752"
User Name	KARL\Karl
Time Zone	South Africa Standard Time
Installed Physical Memory (RAM)	48,0 GB
Total Physical Memory	47,9 GB
Available Physical Memory	32,7 GB
Total Virtual Memory	54,9 GB
Available Virtual Memory	35,4 GB
Page File Space	7,00 GB
Page File	C:\pagefile.sys
Kernel DMA Protection	Off
Virtualization-based security	Not enabled

Hyper-V - VM Monitor Mode Extensions	Yes
Hyper-V - Second Level Address Translation Extensions	Yes
Hyper-V - Virtualization Enabled in Firmware	Yes
Hyper-V - Data Execution Protection	Yes

Development Phone: Samsung Galaxy S8

Android Version	9
API Level	28

Built With
Android Studio – The IDE used to develop the application
Maven – Dependency management
Gradle – Automation and management of the build process
MapBox – Maps integration (SDK)

Versioning

Version Code	30
Version Name	1.30

Authors
Karl Dicks – 17667327

Acknowledgments
Inspiration: One Direction
Website: http://www.onedirectionmusic.com/

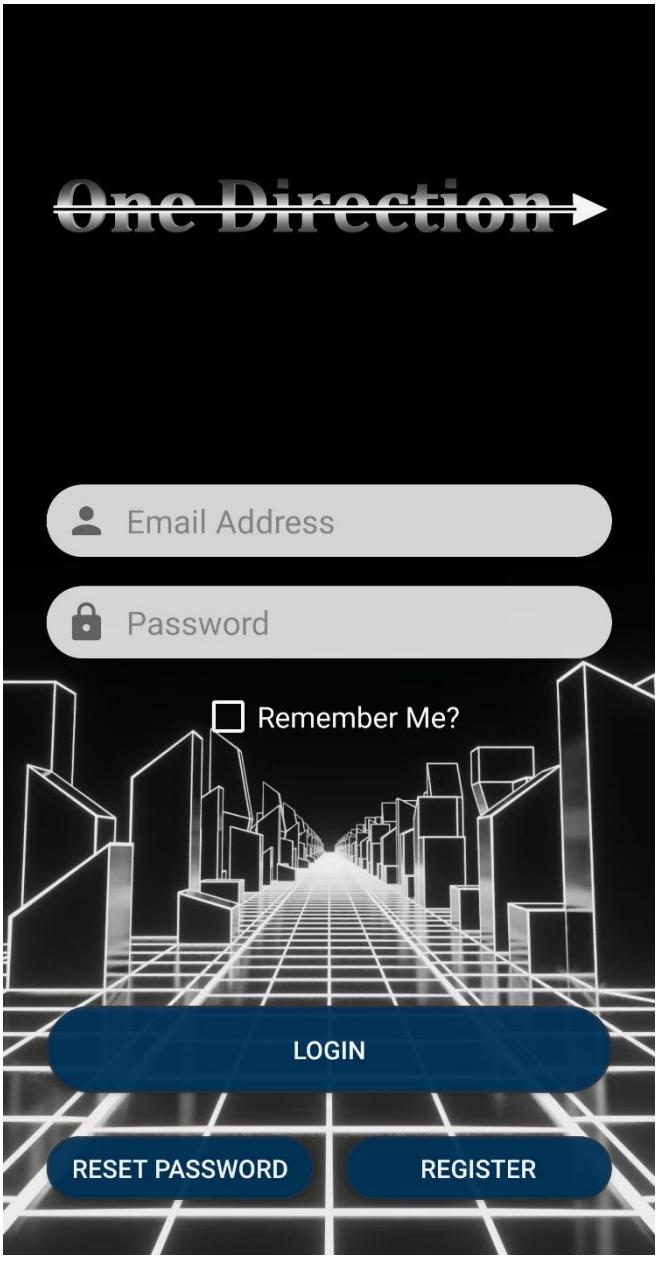
Deployment
Documentation will be included in the final POE, as marks have been allocated to this section for the POE, and not Task 2.

Demo
Video link: https://youtu.be/1bB2kAicRQo

Screenshots

The user interface for One Direction has been designed, and all functionality has been implemented. Below is the interface for my maps application:

Login



Once the application has loaded, the user will be presented with the login page.

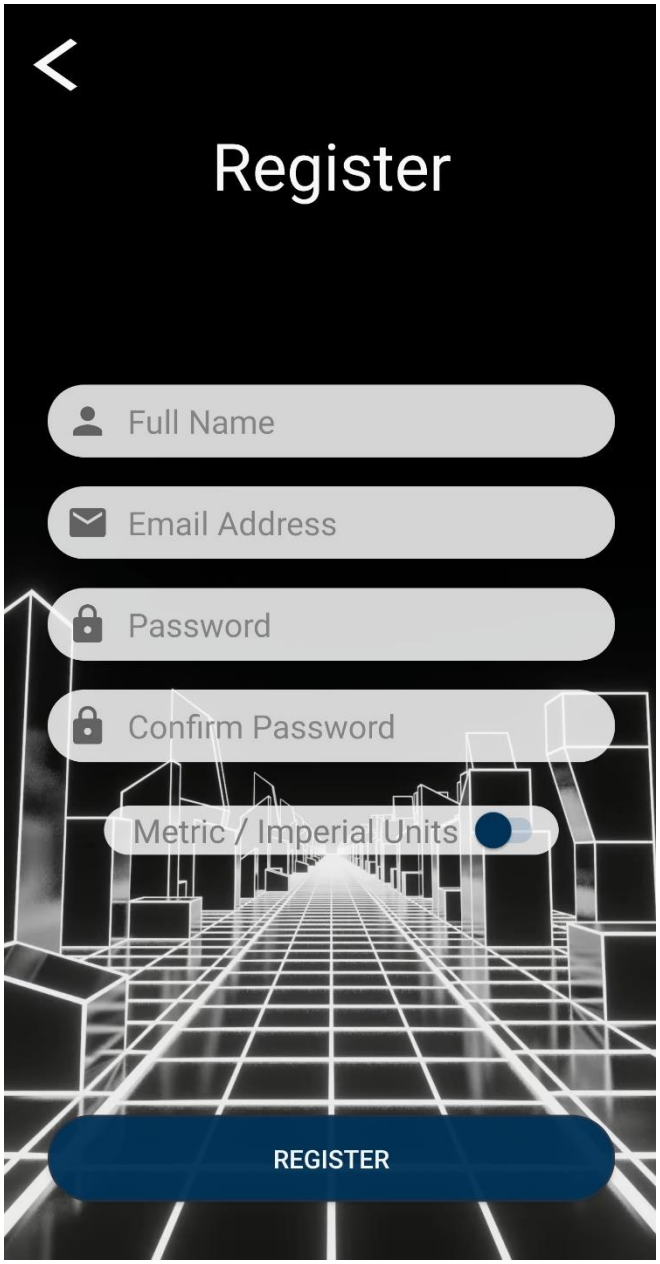
User authentication will occur once the user enters their unique email and password, and presses the “LOGIN” button.

The “Remember Me?” checkbox will remember the user account, and not request user login each time they open the application.

The login process is asynchronous, which means that there will be a delay when contacting the Firebase data store. During this time interval, a pink spinner will be displayed to let the user know that this process is currently occurring.

The user may register a One Direction account by pressing the “REGISTER” button, which will bring them to the register page (shown on the following page), or reset their account password by pressing the “RESET PASSWORD” button.

Register



When the user presses the “REGISTER” button on the login page, they will be presented with a register form (shown on this page).

