

National College of Ireland

BSc Computing

Software Development

2021/2022

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SafeRoute App

Technical Report

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Executive Summary

The goal of this report is to clarify the development of the project being created which is an application known as “SafeRoute” which is designed to help a vulnerable person travel home by plotting a route through areas which include special conditions such as greater traffic/footfall and areas which feature a greater presence of Garda traffic cameras to enable full visibility to a person who may have fears of attack or abduction. I aim to describe the process from gathering requirements to actually developing the application using the various technologies available at my disposal.

1.0 Introduction

1.1. Background

I had initially come up with several ideas for my final year project and discussed them with Lisa Murphy of NCI in August of 2021 and upon describing this idea to her the reception I got was quite enthusiastic. I had reservations about how I could actually build something like this, and I was kind of looking to do something manageable but after a lecture in the module for Software Project it was made clear that this project should be complicated and it should be a challenge so therefore I went with this idea as it provides a vital real world application as more and more woman are subject to attacks in public when travelling home alone at night.

Another reason I chose to do this was because at the time the Sarah Everard kidnapping in the UK was in the media again due to the trial taking place of the perpetrator, Wayne Couzens. It was when I watched an interview with a representative of the London police on Sky News talking about the details of how the crime happened is when I felt this application would be useful in a situation like that. The killer would be perpetrated due to camera footage from a passing bus.(theguardian, December 2021)

I thought that an app like mine would benefit if a person was walking in a more visible location with more traffic not just in the instance of the crime mentioned but in many other unsolved crimes this could be a concept to help aid solving crimes or completely avoid future crimes.

1.2. Aims

The goal of this project is to develop a fully functioning application which can function as is being proposed. The functions of this application involve a user registering on the application and then being able to plot a route from their starting point which may be work or a friend’s house late at night if they need to walk home alone. The user should be able to plot a route home which will try to calculate a route which will take the user through as many busy areas as possible and also areas which feature Garda traffic cameras to further visibility. While on a route, a user’s audio and video will automatically record anything it may pick up in the background which may help gardai if a crime is to take place. While the users audio is recording on their route, the aim is also to add a feature that will detect key words such as “get away” or “leave me alone”

which can then enable the application to automatically dial out a number which may be a pre designated family member or friend or potentially, the emergency services.

1.3. Technology

The main technology being used on this project will be Android Studio as I am familiar with it due to working on past projects in NCI. Android studio is a very popular IDE for building android applications and thus features a ton of tutorial videos on YouTube. I like to use android studio as it allows me to build applications in Java and I am very familiar with the Java Programming language from studying it in NCI. I will build the application in Java as it will make the task more manageable as I am not as fully familiar with Kotlin even though Kotlin is the preferred language for newer android apps being developed.

For the storage and retrieval of data from a database I will be taking advantage of Googles Firebase platform to allow users to store registration/profile data as well as the storage for any audio/video recording of a user's routes. Firebase is a good tool to use for a back end as it is highly interactive with android studio.

For the voice recognition it may be possible to use a feature for android known as Speech Recognizer to pick up key words when the audio is recording. Another avenue for this is integrating python in android studio and using the python programming language to detect the keywords.

The introduction of waypoints within google maps will be that of the Garda CCTV traffic camera locations will be a challenge but will be a valuable tool as while the cameras record mainly road traffic, they do also pick up pedestrian traffic from foot paths, this can be seen in cork city centre. (IrishExaminer, December 2021)

1.4. Structure

Throughout this report I will be discussing the main requirements for the completion of the application in a more detailed manner as to which I have spoken previously in introduction sections of this report and also my project proposal.

Firstly, I will discuss the requirements in detail one by one which will include use case scenarios with actors using the system and its functions. This will of course include Use case UML diagrams to depict each function being used by the user and its flow. These requirements also include the user, data, environmental and usability requirements. This section aims to delve into the kind of data I will be working with to build the app which includes the use of Garda traffic camera data and also usability requirements which may be that of the aim to make the app accessible to everybody when it comes to people visually impaired which may require the need for larger touch targets or screen readers etc.

2.0 System

2.1. Requirements

impaired can easily access the application with things such as an emphasis on greater sized touch targets etc. I aim to build this app so that anyone who uses a smart phone should not need a whole lot of time spent learning to use the application. The login and registration will mirror most other popular applications to add familiarity from a user point of view which will include that of a user-friendly GUI. The user will be required to enter an email address as that will be used as a unique identifier in the firebase database. The user profile will be a simple profile which nice sized touch targets and easy navigation for ease of access and a main button which is highlighted to initiate the maps/route activity will be highly visible so that any age or technical literacy will be able to use the application. With the main function of this application being the route plotter function, which aims to use Google Maps, this may require some training for people who may need it mainly elderly people and people who may not be as tech oriented. Google maps is very user friendly and is integrated within most people's smart phones so therefore I would allow 10-20 minutes for someone unfamiliar to pick up on how to use the application.

2.1.1. Functional Requirements

1. **Allow a user to create an account:** The system must allow a user to register successfully with their emails and set a password to create an account.
2. **Allow a user access to Google Maps:** A user must be able to access google maps that is integrated with the application and thus allowing them to see current location.
3. **Allow a user to plot a route between two points:** The application must allow the use of google maps to plot a starting location and an endpoint or final destination.
4. **Display markers on maps to highlight location of traffic cameras:** the user must be able to see marked on a map where traffic cameras may be.
5. **Route a user through areas (where possible) which include garda traffic cameras and streets which include greater traffic/footfall:** the application must try where possible to have parts of a user's route or all, if possible, go through areas with higher presence of traffic cameras or greater vehicle or pedestrian traffic.
6. **Record Audio and Video during Route:** The application must be able to record all background Audio and Video only when route is initiated and must terminate when route is finished. The user will of course consent to the use of their microphones/cameras when first accessing the app.
7. **Listen for keywords for potentially dialling out to a number:** the app must be able to monitor the background audio for keywords when a user is on their route and microphone is recording which may then dial out to a predesignated number for a family/friend or potentially emergency services when prompted.

2.1.1.1. Use Case Diagram



2.1.1.2. Requirement 1 – User Plots a Route

User will plot a route from a starting point to a destination endpoint in a safe manner

2.1.1.3. Description & Priority

The user will input a destination address and the system will generate a route to their destination which will be calculated by routing the user through highly populated areas with plenty of CCTV coverage to highlight visibility. This function of the application is the main function being proposed therefore will have the highest priority.

2.1.1.4. Use Case

Scope

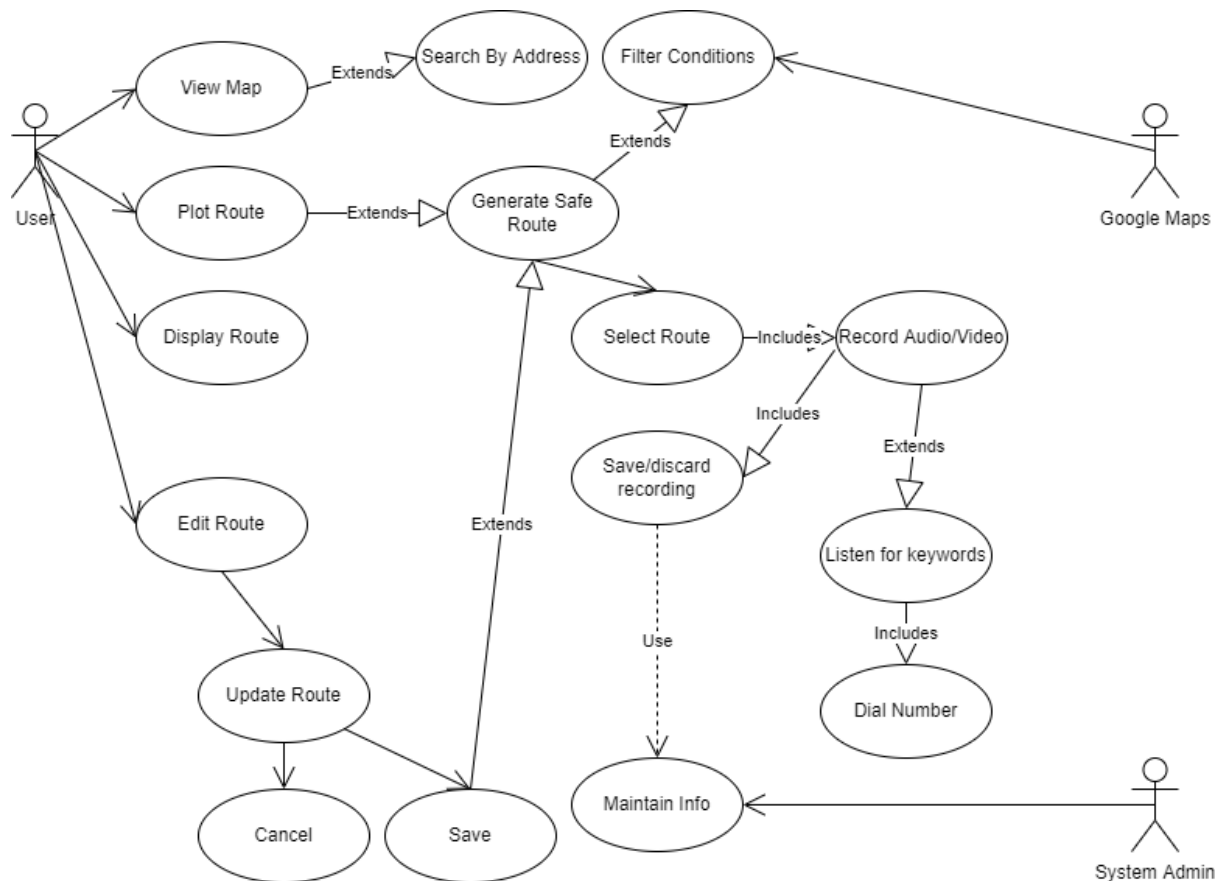
The scope of this use case is to allow a user logged in to create a new route. The system will redirect from a user's profile to a route activity in the application. The application will take in user data for destination. The system will use google maps api's for plotting a route through heavy traffic/footfall areas. System will also use waypoints of traffic cameras input into maps and generate route to include these waypoints where possible. While route is running, system will use device microphone and camera to record audio/video. System will listen for keywords

while recording audio to enable automatic dialling function. The system can also save route recordings if necessary.

Description

This use case best describes the core function of the application. The function involves plotting a route for the user along with recording media.

Use Case Diagram



Flow Description

Precondition

1. The user device has internet access.
2. The user has created an account.
3. The user is logged in.
4. User has given permission for location access.
5. User has given permission for Audio recording.
6. User has given permission for Camera access.

Activation

The use case begins when the user initiates route function by pressing plot route on user profile page.

Main flow

1. User initiates Route function
2. User inputs destination address
3. Preliminary route is generated
4. Google creates new route with parameters of traffic and CCTV locations
5. Route begins, Audio and video is recording.
6. Attack occurs, keyword is heard by microphone, device dials out to designated number.
7. User ends route
8. Recordings are saved in database for analysis.

Alternate flow

A1 : Safe trip

1. User creates route as per main flow.
2. Route begins, Audio and video is recorded.
3. User has uneventful journey
4. User ends route
5. Recordings are discarded due to not needed.