They will need to enter the following information:

- Full Name
- Email Address
- Password
- Confirm Password
- Preferred Units of Measure

Input validation has been implemented in the following ways:

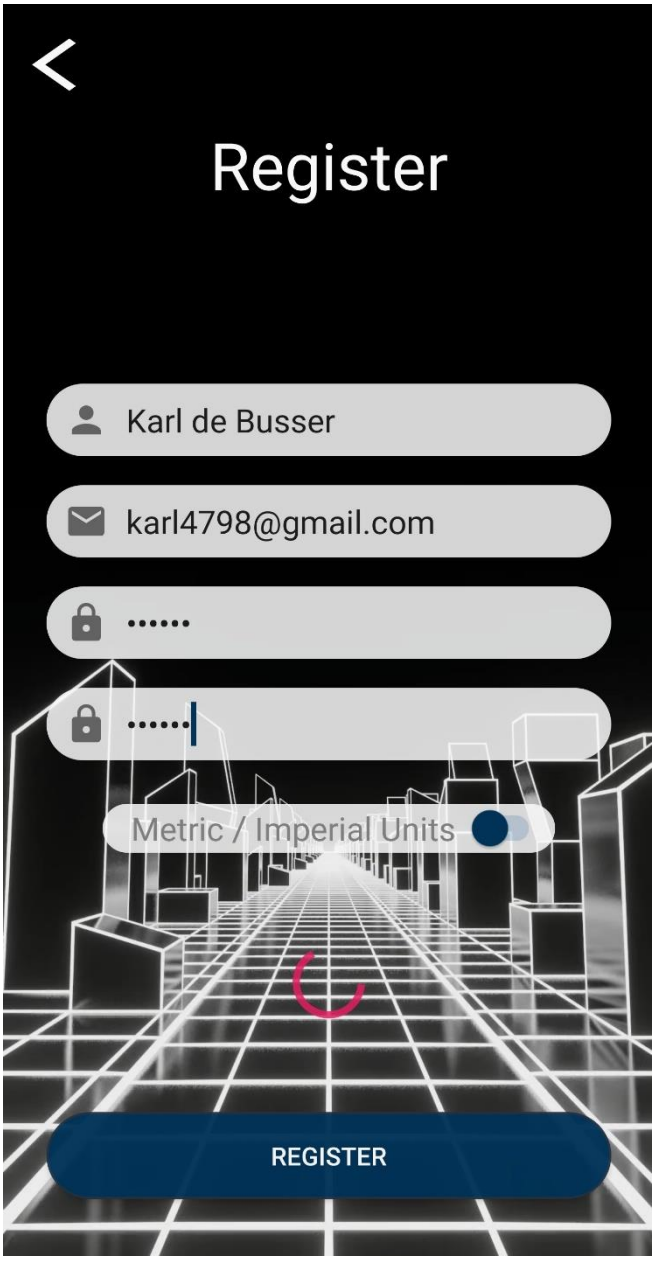
- Passwords Must Match
- Minimum Password Length is 6 Characters.
- No Input Fields Can be Null
- Email Address Must Conform to Regular Expression – Must be Valid.
- Email Address Cannot be Currently in Use by Another Account.

This validation is completed to ensure that garbage, duplicate, or malicious values are not persisted in the data store.

Once the user presses the “REGISTER” button, validation will be processed, and if this is passed, the user account will be created.
After the user account has been created, the user will be requested to verify their email address, by clicking a link which would have been sent to their email address automatically.

They will be navigated back to the login page after registration, and prompted to validate their account.

Account Created



Once the user has pressed the “REGISTER” button, their account will be created (as shown).

The image on this page provides an example of how account creation will appear.

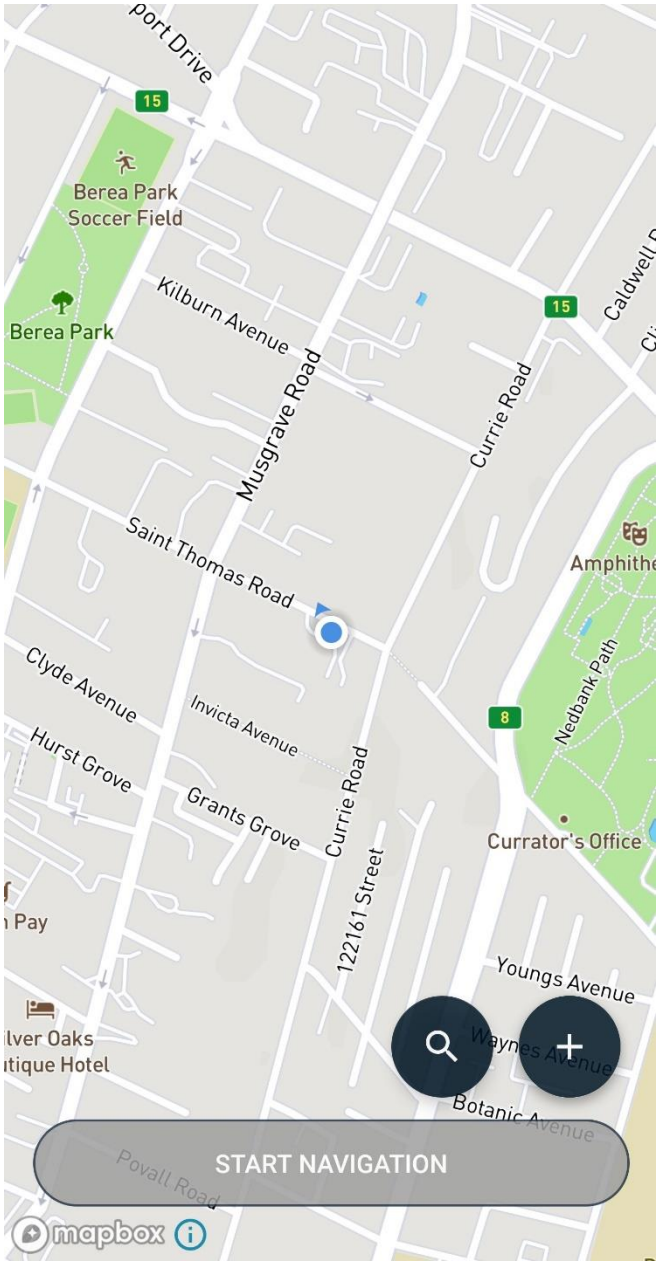
The spinner will be presented (and turn) during this asynchronous event.

Once finished, the user will be prompted to check their email for a verification link, which they will have to click in order to use their account.

If the phone cannot reach Firebase due to network or other transient errors, a toast will be displayed. This message will provide error details.

If validation fails, then a toast message will describe how the user can fix the incorrect values.

Home



Once the user has logged in, they will be presented with the home screen.

This contains the following features:

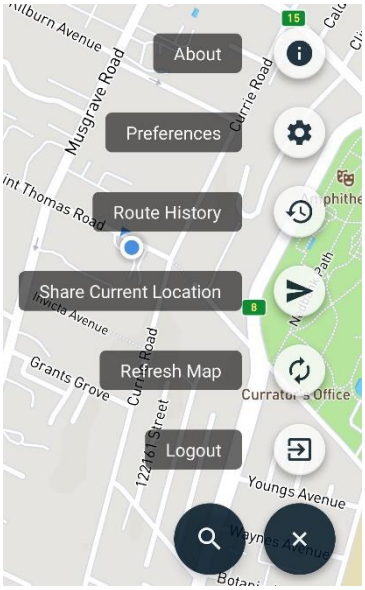
- A Detailed Map
- Current Location on the Map
- Start Navigation Button, which is Disabled by Default.
- Search Button.
- Menu Button (Floating Action Button).

The “START NAVIGATION” button is disabled by default, and only once the user drops a pin on the map, will it become enabled.

The user can drop a pin on the destination address by moving the map to the destination, and pressing the screen of the device, or they can press the search button (Pink magnifying glass symbol) and enter a search phrase.

The user can access the main menu of One Direction, by pressing the Floating Action Button (Pink + Symbol). The menu is displayed on the following page.

Menu



Once the user has pressed the menu (Floating Action Button), additional buttons will appear.

The following actions can be triggered from this menu:

- About
- Preferences
- Route History
- Share Current Location
- Refresh Map
- Logout

A detailed description of these actions is provided below.

Menu Functions

About
This action results in a modal popup being displayed (shown on the next page), which allows the user to view application information (version number, etc).

Preferences
This action results in a modal popup being displayed, which allows the user to set their preferences.

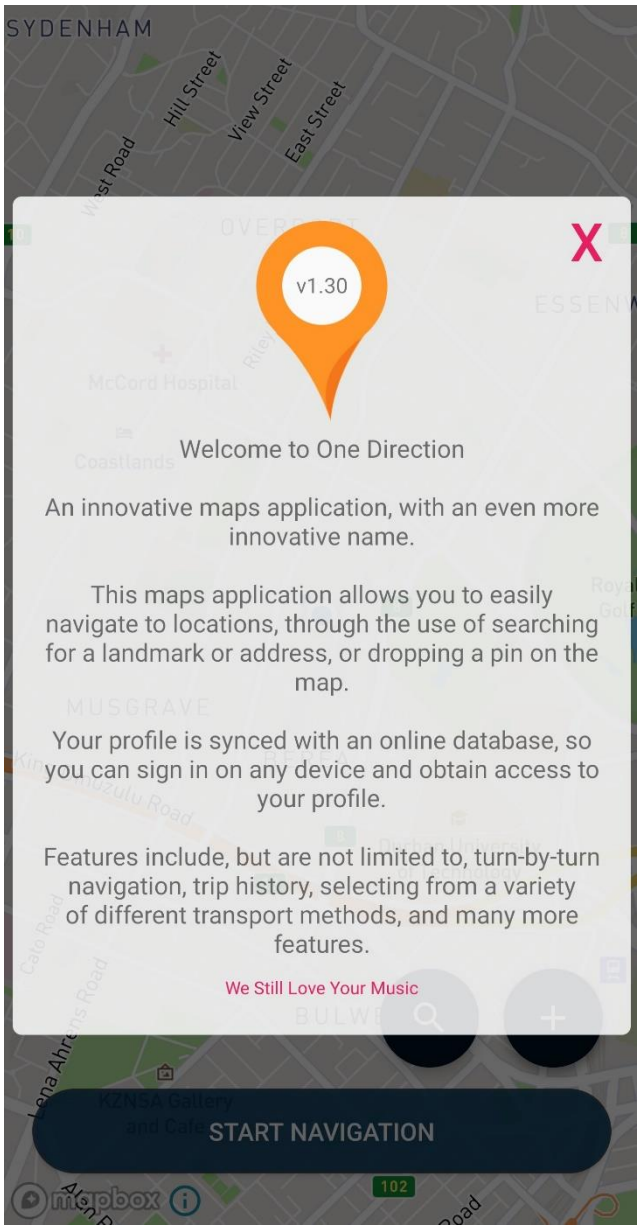
Route History
This action results in a modal popup being displayed, which allows the user to view all previous trips.

Share Current Location
This action results in an edit text being displayed, and the “START NAVIGATION” button changing to “SEND MY LOCATION”. Once pressed, the user’s current location will be sent to the phone number which has been input in the edit text.

Refresh Map
This action results in the destination address, and navigation route, being cleared from the map. It refreshes the map and re-triangulates the current user location, along with their set preferences.

Logout
The user may log out of their account by pressing this button. This action will end the session, so even if they press the return button on the phone, they will not be able to log in again without providing their unique login credentials.

About



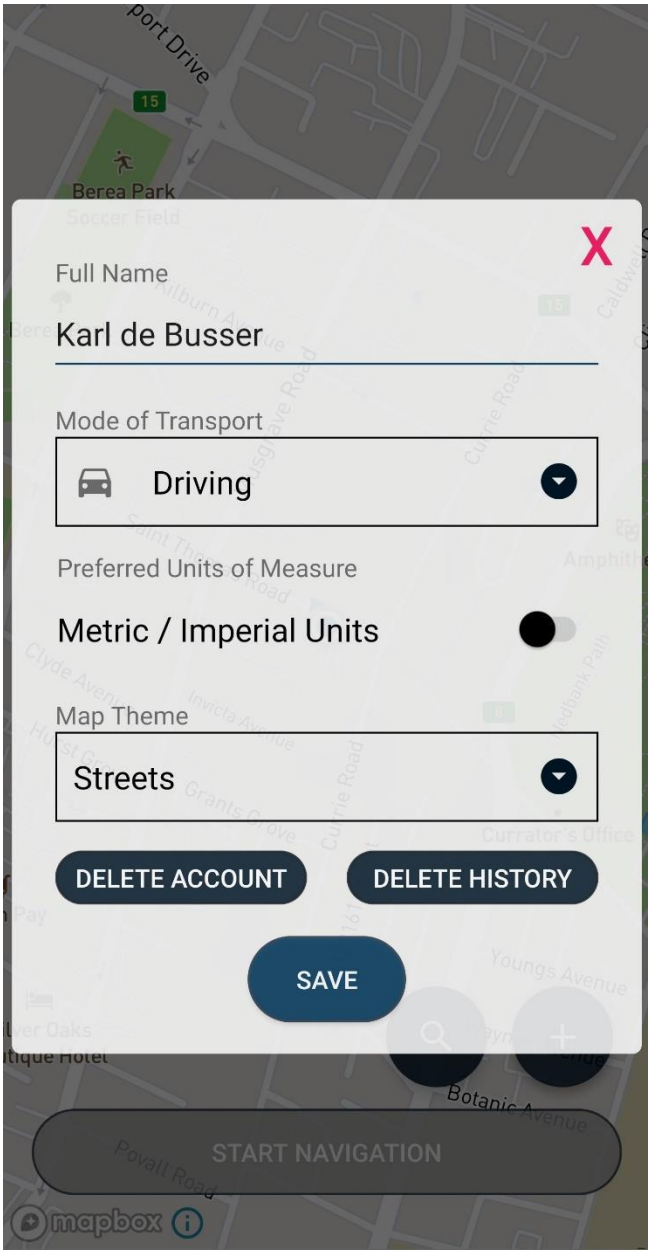
Once the "About" button is pressed, a modal popup will be displayed, which includes the following information:

- Application Name
- Application Version Number
- Features
- A "We Still Love Your Music" Link.

This information can be used to determine which version has been downloaded onto the phone, and also contains feature information.

When pressed, the "We Still Love Your Music" link will navigate the user to a YouTube video.

Preferences



Once the “Preferences” button is pressed, a modal popup will be displayed, which includes the following information:

- Full Name of the Logged in User
- Preferred Method of Transport
- Preferred Units of Measure
- Map Theme
- Delete Account Button
- Delete History Button

The user may change their preferences by pressing on their respective edit text, spinner, or switch button.

For example, the user may change their preferred mode of transport to Walking, Cycling, or Driving.
They may also set their preferred units of measure from Metric to Imperial, or vice versa.

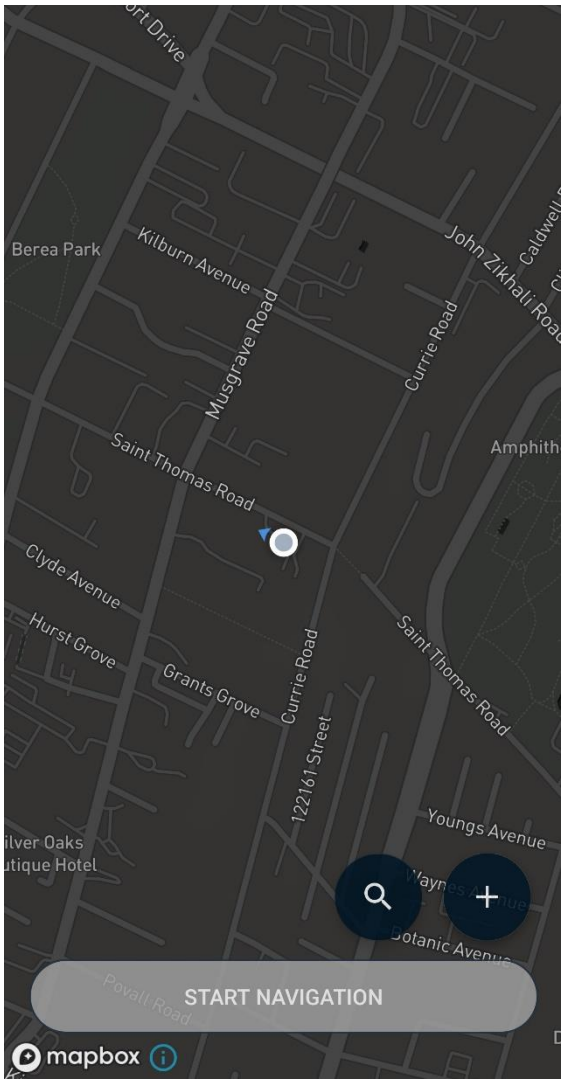
The map theme can be changed from “Streets” to a number of other themes, which are shown on the next page.