Exceptional flow

E1 : Change of Route

1. User creates route as per main flow.
2. Route begins, Audio and video is recorded.
3. User decides to change destination
4. Initial route is terminated, user can save or discard recordings.
5. User creates new route.
6. Google generates route with all previous parameters.
7. Route begins, audio/video is recording.
8. Attack occurs, keyword is picked up, phone dials out.
9. User is intercepted by law or friend
10. Route is ended
11. Recording is saved.

Termination

Upon route being ended, system will then prompt user to keep or discard recordings.

Post condition

The system will then enter a wait state while logged out or logged in on user profile with no routes set.

List further functional requirements here, using the same structure as for Requirement1.

2.1.1.5. Requirement 2 User Registration/Login

2.1.1.6. Description & Priority

The user registers with an email address and password. This is a high priority as an account must be created to use the application and the account must be identified by a person's email.

2.1.1.7. Use Case

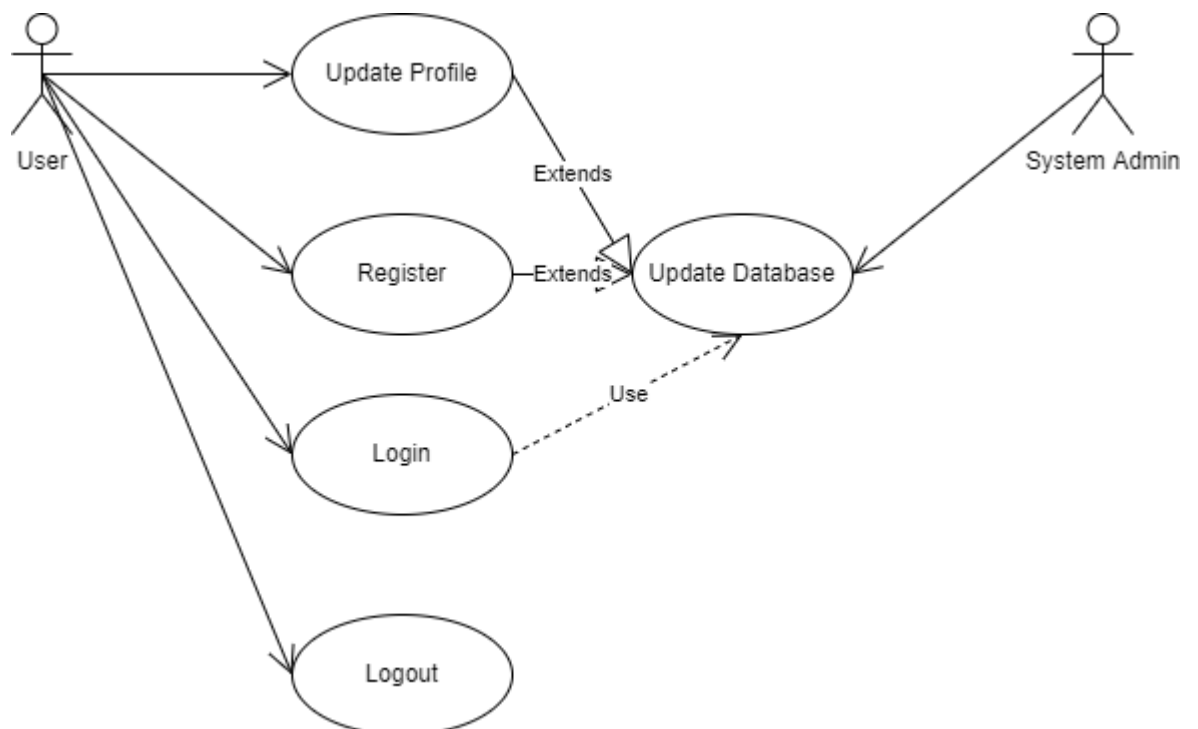
Scope

The scope of this use case is to allow a user to create an account so that they may use the main features in the application. The user must provide an email address which will then be used as a unique identifier for their account. The user must also enter their name and a password also.

Description

This use case describes the registration function of the application which will use the firebase database to store the data and then this data will be retrieved when a user successfully logs into their account.

Use Case Diagram



Flow Description

Precondition

1. The user must have internet access.
2. The user must have an email address

Activation

This use case begins when the user opens the application and does not have an account, so they press on the register button on the login page.

Main flow

1. User opens app
2. User presses register button on login screen
3. User is at register page
4. User enters email address, name, and password
5. User is registered successfully
6. User is brought to a login page
7. User logs in and is brought to a profile page.

Alternate flow

A1 : Already has an account

1. User is at register page
2. User enters email that is already registered
3. System notifies user of this
4. User then goes back to login
5. User logs in with email as account already exists

Exceptional flow

E1 : Passwords not matching

1. User is at register page
2. User enters email, name and fills in both password text fields
3. Passwords do not match
4. System tells user to have matching passwords
5. User enters both matching passwords
6. Account is created. User can log in
7. User is brought to profile screen

Termination

The system will present user with a profile page as registration activity is

Post condition

The system will then enter a wait state while logged out or logged in on user profile with no routes set.

2.1.2. Data Requirements

System Data Requirements:

1. The system requires user data to be inserted upon registration as this is necessary to create an account as an accounts email is used as a primary identifier. The database requires an email, username, and password. This data can be seen by the user for their own account but also by a system administrator within the firebase database.
2. Google map data is required to display maps within the app, also required is google data of traffic in areas of a map.
3. Garda traffic camera data is required for locations to plot on a map within the application. This data is publicly available in CSV format on the Garda website.

2.1.3. User Requirements

1. The user is required to have an android phone as this application is being developed for android devices.
2. The user must have an email address, username, and password.
3. The user must have internet connection to enable map location.
4. The user must give permission for camera and audio access for full functionality of the app.

2.1.4. Environmental Requirements

1. The user is required to have an android phone as this application is being developed for android devices.
2. The user must have internet connection to enable map location.
3. User must have an acceptable version of android on their phone.

2.1.5. Usability Requirements

1. Application must be user friendly and not complicated to use.
2. The app must apply best practices for ease of access for people with visual impairments.
3. Application must have a steady flow when completing its primary task.

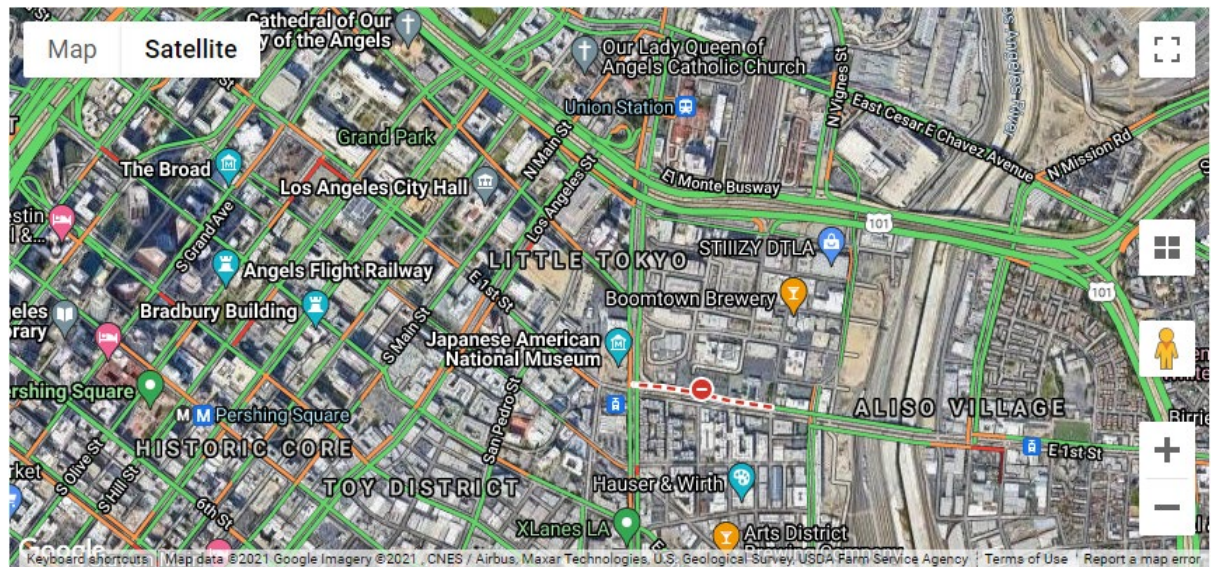
2.2. Design & Architecture

The main UI of the application is done in a simple manner as the UI is not key to the application, but it is always important to have good User Interface and User Experience. I have chosen to go with a red colour as red is a warm and safe colour in branding and I want to have this app give a feeling of safety. From my time in my internship as a Front-End Mobile Developer I learned that best practices are important so therefore sufficient touch targets and user-friendly UI for people with impairments is important.

For the functionality, I will be implementing google maps along with google traffic data available with help of the traffic layer API. This API provides a layer of traffic over the map with colour codes to highlight current status of traffic patterns.

SpeechRecognizer is a class in android studio which may be used to interpret any keywords picked up within a user's recording. While this is available, I may also look to python for speech recognition and determine which is best of the two.

Firestore will be used to implement a database for the user's registration data, profile data and storing recordings the user wishes to save.



The google traffic layer as seen in operation in the figure above, note the different colours to determine traffic status.

Another feature that may be implemented is a feature to upload images which people may find useful.

2.3. Implementation

The main function will be the map function which will include that of plotting the user route. This will be an activity in android studio. I hope to get google maps core functionality working in the application soon and then build on that.