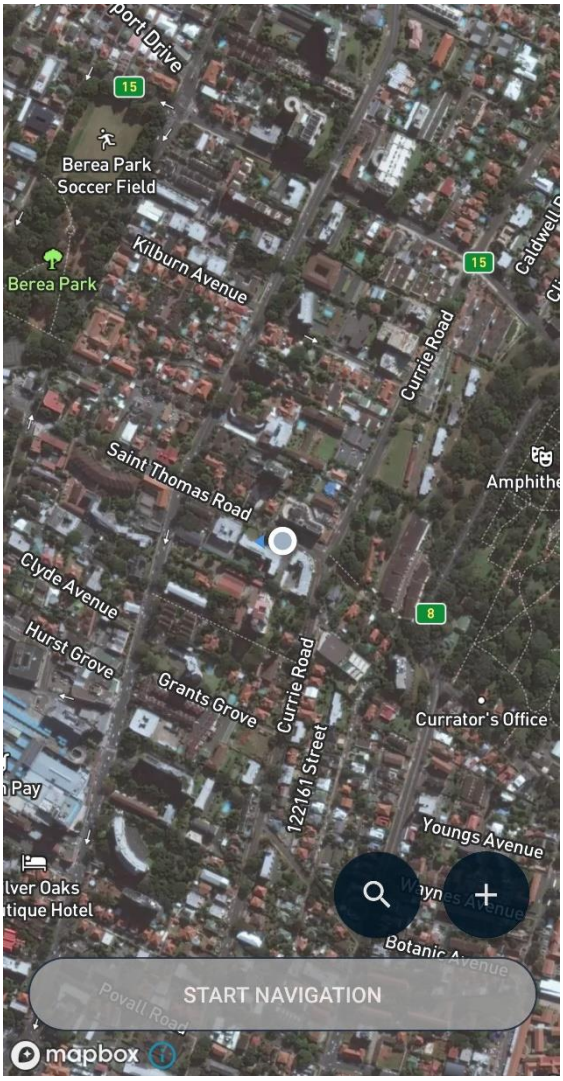
The user can delete their trip history or entire account by pressing the “DELETE HISTORY”, or “DELETE ACCOUNT” buttons, respectively.

Once changed, the user can press the “SAVE” button to save the preferences to their Firestore profile.

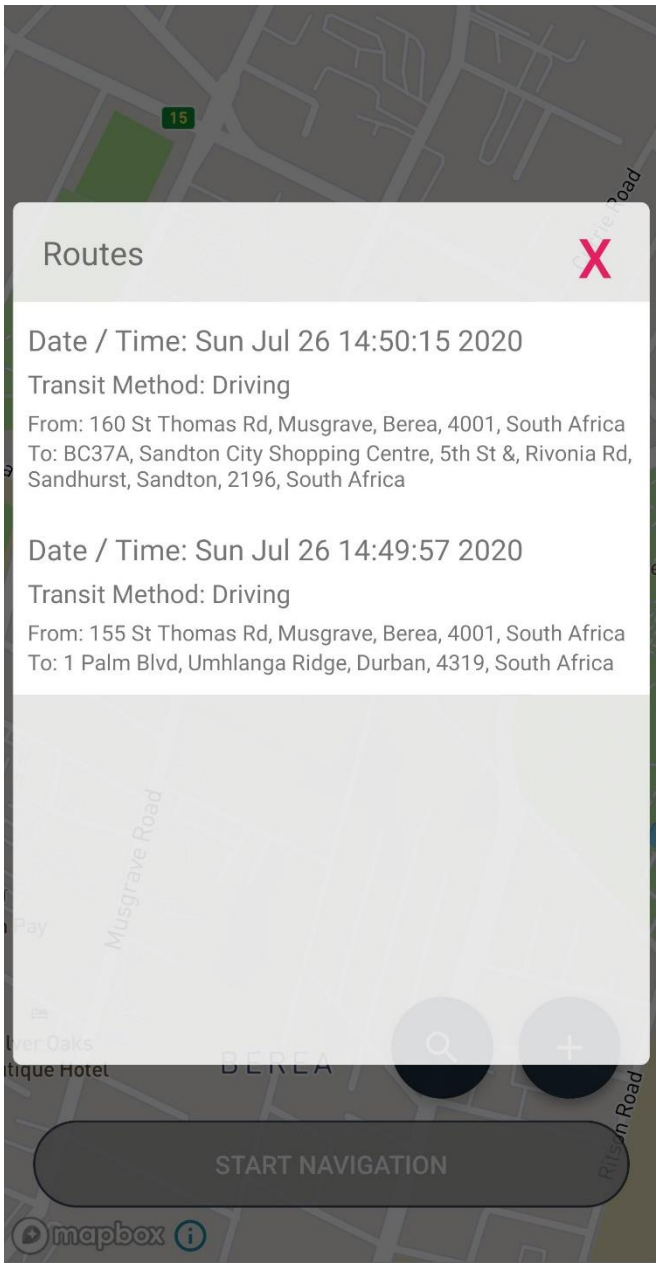
Map Themes

The user can select different map themes from within the user preferences page, and some examples are shown below.





Route History

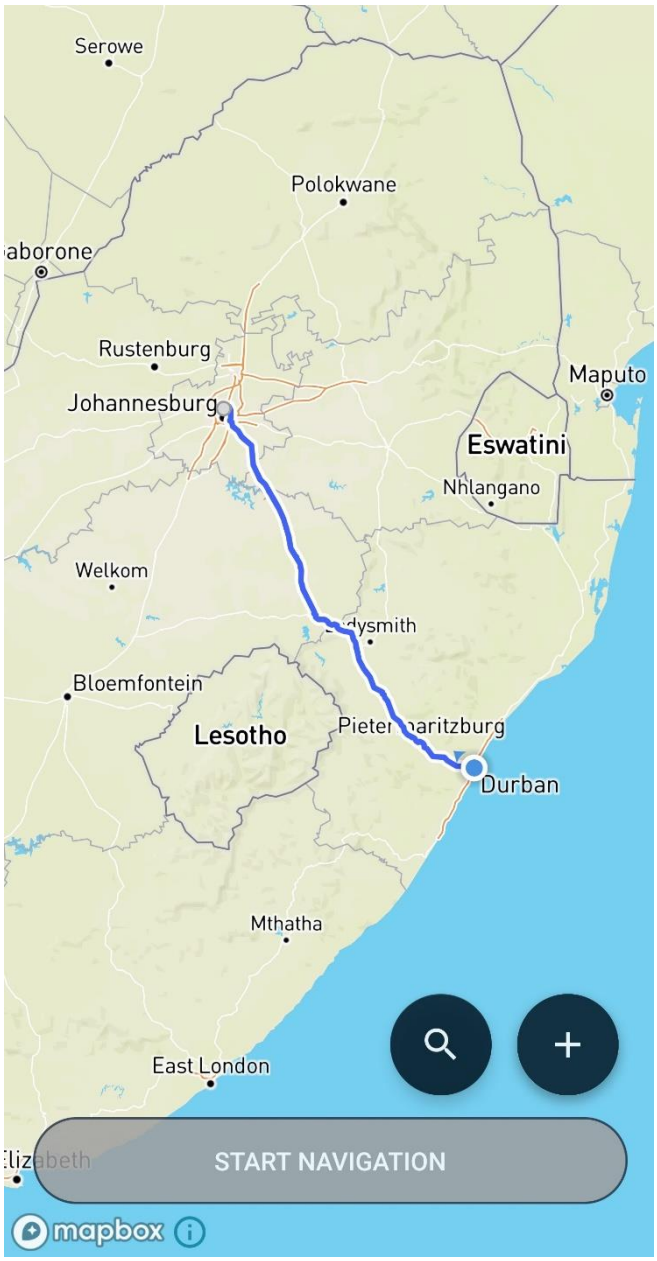


Once the “Route History” button is pressed, a modal popup will be displayed, which includes the following information:

- Date and time of the trip
- Method of Transport
- From Address
- To Address

The user can click any of the available items on the list, which will draw the route on the map, and close the modal popup window (shown on the next page).