The registration and login classes use Firebase and that is in implementation as of now. Here is a code snippet of an example of this implementation in the Register.java class.

```
@Override
protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    getWindow().setFlags(WindowManager.LayoutParams.FLAG_FULLSCREEN, WindowManager.LayoutParams.FLAG_FULLSCREEN);
    setContentView(R.layout.activity_register);

    final EditText fullname = findViewById(R.id.fullname);
    final EditText email = findViewById(R.id.email);
    final EditText phone = findViewById(R.id.phone);
    final EditText password = findViewById(R.id.password);
    final EditText conPassword = findViewById(R.id.conPassword);

    final Button registerBtn = findViewById(R.id.registerBtn);
    final TextView loginNowBtn = findViewById(R.id.loginNowBtn);

    registerBtn.setOnClickListener(new View.OnClickListener() {
        @Override
        public void onClick(View view) {

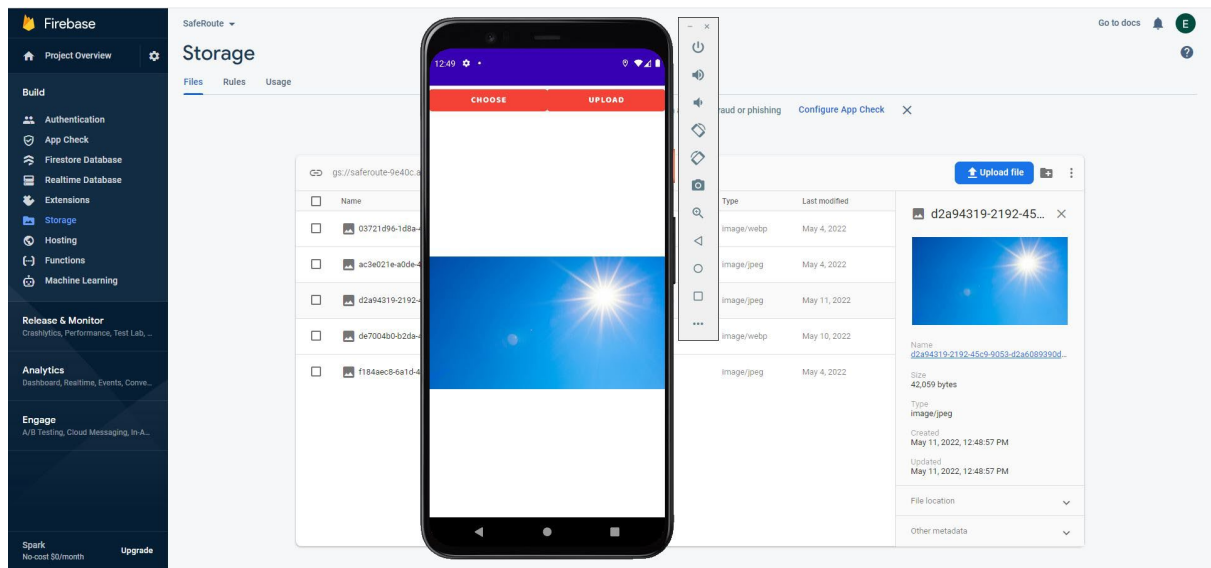
            final String fullnameTxt = fullname.getText().toString();
            final String emailTxt = email.getText().toString();
            final String phoneTxt = phone.getText().toString();
            final String passwordTxt = password.getText().toString();
            final String conPasswordTxt = conPassword.getText().toString();

            if(fullnameTxt.isEmpty() || emailTxt.isEmpty() || phoneTxt.isEmpty() || passwordTxt.isEmpty() || conPasswordTxt.isEmpty()){
                Toast.makeText(context, Register.this, text: "Please fill in all fields.", Toast.LENGTH_SHORT).show();
            }
            else if(!passwordTxt.equals(conPasswordTxt)){
                Toast.makeText(context, Register.this, text: "Passwords Do Not Match", Toast.LENGTH_SHORT).show();
            }
            else{
                databaseReference.child("users").addListenerForSingleValueEvent(new ValueEventListener() {
                    @Override
                    public void onDataChange(@NonNull DataSnapshot snapshot) {
                        if(snapshot.hasChild(emailTxt)){
                            Toast.makeText(context, Register.this, text: "Email already registered", Toast.LENGTH_SHORT).show();
                        }
                    }
                })
            }
        }
    })
}
```

I am unsure of where I may put the speech recognizer and the route recording functions as of now, but these two functions will potentially be within the maps activity when full implementation is in progress.

The map function is implemented as a mapview within a cardview in the XML file. The map activity also features a search bar for a user to input an address in which they wish to search. The user can search an address, or the name of a place and the map will find the best match and then place a marker on that place. If the user has set a route or a marker on a location then they can use the two buttons for start route and end route, these will start the devices audio recorder and the device will use the mic to pick up any sounds and then the user can press end route at which point the audio will be uploaded to firebase for storage.

While I had stated before I would build the app in Java, during development, I used tutorials based in Kotlin and due to Kotlin's good interoperability with the Java language in Android studio, I decided to use both Java and Kotlin as it seemed good for me and also improved my Kotlin skills.



The back end of this application utilizes googles firebase platform. The application will upload images and audio to the cloud storage database on firebase and then the apps user information for registration and login will be stored in the Realtime database all under the same project.

```
private fun startRecording() {
    recorder = MediaRecorder()
    recorder.setAudioSource(MediaRecorder.AudioSource.MIC)
    recorder.setOutputFormat(MediaRecorder.OutputFormat.AAC_ADTS)
    recorder.setOutputFile(fileName)
    recorder.setAudioEncoder(MediaRecorder.AudioEncoder.AAC)
    try {
        recorder.prepare()
    } catch (e: IOException) {
        Log.e(LOG_TAG, msg: "prepare() failed")
    }
    recorder.start()
}

private fun stopRecording() {
    recorder.stop()
    recorder.release()
    //recorder = null
    uploadAudio()
}

private fun uploadAudio() {
    progress!!.setMessage("Uploading Audio . . .")
    progress!!.show()
    val filepath = storageReference!!.child( pathString: "Audio").child( pathString: "new_audio.mpeg")
    val uri = Uri.fromFile(File(fileName))
    filepath.putFile(uri).addOnSuccessListener { progress!!.dismiss() }
}
```

Here is the applications audio function in which the app will start recording with the devices microphone once given the permissions of course and then upload to the firebase database in an mp3 format which when accessed in the database can be downloaded and played on a computer.

```

latlngs.add(LatLng( latitude: 53.324883, longitude: -6.299314))
latlngs.add(LatLng( latitude: 53.353728, longitude: -6.254723))
latlngs.add(LatLng( latitude: 53.473407, longitude: -6.221376))
latlngs.add(LatLng( latitude: 53.319832, longitude: -6.291236))
latlngs.add(LatLng( latitude: 53.337386, longitude: -6.262768))
latlngs.add(LatLng( latitude: 53.346327, longitude: -6.243533))
latlngs.add(LatLng( latitude: 53.285592, longitude: -6.407888))
latlngs.add(LatLng( latitude: 53.343127, longitude: -6.269914))
latlngs.add(LatLng( latitude: 53.347716, longitude: -6.259278))
latlngs.add(LatLng( latitude: 53.402575, longitude: -6.291566))
latlngs.add(LatLng( latitude: 53.323364, longitude: -6.207084))
latlngs.add(LatLng( latitude: 53.380245, longitude: -6.210704))
latlngs.add(LatLng( latitude: 53.33929, longitude: -6.354948))
latlngs.add(LatLng( latitude: 53.287453, longitude: -6.246474))
latlngs.add(LatLng( latitude: 53.387746, longitude: -6.32044))
latlngs.add(LatLng( latitude: 53.272953, longitude: -6.124833))
latlngs.add(LatLng( latitude: 53.427074, longitude: -6.243001))
latlngs.add(LatLng( latitude: 53.351504, longitude: -6.258752))
latlngs.add(LatLng( latitude: 53.265442, longitude: -6.235214))
latlngs.add(LatLng( latitude: 53.386048, longitude: -6.295778))
latlngs.add(LatLng( latitude: 53.406863, longitude: -6.397759))

for (point in latlngs) {
    options.position(point)
    options.position(point).title( title: "CCTV")
    options.position(point).icon(BitmapDescriptorFactory.fromResource(R.drawable.cameras))
    options.position(point).snippet( snippet: "Garda Traffic Cam")
    googleMap.addMarker(options.position(point)
    )
}

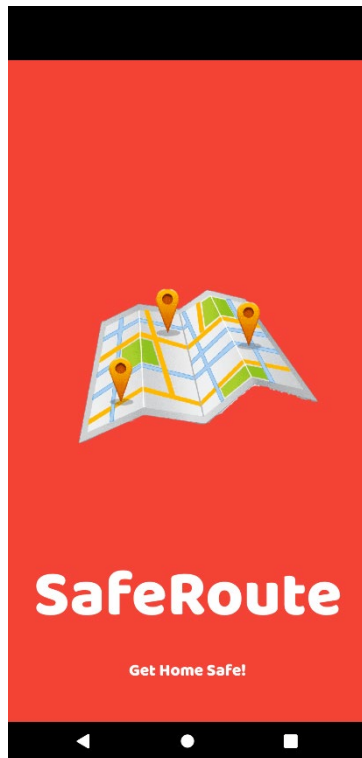
```

Here is the implementing of the Garda CCTV traffic cameras of which are publicly available in the form of a spreadsheet with coordinates of each camera. I had gotten a large spreadsheet of over 1300 camera locations and in time whittled the number down to 292 of which are all Dublin locations so as to focus on a smaller area. To avoid more time consumption, the points were placed in an array and each point is an array object which calls all of these points to the map in a for loop which also places a title, description, and pin icon on them.

Zone Number	County	Road Type/Description	Fatal Collisions	Serious Collisions	Minor Collisions	Total Collisions	Start Latitude	Start Longitude	End Latitude	End Longitude	Length (KM)
248	Dublin	Regional	0	1	7	8	53.61281	-6.188607	53.599967	-6.185746	1.59
249	Dublin	Regional	0	1	0	1	53.597129	-6.16165	53.586151	-6.143006	1.98
251	Dublin	Regional	0	2	11	13	53.416024	-6.178003	53.45116	-6.147267	5.31
252	Dublin	Regional	0	0	12	12	53.427707	-6.229529	53.413129	-6.238983	1.86
254	Dublin	Local	0	1	2	3	53.401188	-6.400307	53.390356	-6.408635	1.36
255	Dublin	Local	0	2	3	5	53.398081	-6.332871	53.403943	-6.358805	2.08
256	Dublin	Regional	2	6	39	47	53.367585	-6.272903	53.403398	-6.310797	5.09
257	Dublin	Regional	0	1	26	27	53.333802	-6.244927	53.332064	-6.235711	0.66
259	Dublin	Regional	0	5	35	40	53.326326	-6.278169	53.30277	-6.308635	3.62
261	Dublin	Regional	0	1	19	20	53.285648	-6.365907	53.308705	-6.386186	3.01

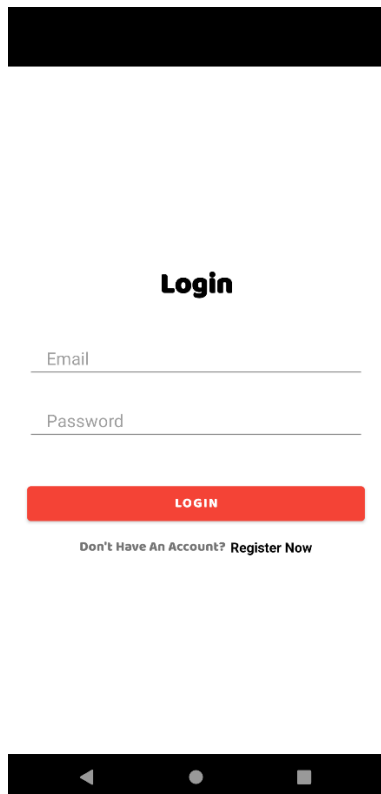
Above is a snippet of the large spreadsheet that I had to gather the start latitude and longitude from in order to successfully place the camera locations on the map.

2.4. Graphical User Interface (GUI)




As you can see, I have gone with a red colour scheme as this represents warmth and safety which I want this application to portray as a whole. The splash screen features an Image which is temporary for now as I could not find any good free png images for the splash screen. The splash screen features an animation where the image and text fade in from top and bottom.

The colour I have chosen is a red colour with a hex code of #F44336. And the font chosen for most of the app's UI is a font called Baloo as I feel it is modern and not too intimidating to a user.



The second image is the login screen which is a quite standard login for a user with a login button featuring the red colour scheme and an acceptable touch target for a user. Beneath this is a button for a user to register If they do not hold an account. This is a smaller touch target as it is the secondary function on this activity.