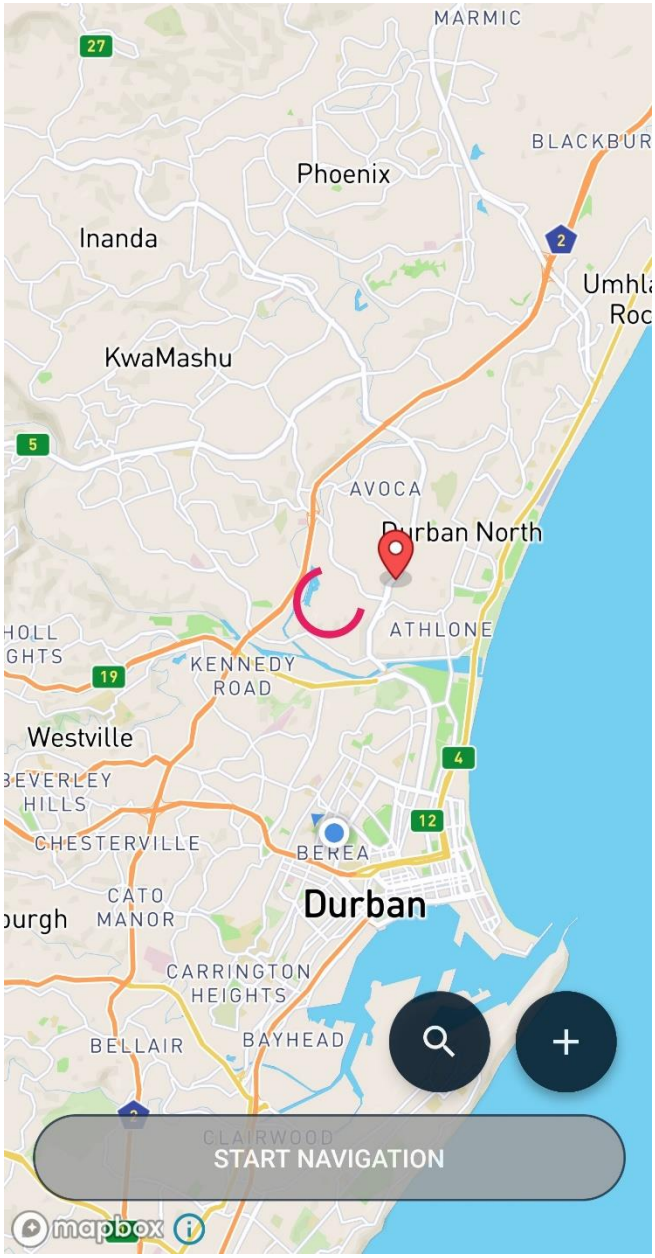
Saved Route



Once the user presses an available route log item, the route will be drawn on the map.

This map will include the beginning and end points of the route, and all navigation turns that were required for the chosen route.

Finding Route



When the user drops a pin on the map (by pressing on a location on the map), a route will be generated.

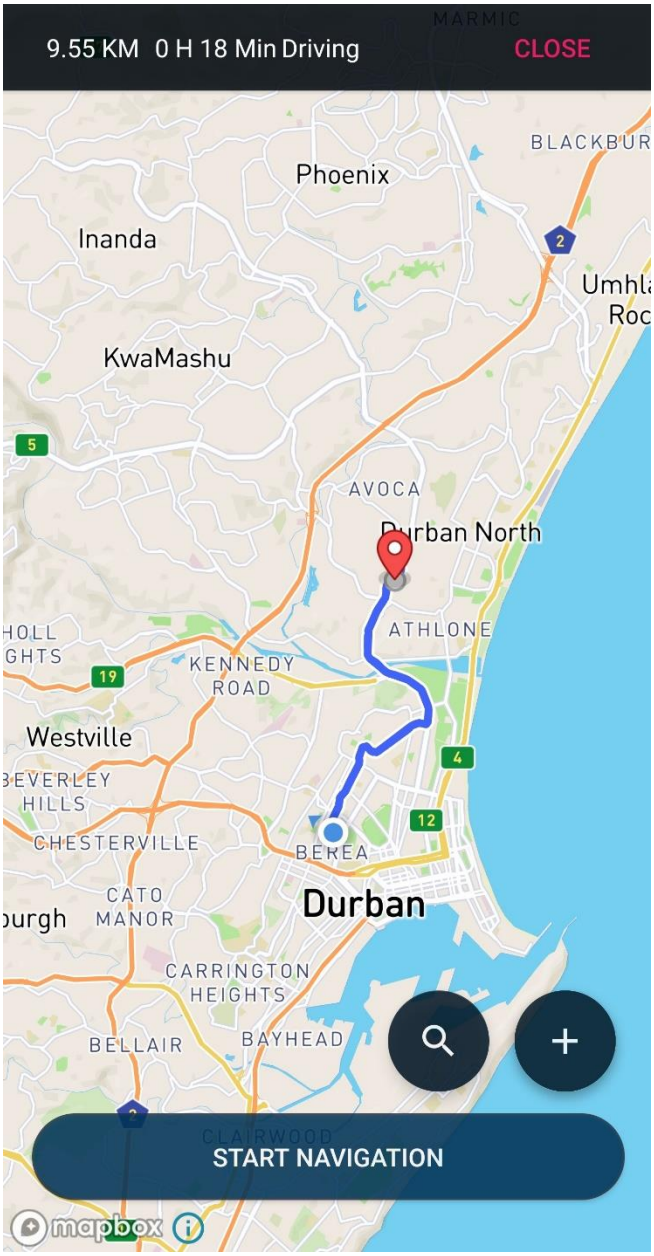
They can also search for a location using a text phrase, entered on the search page (shown on the following page).

The MapBox SDK will take into consideration the user's preferred mode of transport. For example, if the preferred mode of transport is walking, then the routing will avoid highways.

The picture provided on this page displays the processing of the route, which is an asynchronous process and is completed by MapBox integration.

The next page provides an overview of what a route would look like, once generated and retrieved from MapBox.

Generated Route

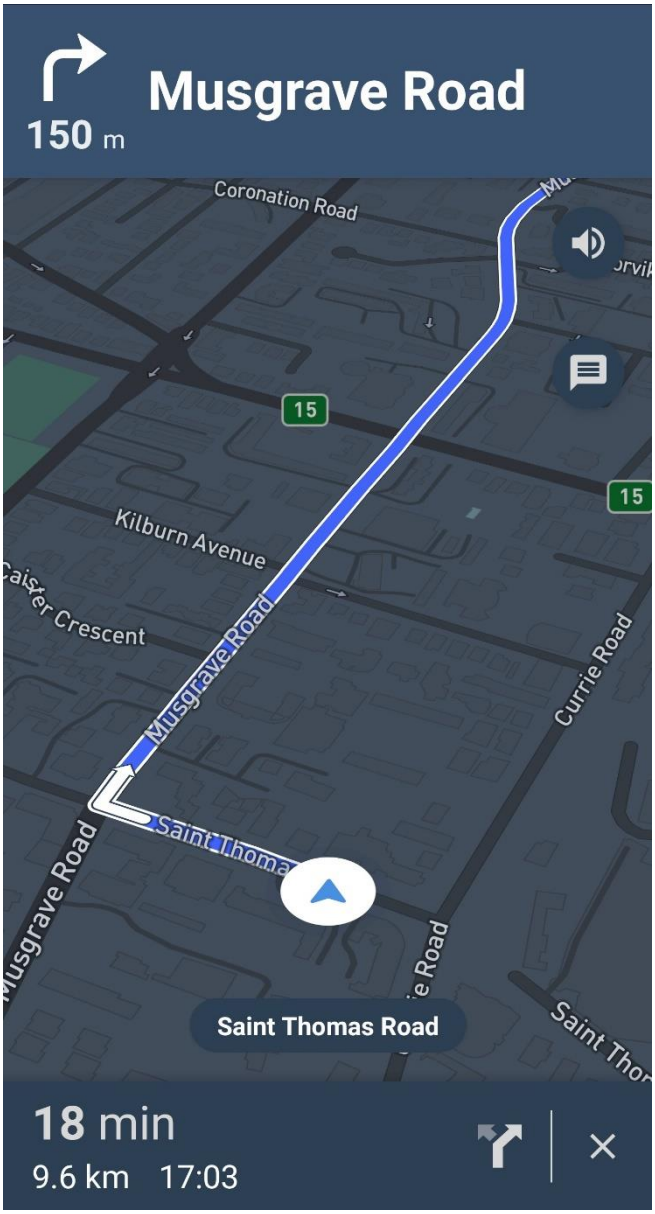


Once the route has been generated, the "START NAVIGATION" button will be enabled, and change color to dark blue – signalling that the route has been generated and that they can start the navigation process.

An overview of the route will be displayed on the map, which will also provide the original and destination locations.

The user can now press the "START NAVIGATION" button and retrieve visual and audio navigational information (shown on the next page).

Navigation



When the user presses the “START NAVIGATION” button, visual and audio navigational prompts will provide turn-by-turn navigation until the user reaches their destination.

The following information will be provided on this page:

- Next Road Turn
- Distance Until Turn
- Turn Direction
- Current User Location
- Current Road
- Travel Time Duration
- Travel Distance
- Estimated Time of Arrival

In addition to this visual feedback, audio navigation will also be provided, much like Google Maps and their competitors.

This includes distance to offramps, turns, and other such navigational information.

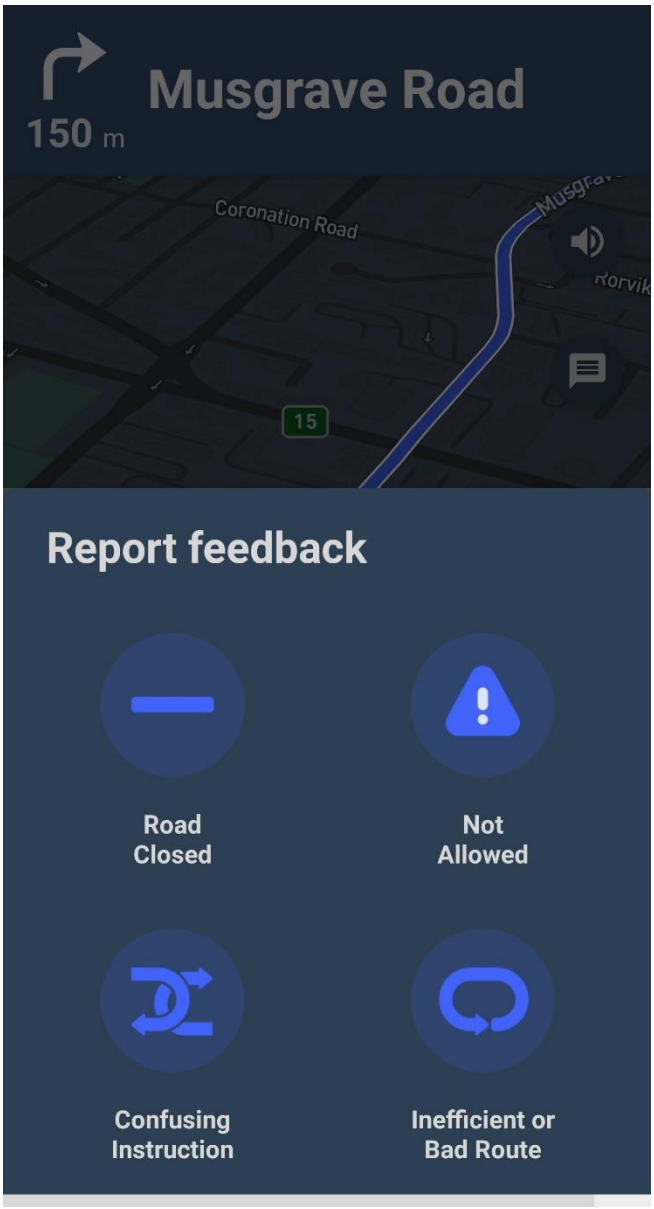
This audio can be muted by pressing the mute button (top right of the screen).

Some additional features present on this page include:

- Reports: Allows users to report road closures, traffic incidents, map issues, and other such information. This is sent to MapBox, and will be used to better navigate its users.
- Detailed Navigation: A detailed listing of turns, offramps, and the distance from the current user location is available.
- Route Overview: The user can view the route overview.
- Stop Navigation: The user can stop navigation by pressing the **X** button at the bottom right of the screen.

Details of the above information is provided in the following pages.

Reports



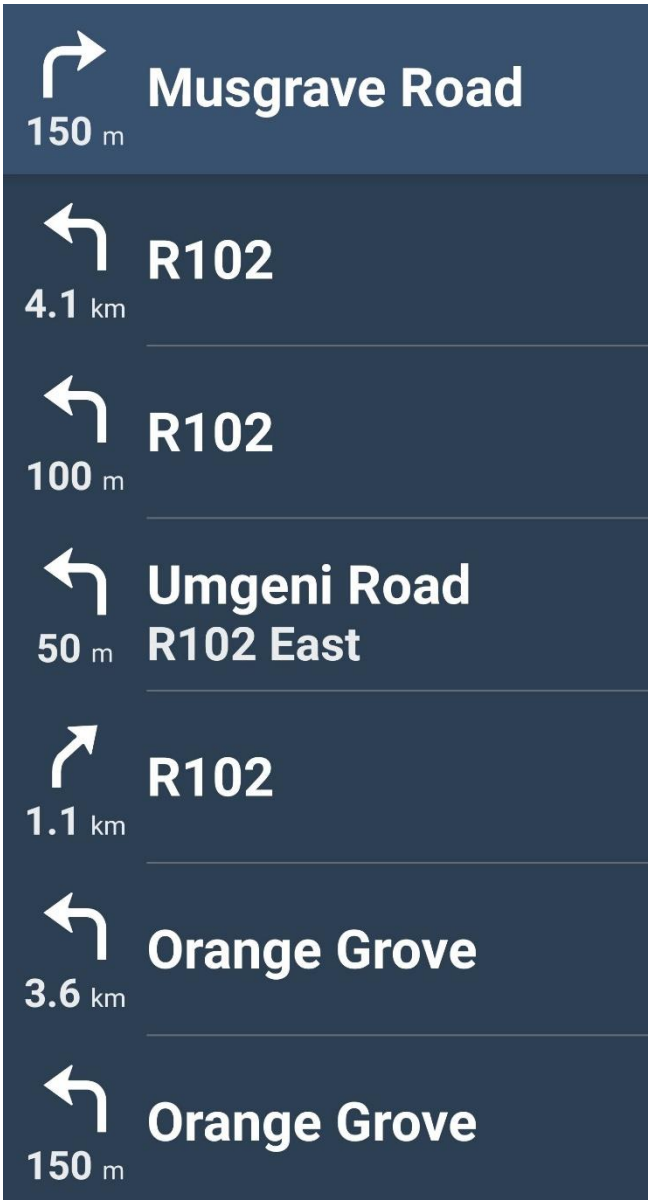
During navigation, the user can press a “reports” button (below the mute / unmute button).