Register Account

Email

Phone


Full Name

Password

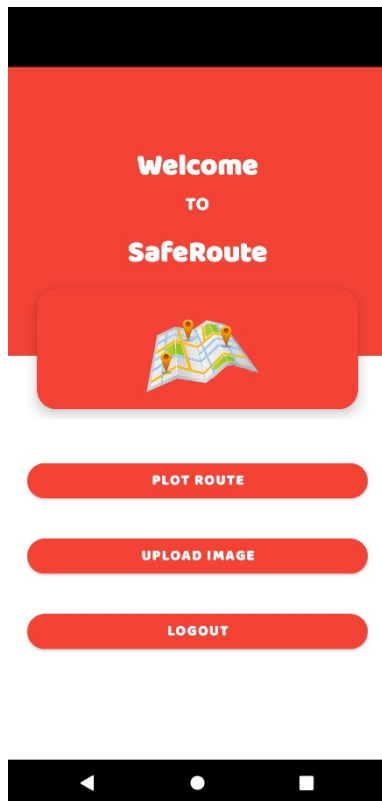
Confirm Password

REGISTER

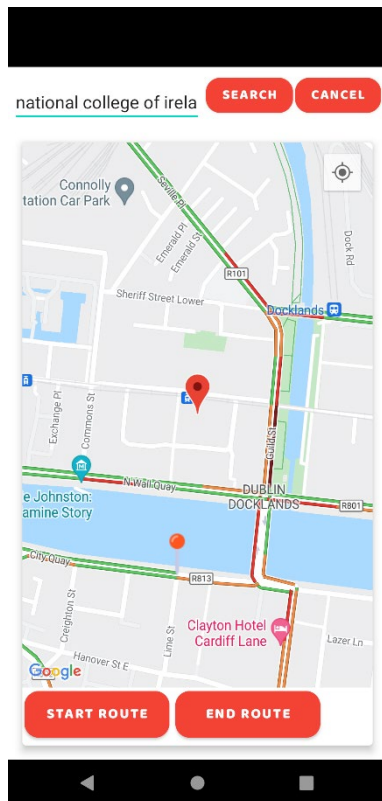
Have An Account? [Login Now](#)



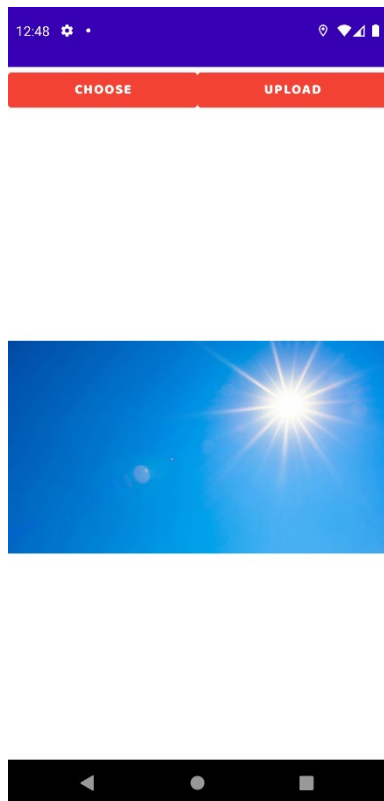
The third image is the register function and will be used if a user does not have an account and is navigated to it from the login page. This function is similar to the login function with more text fields and again the smaller button to go to the login page.



This is the users main page once logged in, the page is very simple as features such as adding a user profile picture are not the main goal here, so I left it out. The user has three functions with appropriate buttons and good touch targets for the user.



Here is the main function of the application which is the apps route plotting function. The google map view is placed within a cardview and then above this is a search function to search the destination and plot a route or cancel a route and start again. Beneath this are the start and end route functions which primarily control the audio recording.



Here is just a simple UI for the image upload feature with just two buttons to search the devices storage and then one to upload to firebase. The user will select an image and then the image will be displayed in an image view before being uploaded.

2.5. Testing

Unit Testing

For the testing of this application, I used a variety of methods to test it. In the actual android studio platform, I used the Junit and Espresso frameworks to perform unit and instrument tests on the application. I do not have much of a testing background, so I performed the testing to the best of my ability.

```
//Testing dependencies
testImplementation 'junit:junit:4.13.2'
testImplementation 'org.mockito:mockito-core:1.10.19'
androidTestImplementation 'androidx.test.ext:junit:1.1.3'
androidTestImplementation 'com.android.support.test:runner:1.0.2'
androidTestImplementation 'androidx.test.espresso:espresso-core:3.4.0'
implementation 'androidx.test.ext:junit-ktx:1.1.3'
androidTestImplementation 'androidx.test.espresso:espresso-contrib:3.3.0'
androidTestImplementation 'androidx.test.espresso:espresso-intents:3.3.0'
implementation 'androidx.test.espresso:espresso-idling-resource:3.3.0'
androidTestImplementation 'androidx.test.espresso:espresso-idling-resource:3.3.0'
testImplementation "com.google.truth:truth:1.0.1"
androidTestImplementation "com.google.truth:truth:1.0.1"
```

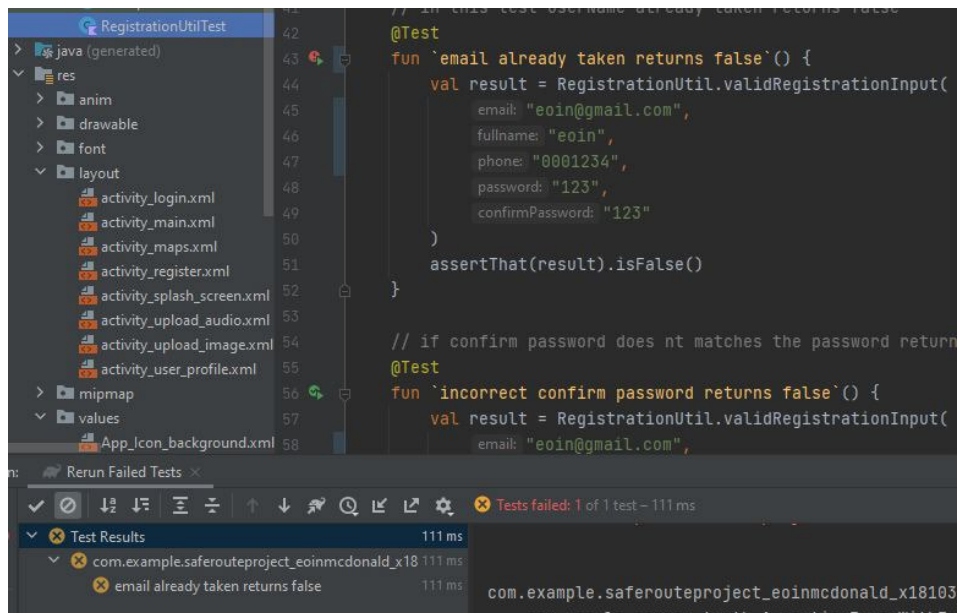
I have created two unit tests one for Registration and one for Login functions on the application. The unit tests are designed to test different scenarios of when the user is using the applications functions of login and registration. These tests are designed to test users inputting correct and false values into the system and also with values missing.

```
// whatever we write in those backticks will be considered as function name
@Test
fun 'empty email returns false'(){
    // Pass the value to the function of RegistrationUtil class
    // since RegistrationUtil is an object/ singleton we do not need to create its object
    val result = RegistrationUtil.validRegistrationInput(
        email: "",
        fullname: "eoin",
        phone: "0001234",
        password: "123",
        confirmPassword: "123"
    )
    // assertThat() comes from the truth library that we added earlier
    // put result in it and assign the boolean that it should return
    assertThat(result).isFalse()
}

// follow the same for other cases also
// in this test if username and correctly repeated password returns true
@Test
fun 'email and correctly repeated password returns true'() {
    val result = RegistrationUtil.validRegistrationInput(
        email: "eoin@gmail.com",
        fullname: "eoin",
        phone: "0001234",
        password: "123",
        confirmPassword: "123"
    )
    assertThat(result).isTrue()
}

// in this test userName already taken returns false
@Test
fun 'email already taken returns false'() {
    val result = RegistrationUtil.validRegistrationInput(
        email: "eoin@gmail.com",
        fullname: "eoin",
        phone: "0001234",
        password: "123",
        confirmPassword: "123"
    )
}
```

Here is an example of the registration unit test I have created in Kotlin which tests for missing or correct values a user may put in as you can see.



Here is the result of the registration Junit test which contains 6 tests in total of which you will see that 5 have passed in this case and one failed of which is a false value being returned in the email already taken test case.

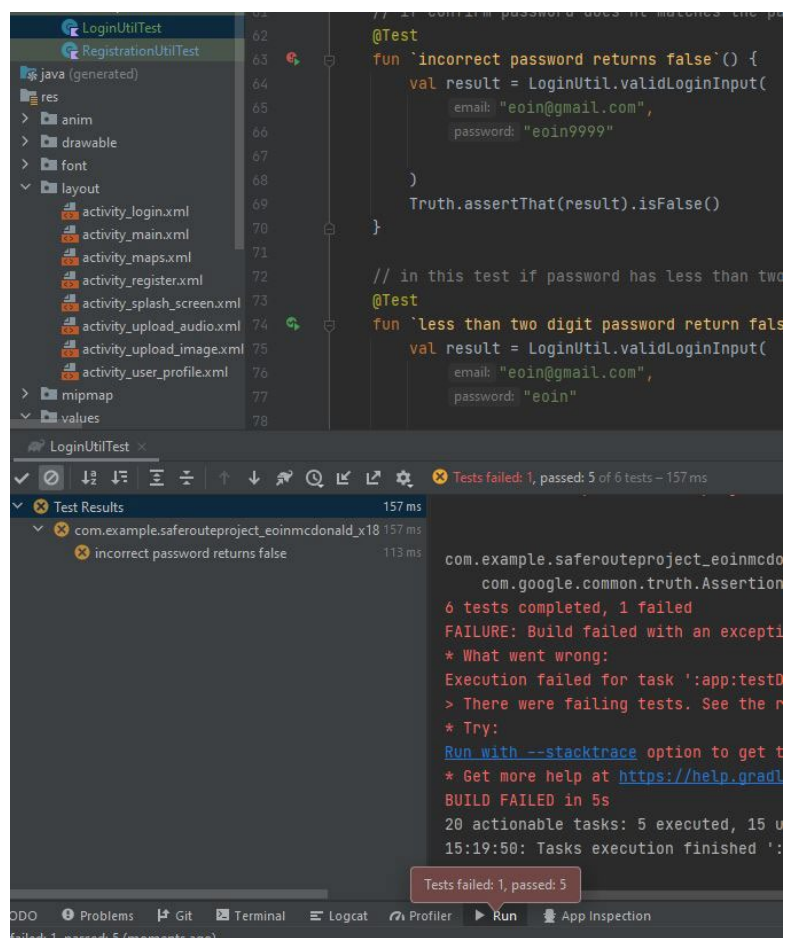
```

@Test
fun `empty email returns false`() {
    // Pass the value to the function of RegistrationUtil class
    // since RegistrationUtil is an object/ singleton we do not need to create its object
    val result = LoginUtil.validLoginInput(
        email: "",
        password: "123"
    )
    // assertThat() comes from the truth library that we added earlier
    // put result in it and assign the boolean that it should return
    Truth.assertThat(result).isFalse()
}

@Test
fun `empty password returns false`() {
    // Pass the value to the function of RegistrationUtil class
    // since RegistrationUtil is an object/ singleton we do not need to create its object
    val result = LoginUtil.validLoginInput(
        email: "eoin@gmail.com",
        password: ""
    )
    // assertThat() comes from the truth library that we added earlier
    // put result in it and assign the boolean that it should return
    Truth.assertThat(result).isFalse()
}

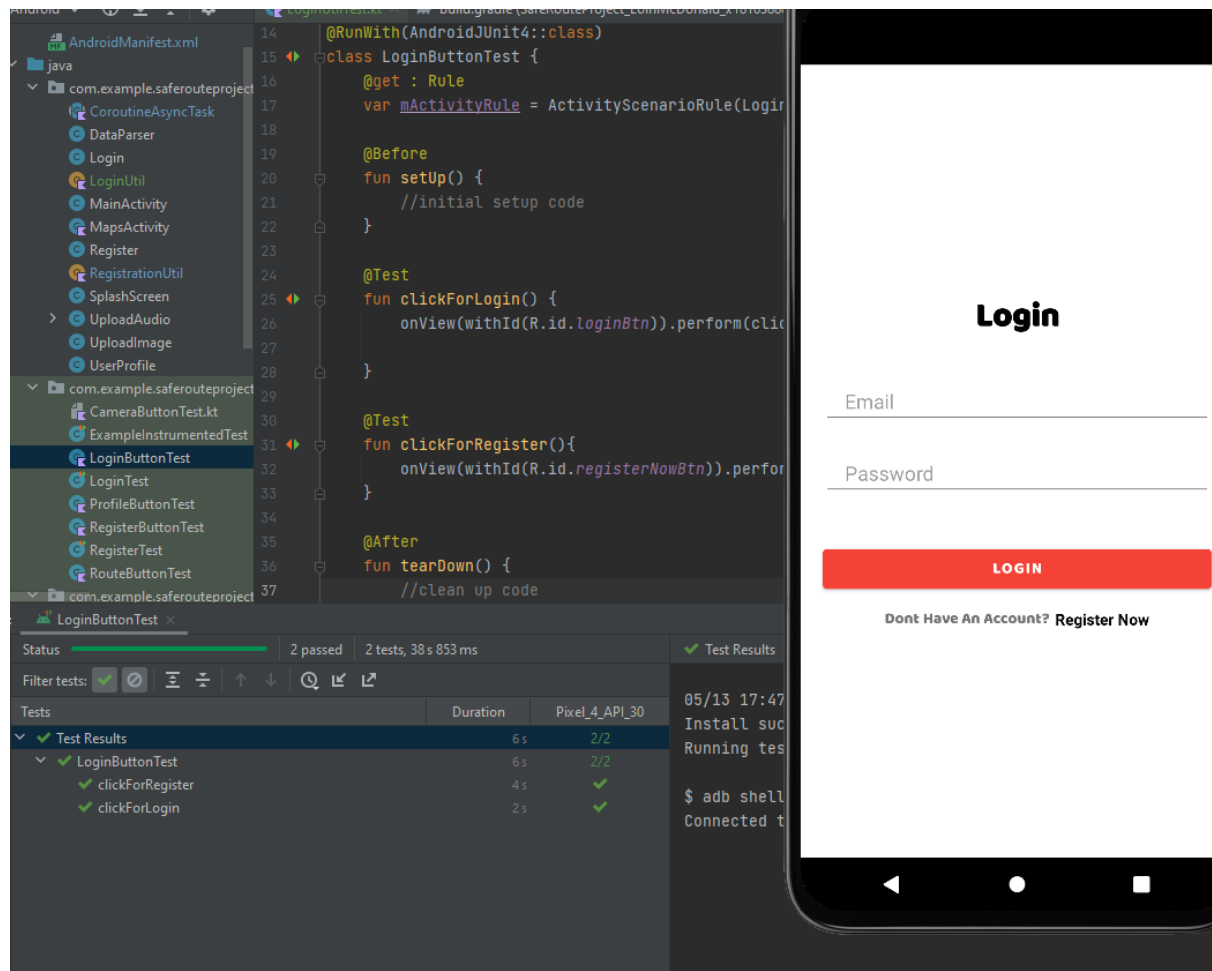
```

Here is a Junit test of my login in which you can see two test cases which cover the scenario of the user not inputting a password or email value in each case respectively.

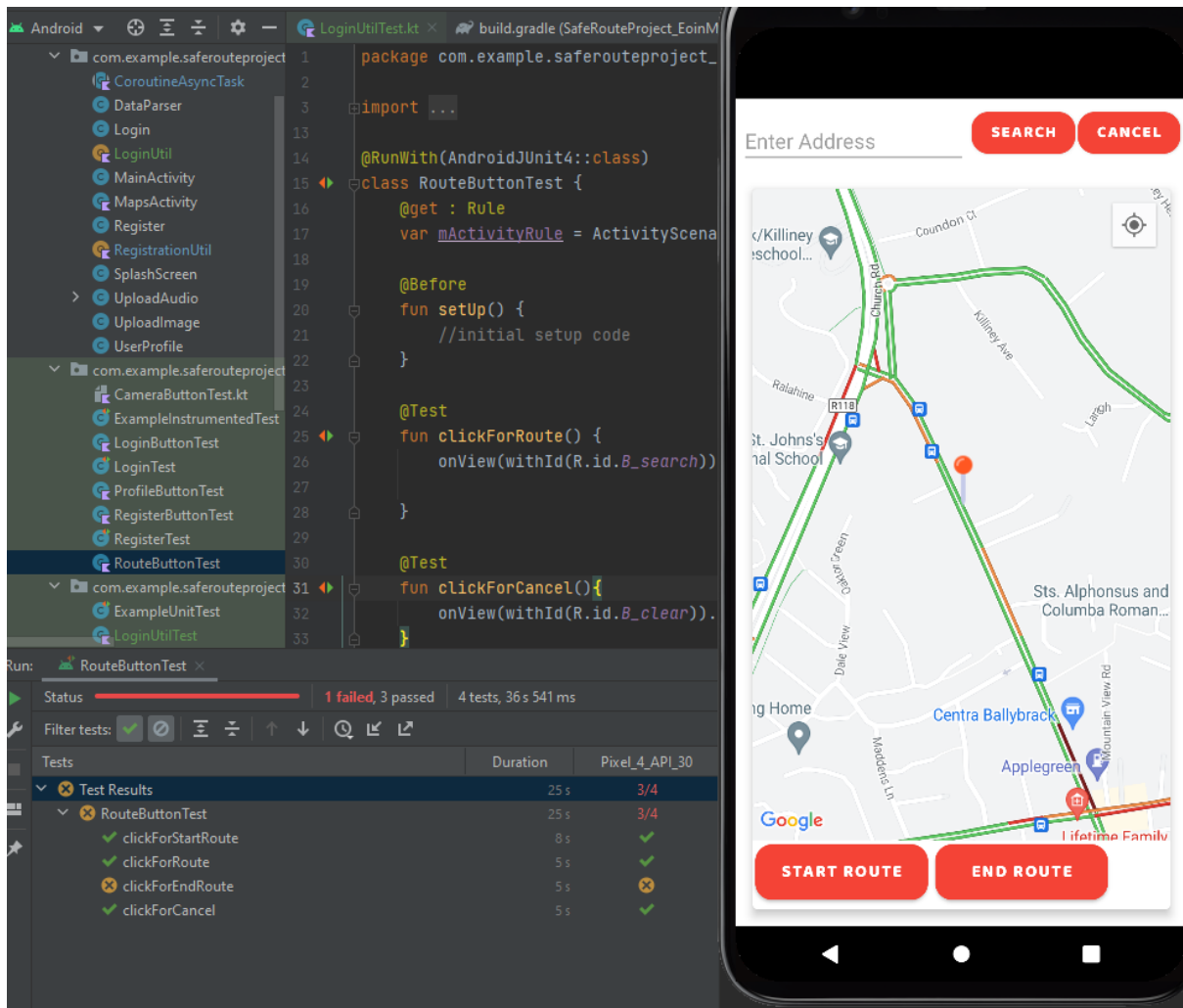


User Interface Testing

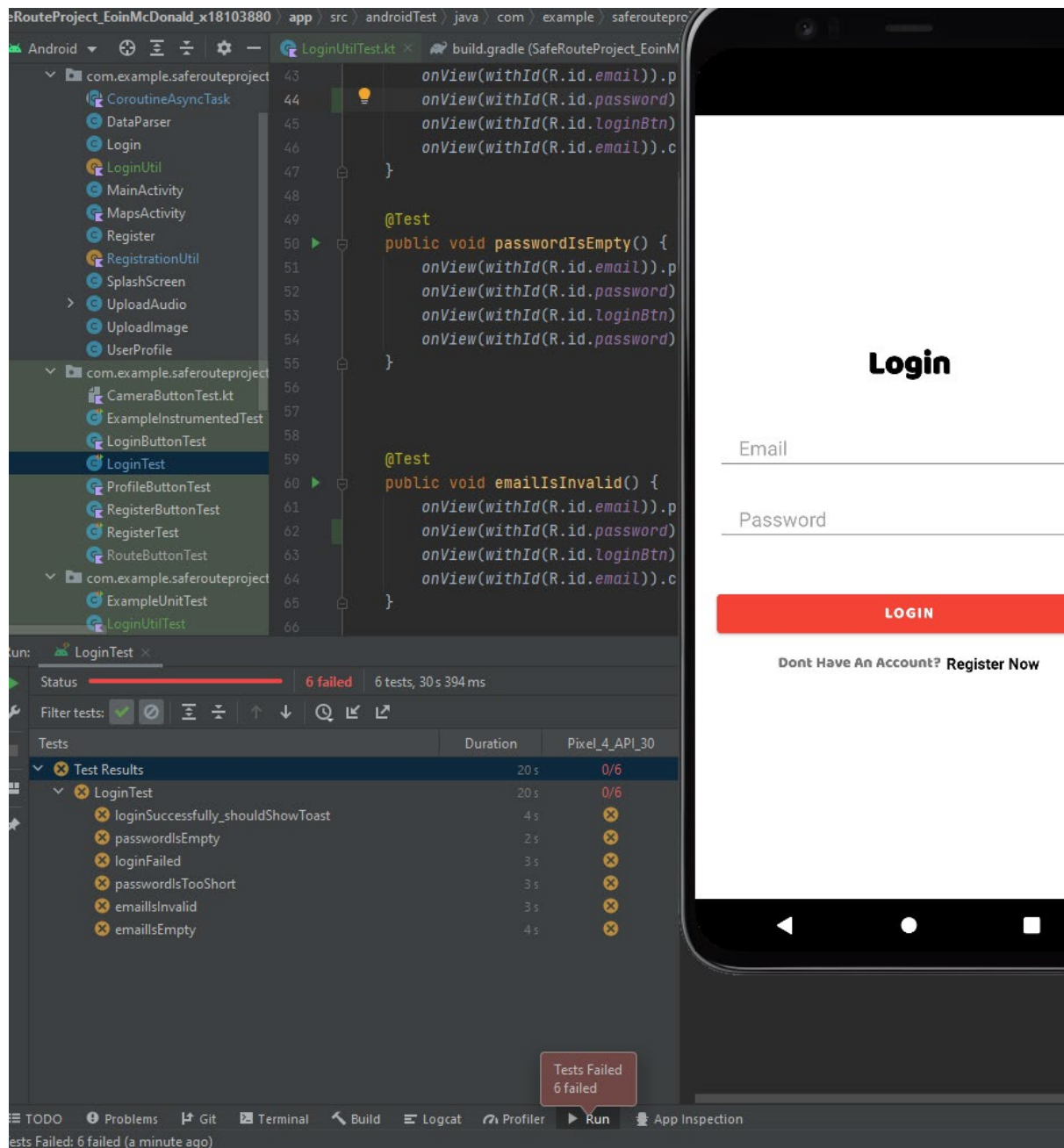
The second type of testing I completed was testing the user interface in the form of instrument testing on the device. I used the espresso framework to do this as it will run the application on a particular activity or fragment of the application and mimic user interaction with the application and also the espresso framework is included with android studio by default.