When the user selects this button, they are able to select any of the displayed report options.

For example, the user can report a road closure, which will help other MapBox users, as it will re-route them around the road closure or incident.

This “reports” page automatically hides after a few seconds, as shown in the very bottom of the image – the progress bar.

Detailed Navigation

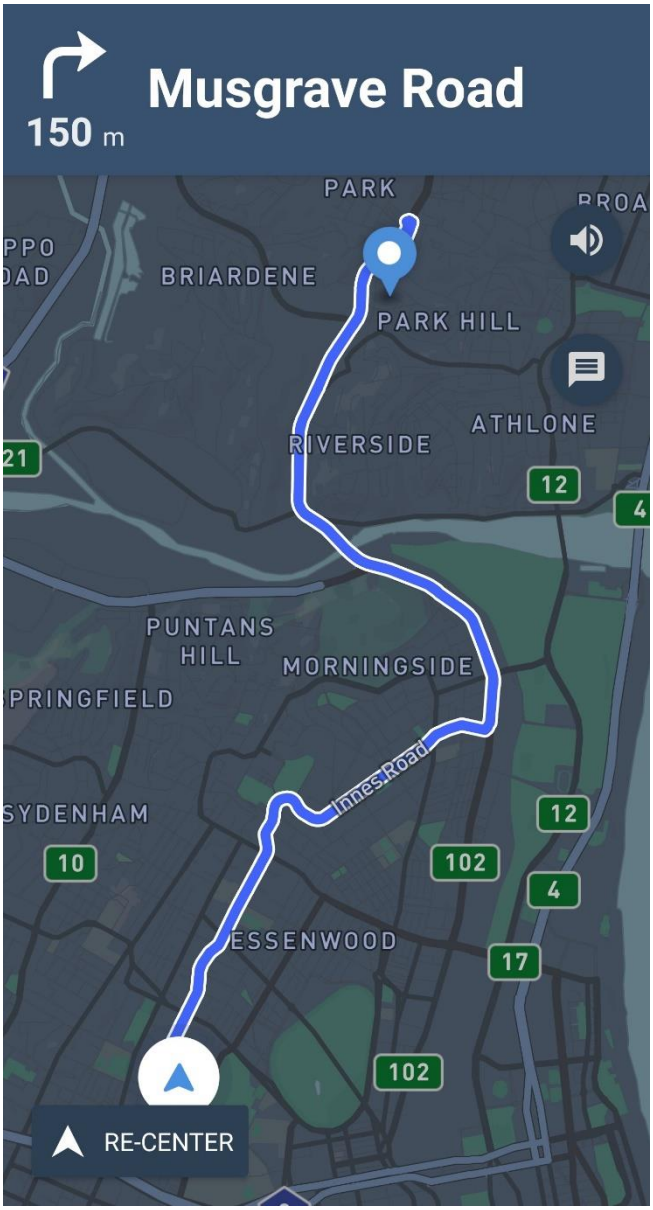


During navigation, the user can press the upcoming turn (topmost banner).

When the user presses this banner button, a list of all turns, offramps onramps, and distance between them is provided.

In addition to this, turn information is provided. For example, in this case the user should take the onramp to the N3, towards Pietermaritzburg.

Route Overview

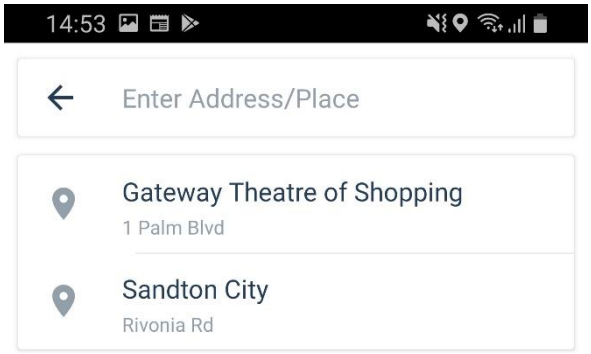


During navigation, the user can press a "route overview" button (to the left of the stop route button "**X**").

When the user selects this button, the route overview is displayed.

The current user location and heading is included, along with the destination and calculated route.

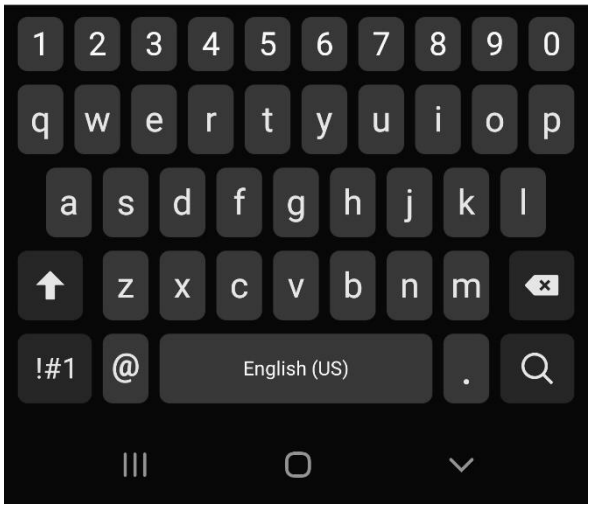
Search



The user can select a destination by clicking on a location on the map (by pressing on the map interface), or by clicking the “Search” button on the home screen (map view) – The magnifying glass symbol.

Once clicked, a new page will be presented, which will allow the user to enter a search term or phrase, which will populate a drop-down list of suggestions. The user may select a location, which will then find the route and navigate the user back to the map page (home screen).

Recently searched for terms will be stored on the page, for ease of use.



Data Listing

One Direction uses Firebase Firestore, Authentication, and SQL Lite services to store user profiles (authentication and preferences), and SQL Lite for trip logs – which can be played back at a later stage. The following information will be stored in the database.

Data Name	Type (Java)	Type (Database)	Nullable	Length
User UID	String	Text	False	Max
Email Address	String	Text	False	Max
Password	String	Text (Hashed)	False	Max
Full Name	String	Text	False	Max
Units of Measure	String	Text	False	Max
Transport Method	String	Text	False	Max
Map Theme	String	Text	False	Max
Trip Log	JSON	Text	True	Max

Some data will be calculated within the application, including:

Data Name	Type (Java)	Length
Distance to Destination	Double	Max
Estimated Travel Time	Double	Max
Estimated Time of Arrival	Double	Max

Some considerations have been taken during the implementation of the database, including:

- All information stored in the database (Firebase) will only be accessible by authorised users.
  Each user will have their own account, and will only be able to view trip logs and preferences for their account, and not others – securing information.
- Email addresses which have been used to sign up must be unique, otherwise Firebase will throw an exception, which will be caught in a Toast message. This error message will inform the user that there is already an account created with the provided email address.
  The account email address must also be verified before use.
- Route information will be cleared from the asynchronous MapBox session when, or if, the user presses the “Refresh Map” button.
- The user may delete their trip history or entire account within the preferences page if they wish to do so.

- Logging out will end the Firebase Authentication session, which secures the application and user data, as the user cannot use the “back” buttons to restore the session – they must be re-authenticated using their unique email and password combination.