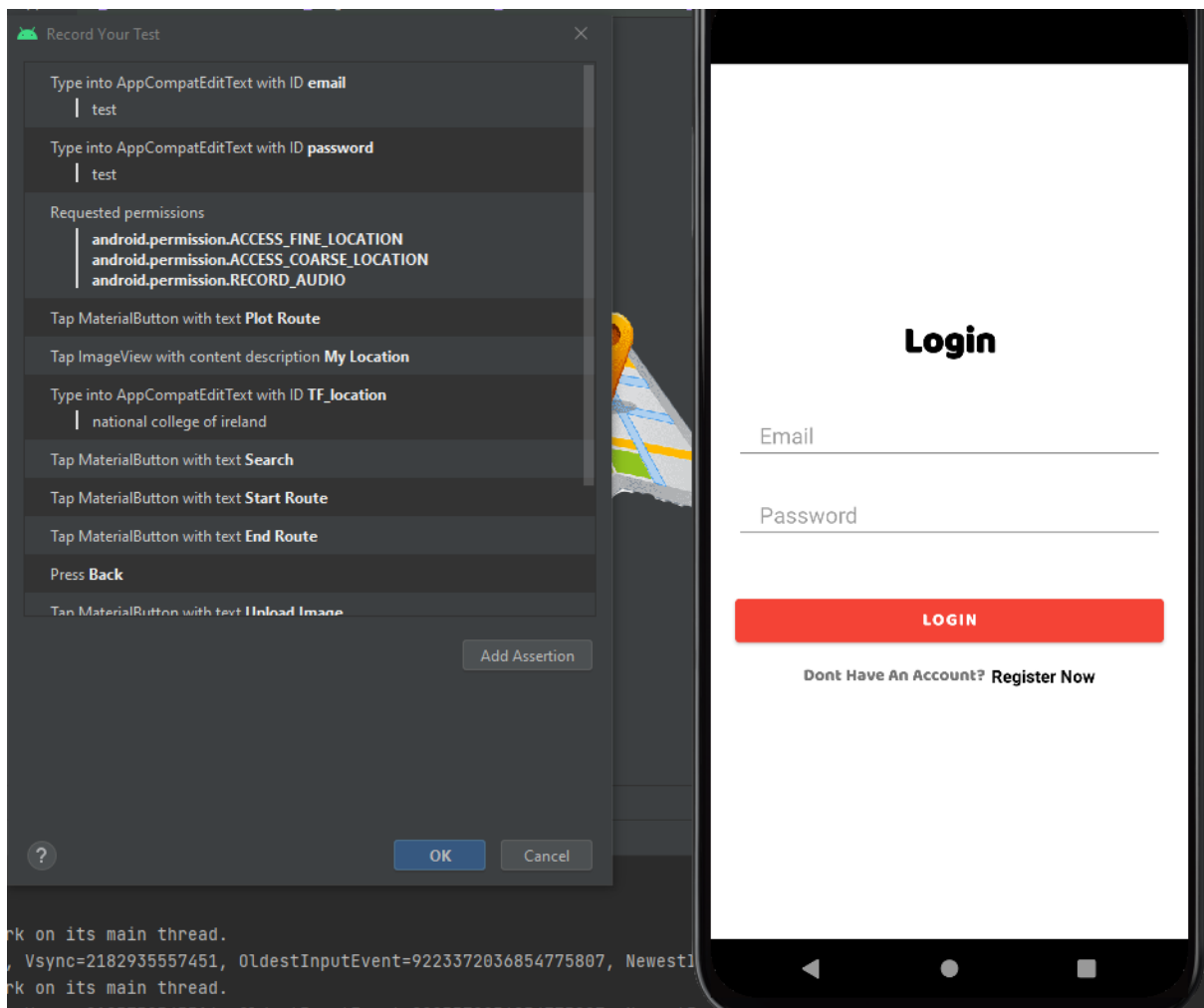
Here is an example of the testing of the login page in which the test that was created will run the device on the login activity and the press the red login button and then also the Register Now button below. You can notice the results in the bottom left corner that this test is a success.



Here is an example of testing done on the apps main function, the map. There are four buttons here and each is tested in the test I created. You can see that of the 4 tests done that one has failed in this instance which is the End Route button.



Here is a test which mimics a user inputting data into the login screen with various conditions set such as no email or password input or both. This test returned 6 failed tests.

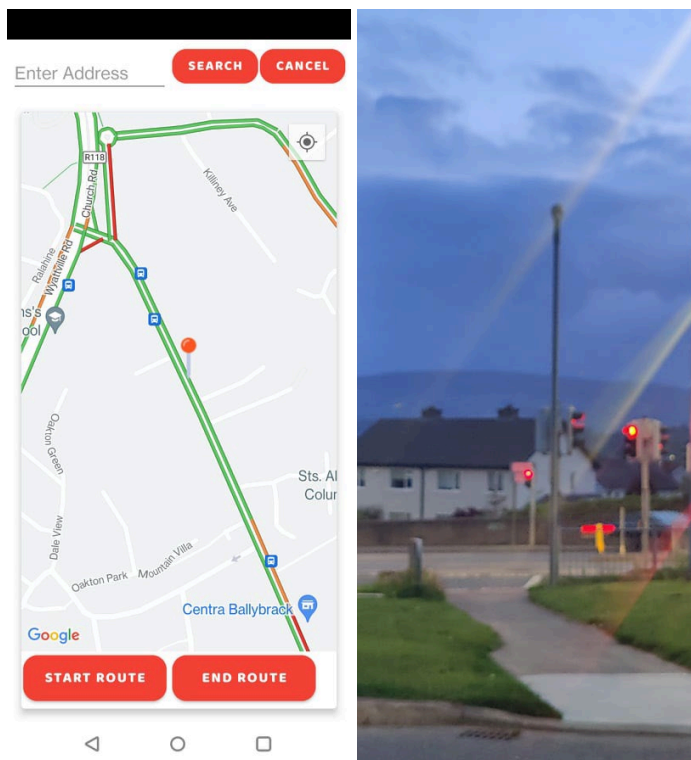


Thanks to the recording feature of Espresso I was able to run the application and log everything I was doing on the application and then use this information to create an app test.

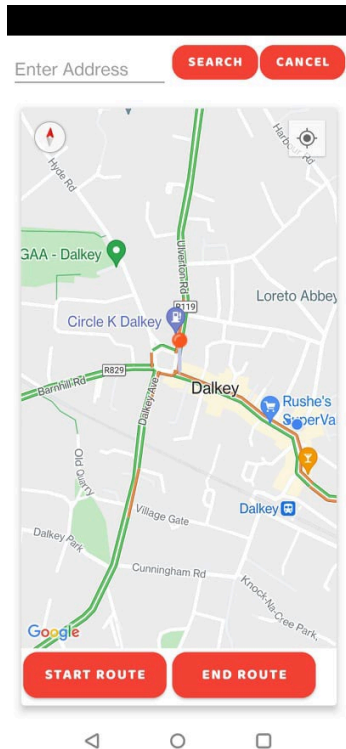
Practical Testing

After developing the app's main features and integrating the traffic camera locations and the traffic data on the map I went to some of the locations nearest to me to see if the traffic camera data was precise and also if the traffic conditions matched those being displayed on the map. The majority of the 292 traffic camera locations were far from my house and more towards the city centre of Dublin and on the northside. There were two locations nearest to me and while on my break from work I was able to visit these and aim to clarify if the locations are precise.

The first location which I went to is an area in south Dublin called Ballybrack. The location of the camera in this area is on a busy intersection of roads and is quite a busy area in general. You can see the camera location and a photograph of the actual camera in the location.



The second location I went to was in a town in south Dublin known as Dalkey. In the town there is a small intersection and on the map a camera location is displayed but when I proceeded to this location I searched for the actual camera, and I could not find one. This shows me that not all of the camera locations may be up to date as there might not be one in Dalkey altogether as it is generally a safe quiet town.




I do not have an actual photo of the camera location like the previous one as when I searched the area, I could not visibly see one unless it may be concealed.

Exit Survey

As part of a UI survey of the apps User Interface I decided to take advantage of the System Useability Scale or Sus. This scale used 10 questions with answers involving 5 choices on a scale of strongly disagree to strongly agree. I created a google forms user survey and got 5 respondents who looked at a demo of my application and then were asked to answer the survey questions I had proposed in a google forms survey.

1. I would use this app frequently.
2. I found this app difficult to use.
3. System was easy to use.
4. I might need help with this app.
5. I found the navigation easy to use.
6. I though this app was confusing at times.
7. I would imagine a non tech person could use this app.
8. I found the apps UI confusing.
9. I was confident using this app.
10. I needed practice before using this app.

https://docs.google.com/forms/d/e/1FAIpQLSeENT914Ikdia5lv7jGQksFd0_2hXb9RQyzTSLRDP7Jq43-hQ/viewform?usp=sf_link

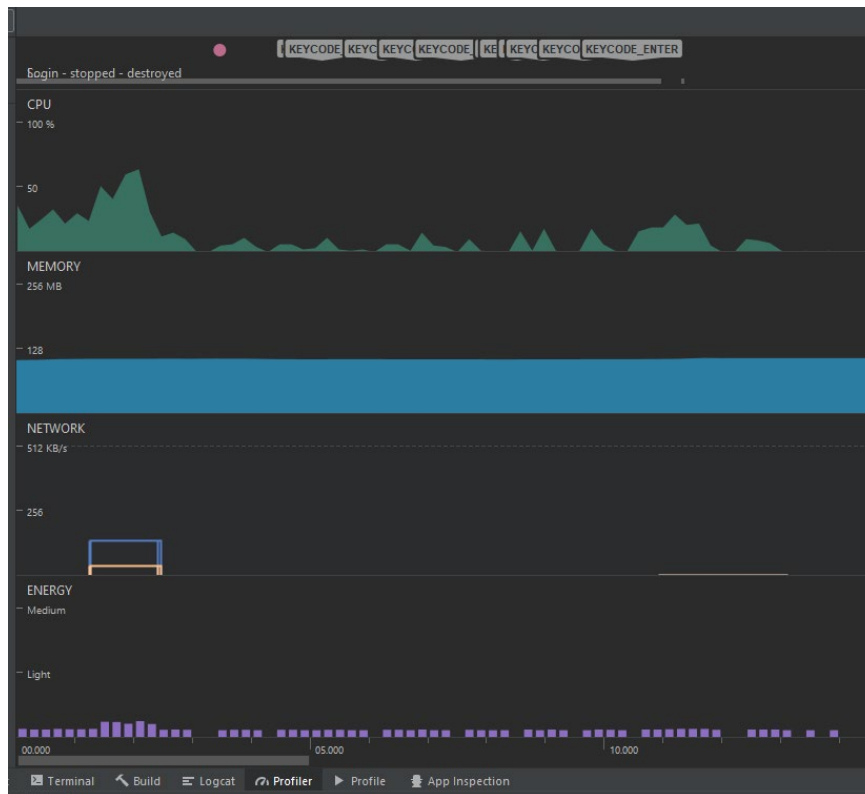


Question	1	2	3	4	5	6	7	8	9	10	SUS Score
User 1	5	1	5	2	5	2	4	1	4	2	87.5
User 2	4	1	4	1	5	1	4	1	4	2	87.5
User 3	5	1	5	2	4	2	5	1	5	2	90
User 4	5	2	4	1	5	2	4	1	5	2	87.5
User 5	4	1	4	1	5	1	5	1	5	1	95

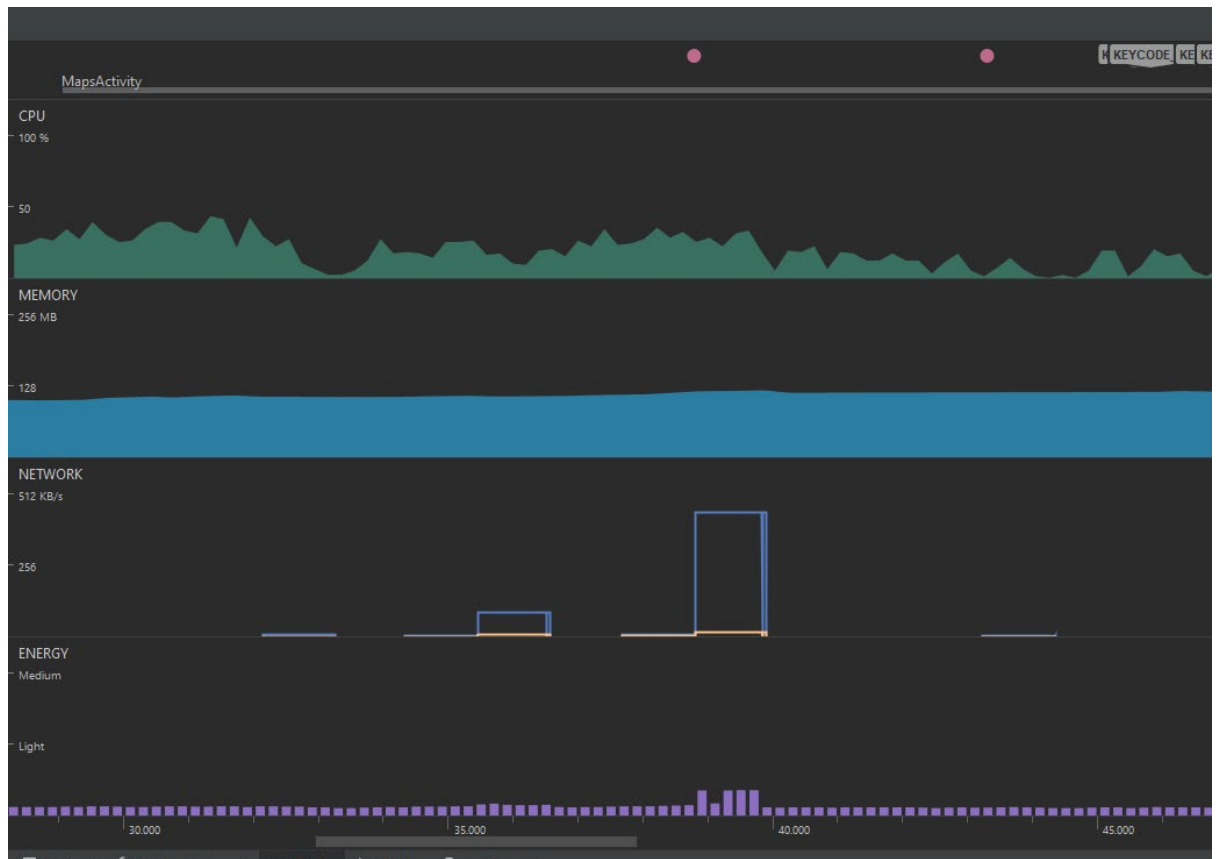
I got 5 responses to my questionnaire and the results can be seen in the table above. Of the 5 scores recorded, the average score is 89.5. On the Sus scale, the standard of which is acceptable is a value of 68 or higher. On the Sus scale an A rating is a value of 80.3 or over and as you can see this application has a higher value than that which means the user interface and user experience is good.

2.6. Evaluation

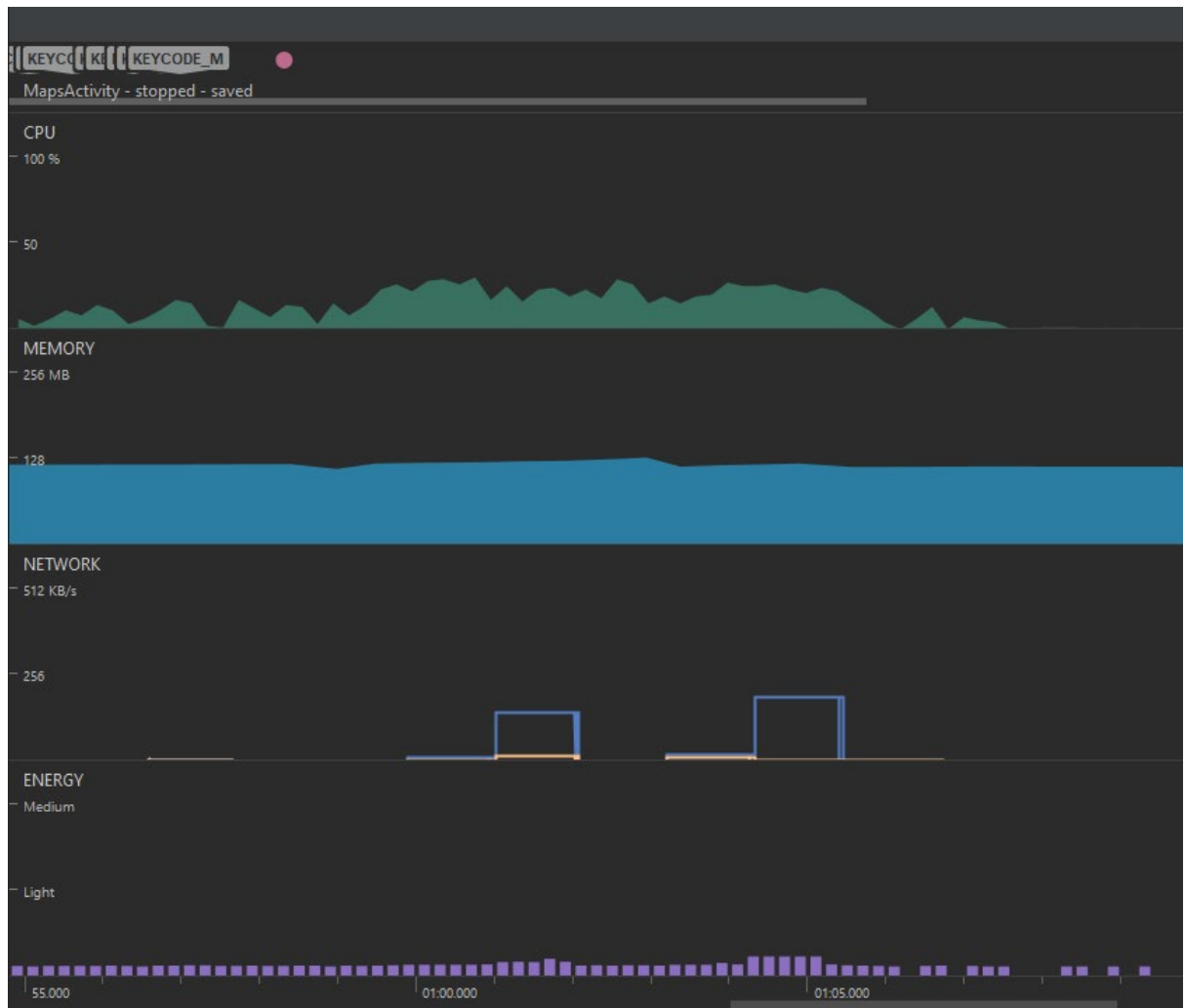
I decided to evaluate the applications actual performance when running on an emulator and to do this I took advantage of the Android profiler which is included in android studio for diagnostics evaluation. The whole goal of the profiler is to measure the usage of RAM, the CPU and network usage.



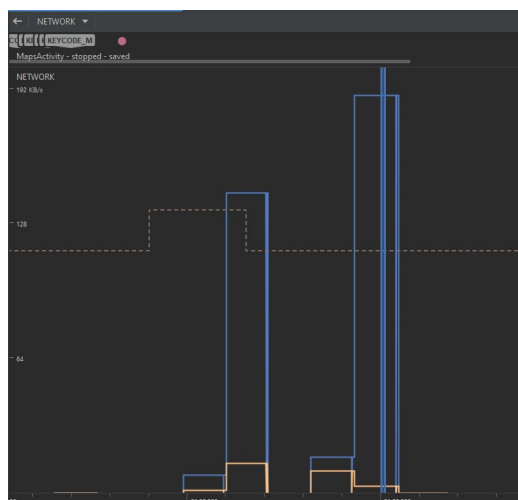
Here is a representation of data during the starting of the application and when I performed the login activity of the application. You will see the CPU levels going fairly high and they do reach about 64% which may actually be because of the application starting up and using a lot of memory. The RAM usage in this period is fairly even at 108MB usage which seems to be consistent for a while. The network usage equates to 38kb/s sent and 140kb/s received. The energy usage levels are quite low also.