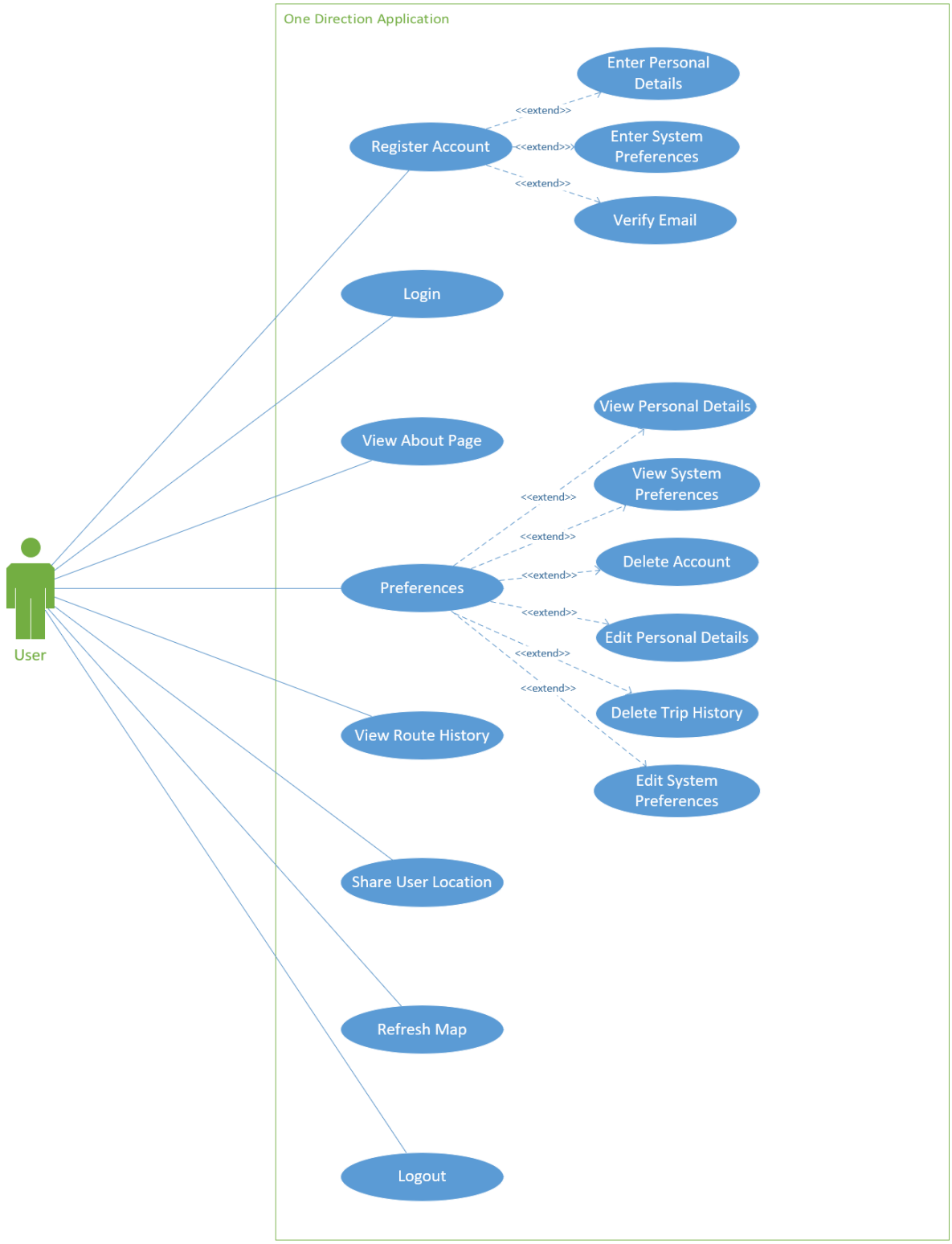
How is the data stored?

One Direction uses Firebase for authentication and data storage (Authentication and Firestore), as well as SQL Lite.
The application will make use of Firebase Authentication for registering and logging in users, with email address and password combinations.

In addition to storing login credentials, One Direction also needs to store user preferences and trip logs. In order to accomplish this, Firestore is used to store user preferences for each registered user in the system. Trip logs are stored in an SQL Lite database file on the phone, for one specific reason: Firebase Firestore does not allow for documents larger than 1mb – I am storing the entire trip JSON (the DirectionsRoute object) in the database, which is then placed on the map when a user clicks on a certain trip log.

Default values will be used for some user preferences, which they may change at a later stage. For example, when the user signs up and enters their details and preferences, their preferred mode of transport is automatically set to driving. They may change this within their profile settings once they have signed up, and logged in.

Use Case Diagram



Preparation for Publishing the Application

The following steps will be taken to publish my One Direction application to the Google Play Store (Oragui, 2018):

1. Firstly, a google developer account will have to be created, and the $25 one-time registration fee will have to be processed. This allows the developer to publish the APK to the Play Store.

2. If the developer choses to sell the application, a merchant account will have to be linked, within the google developer account. For the moment being, the application will be free to use, however advertisements will be included later on, in order to monetize the application.

3. The application will then have to be created – which has been done in our Task 2 assignment, and refined and completed in the POE. This application will have no errors, as it will have been thoroughly tested in every possible scenario.
   After the application has been developed and tested, it can be added to the developer account by navigating to the "Create Application" tab on the developer console (within the Google developer account).

4. The store listing will have to be prepared, essentially advertising it on the Play Store. This includes the following information, which must be filled out before the application can be published:
   a. Product Details – Application details must be filled out during this process, including an application title, and description. This will all be filled out for One Direction.
   b. Graphic Assets – Screenshots, videos, promotional graphics, and icons can be added here, in order to showcase the application. This is essentially an advertisement for the application, so it must look very professional.
   c. Languages & Translations – Translations for the application can be added for different regions. Localized images, screenshots, and languages can be used for different regions around the world.
      For now, only English is supported by One Direction, however this may change in the future if requirements change.
   d. Categorization – The application will need to be added to a certain category (in this case Navigational and Mapping applications). This category is used to filter results for users who search the Play Store.
   e. Contact Details – This part allows customers to access support regarding the application. An email address is required, however other information can be included.
      The email of the developer will be included here, which is "karl@karldicks.co.za". (Oragui, 2018)

f. Privacy Policy – A privacy policy for the application will have to be developed, and incorporated in the application (via a URL, or other method).
Due to this application requiring personal information, a suitable privacy policy will be required.

5. Upload the Android Package Kit (APK), which has been generated for One Direction, to the Google developer console, and release the application either to a select number of "test" users, or for the greater public.
The application will be published and accessible by only a limited number of application testers before it is available publicly, across selected regions that the developer has chosen.
I would publish the application globally, in all regions that support Google Play Store.

6. The application listing will require a content rating. This application is very similar to Google Maps or other such applications, and therefore will have a 3+ rating. The Google content rating will be assigned through the use of their questionnaire, which aims to determine the content of the application through a series of questions.

7. Set up pricing and distribution – The application will be set to "free" for the moment being, and advertisements may be added later on in order to monetize the application.
Making the application free to use will draw in users initially, and once they are using the application, advertisements can be introduced to monetize the application across a number of users, which is therefore much more effective.

8. Once the above processes have been completed, the application will be reviewed, in order to make sure all requirements have been met for the publishing of the application. Once the developer is satisfied with the release rollout, they can confirm the rollout, which in turn will publish the application to all users and regions specified during the process.
The One Direction application will now be accessible on the Google Play Store.
(Oragui, 2018)

The above list details how I would publish my One Direction Android application to the Google Play Store. I have provided the Android Package Kit (APK), which is the installer for the One Direction application within the solution files in a folder named "APK".
(Oragui, 2018)

Conclusion

In conclusion, this document has provided extensive development information in order to detail how and why the application was developed in the way that it was.
It described the functions of each page within the “Help File” section, and provided design information within the “Screenshots” section.
A “Readme” section was also included to provide development environment information, instructions on how the application should be run, and other such information.
Additional information such as a data listing was provided, which detailed how, where, and why data was stored by the application.
Lastly, a use case diagram was included, which showed all functionality of the program, from the user’s perspective.

During the course of this project, we have learnt how to develop advanced Android applications in the Java programming language and XML. We also learnt how to use SQL Lite databases and Firebase Firestore and Authentication, which provides versatile relational, and non-relational databases.

Once we receive feedback for this task, we will be in a position to complete our POE task, which aims to improve our Task 1 and 2 projects. (The Independent Institute of Education (Pty) Ltd, 2020)

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