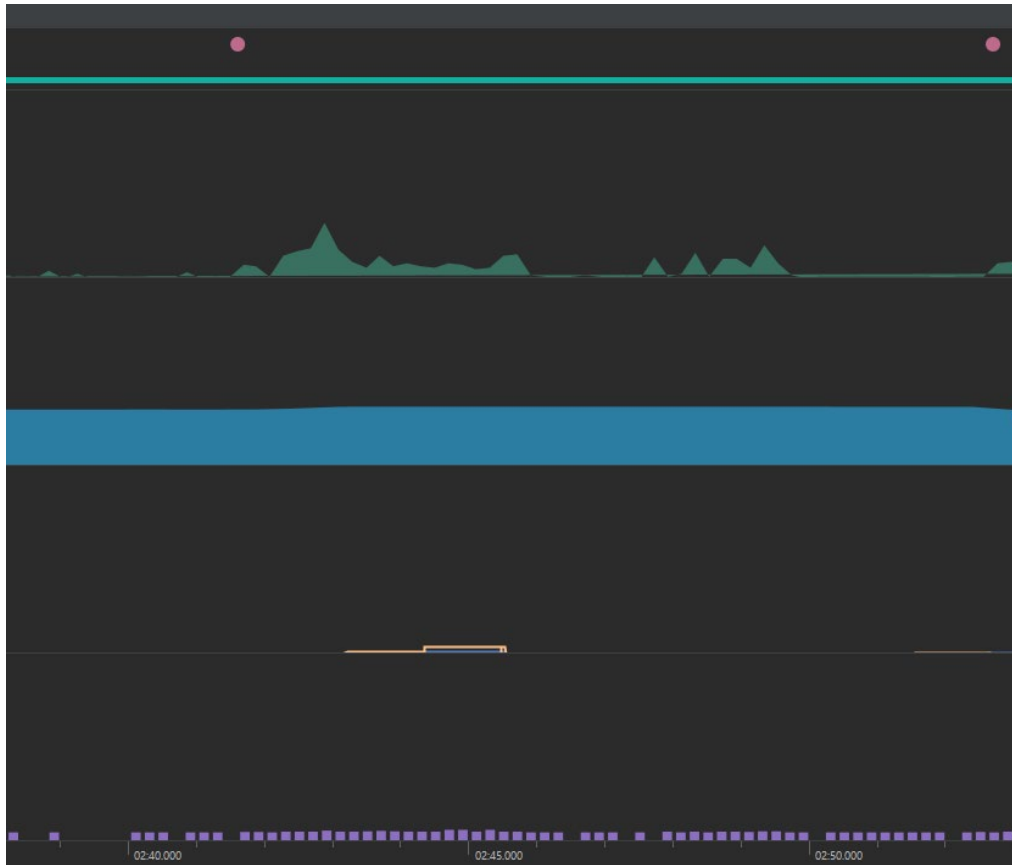


Here is a capture of the applications main function, the maps activity. The CPU level reaches a peak of 44% which is mainly due to the map being initialized and then after several seconds drops to the 20-30% value and then further drops to around the 10% mark. The RAM usage is slightly higher as it goes up to the 120mb value. There is a spike in network usage as you can see, and this would be when the user searches an address then the map is relocating the user to this address. 18kb/s is sent and then 450kb/s is received in the request. Again, the energy usage is quite low.



We are still on the maps activity here but this is when I initiate the audio recording function. You can notice the CPU and RAM usage does not really differ drastically but there is some usage of the network. You can see below the usage due to the user uploading the audio file to firebase.





Here is the upload image activity. CPU usage is quite low on the system as is RAM usage as its only using about 100m of RAM. The uploading of the image to firebase sends about 11kb/s of data and receives about 3kb/s back.

3.0 Conclusions

The concept of this application is a good one when discussed in terms of what we have seen take place when people have been walking home alone at night. When I developing this application my main inspiration was that of the Sarah Everard case in the UK in which the woman was abducted by a police man when travelling home and the only footage of the arrest just happened to be from a passing bus at the time, I always imagine if the bus in question had not been travelling at that time and if there was no record of the kidnap which is why I wanted to build this application to give someone maximum visibility. During my development of the application, another tragic incident occurred which was the murder of Aishling Murphy in Offaly in 2022.(bbc.com, May 2022)

The incident with another woman attacked for no reason shows that applications like this can be useful if not to stop the attack happening but to help in evidence gathering if an incident occurs. I always maintain a stance that while these kinds of apps are helpful, they should not need to be developed but unfortunately, we live in a bad world at times.

I don't like marketing this application only at women as I always said it was for vulnerable people and that can include men, women, and young adults/children.

My biggest drawback was not getting some of the main functionality working such as the routing. I spent so long focusing on getting it done and looking through tutorials and stackoverflow to get it working. I focused on this too much and had to leave it the way it was due to me running out of time and needing to focus on the documentation and other aspects of the project.

4.0 Further Development or Research

If I had some more time, I could definitely get the apps functions that I stated in earlier documentation working which would have been great. Unfortunately, with the other modules in the course which I found difficult and also balancing everything with my job I could not get everything done.

Obviously with a bit of backing this app could be a vital help to people commuting home and deter people from attacking other if they think that person may have this app installed so I do think it could be a major app in the community to deter senseless attacks like the cases of Aishling Murphy and Sarah Everard.

There are several applications available to help people feel safe but some only route near police stations and in Ireland nowadays police stations are far and few so I do think the traffic cameras are a good idea and with more time and resources this app would be big.

5.0 References

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6.0 Appendices

6.1. Project Proposal



National College of Ireland

Project Proposal

SafeRoute

7/11/2021

BSc. Computing

Software Development

2021/2022

Eoin McDonald

X18103880

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Contents

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7.0 Objectives

The goal of this project is to create an application to enable a user to plot a safe route home in a situation where a user may feel vulnerable to attack or interference.

I plan to build an application on android in which a user may login to an account and once logged in, they may plot a route home if walking alone at night. The application aims to aid the user by plotting a route according to how busy an area is in the sense that the busier an area and the more visibility by other individuals then the less prone to attack a person may be. As well as using google map data of busy areas, I would also like to route a user through areas where there is Garda traffic cameras where available so that in the events of attacks then there may be greater opportunities to track perpetrators. Information of the locations of Garda traffic cameras around the country is publicly available here:

<https://www.garda.ie/en/roads-policing/safety-camera-locations/>

Another aspect I hope to utilize with this app is that of using the user's camera and microphone to an advantage of potentially picking up background conversation/video footage to potentially help in the aid of investigation of attacks. I would propose that when the user has plotted a route and opts to begin the route then and only then will the user's microphone and camera record background content and following a successful uninterrupted journey would the recorded content be discarded but in the event of attack then the user could choose to save the content to be uploaded to a firebase database.

I would also potentially like for this app to listen for keywords and once the app picks up these keywords then the phone may dial out a certain number.

I would like to note that the users would have the choice to allow the application to access their microphone/camera in the case where somebody may not wish to have their data recorded.

In relation to any privacy invasion issues people may have with this idea, I would like to note that Facebook Messenger, an app many people use openly, collects information such as: Precise Location, Coarse Location, Physical Address, Email Address, Name, Phone Number, Other User Contact Info, Contacts, Photos or Videos, Gameplay Content, Other User Content, Search History, Browsing History, User ID, Device ID, Third-Party Advertising, Purchase History, Financial Info etc.....

8.0 Background

I had initially come up with this idea in the summer and highlighted it with a member of NCI staff, Lisa Murphy who was very enthusiastic about this idea but I was worried I could not be able to build this project and that there may be some issues with ethics and the recording of someone's voice/video footage on an application but it was after it was highlighted in the module that the final year project should be very challenging and therefore I decided to go with this idea as I feel it tackles a key issue. Another reason I decided to go with this idea was because one day in September I was watching a breakdown of what happened in the case of the Sarah Everard abduction and murder in the UK in early 2021. I watched how this woman was intercepted by the killer, Wayne Couzens and the only footage of the kidnapping was that from camera footage from a passing bus at the time that led to an arrest. Imagine a woman in that situation but instead being routed through a busy area and with potential background noises/conversation being recorded which may lead investigators into a greater detail of what happened in a situation like this and why it occurred maybe?

I would aim to build this application in Android Studio using Java or Kotlin. I would start with the user login and registration firstly and then once those features are set up and the UI is thought out, I could begin on working on the main functionality by integrating google maps and accessing the various API's which google provides for traffic conditions in an area. Then I would integrate Garda traffic camera locations as well as the recording functionality by allowing the app to prompt users for permission to access the camera and microphone.

9.0 State of the Art

There are three apps that exist that are similar to my idea. These applications seem to be all aimed at children in particular and involve the use of a connection to a parent device to monitor the child's journey.

The first app is RouteGuard/RouteGuardian which are two apps that allow a parent to link to their child's phone and the app will send check in data from the child's phone every so often to keep the parent up to date of their child's exact location.

See: <http://www.routeguard.co.uk/>

<https://play.google.com/store/apps/details?id=com.agilysis.routeguard2&hl=en&gl=US>

The second app is Sister. This application follows a similar idea to mine in the sense that it will route a woman through areas near police stations and allow a user to link their accounts to a friend's phone for GPS confirmation but it will not record the routes Audio/video and solely relies on routing near police stations which aren't as plentiful in Dublin so mine would focus more on routing someone in high traffic/visibility areas with potentially police traffic cameras and also recording background audio.

See: <https://play.google.com/store/apps/details?id=com.wavelt.sister>

The third app, bSafe - Never Walk Alone is probably the closest to my idea as it allows the recording of Audio and video in the background. This application does carry out most of the features I am proposing, however it will not route a person through busy/high visibility areas that also contain lots of CCTV.

See: <https://play.google.com/store/apps/details?id=com.bipper.app.bsaf>

10.0 Technical Approach

To identify requirements, I will firstly look at similar apps to mine and see what key features I can incorporate and then add features not found in these apps to make my application differ from the alternatives. I will gather information with surveys potentially using a mix of forms and social media. I may make use of the google forms tool to create these surveys with carefully tailored questions for my target audience, in this case my target audience would be woman aged 16 – 35 preferably but if its an issue with ethics when it comes to surveying underage individuals then I will alter this to 18 – 35 years age bracket. Another form of survey I would undertake also is the use of social media and in particular Instagram. I would use my Instagram stories to create polls for members of my following to vote on and leave feedback also via messenger.

I will potentially approach this project with an agile methodology in mind in the sense that I would try to get some basic functionality working at first to demo. I would mainly concentrate on UI/UX design before hand maybe using a design tool such as Figma to create mock-ups to visualise the application. Once this is completed then I would have a clear vision to how I will approach the actual development of the application and how to break down individual tasks. One tool that could be of use is Trello maybe to break down tasks and determine what is most important to be completed. The beauty of Trello is that I can plan milestones and date whatever tasks need to be completed by a certain time, so I do not fail to meet key deadlines. Trello is good in the sense that it can be integrated into Microsoft Teams as I had used it during my internship as my team would view this every morning to plan out the day.

11.0 Technical Details

The main tool used to develop this idea will be Android Studio as I feel it has a lot of supports for different libraries and such. I would code the application in Java as I am most comfortable with that language having learned it for several years now. Also, I would of course be using XML to implement the design of the application.

I would hope to use Google maps API to implement google maps into my application and also then access the various APIs to show traffic data in areas of the city and then display these high traffic areas over the map. After this I would access the Garda Traffic camera Data and use the various positioning data to add the different waypoints of the camera locations onto the google maps feature to help route the user where applicable.

Other considerations are that of accessing users' microphone and camera to record once the route is in progress and going further on the accessing of the microphone, I would potentially like to add a feature that may listen out for keywords from a user and thus then dialling out a specific number or potentially the emergency services.

12.0 Special Resources Required

I suppose the main special resources that may be needed would be the data from the Garda Traffic camera available publicly from their website. This would be the main resource.

Also, the use of Google maps and their API data for the various conditions involved in displaying the particular data on the maps.

Potentially, if I do go ahead with a feature that would listen out for keywords to dial out a number then I may need to use python or some machine learning/AI resources like OpenCV or something like that to use in Android Studio.

13.0 Project Plan

The ideal plan to begin with would be to first obviously propose my idea then once that is completed then I could start to begin designing the application itself and its functions in line with data gathered from surveys.

I would ideally pick which kinds of questions I would ask in a potential survey and get feedback on them before I decide to use in a survey. I would ideally like to have this step-in implementation by December as to gather as much data as early as possible. After this I would like to design my app around the data received and make it as user friendly as possible with a good user interface and good user experience. I would use Figma as a design tool to create mock-ups for my app as Figma is a great tool to design with and you can copy the XML code for implementation in Android Studio, so it provides an easier streamlined production experience. I would ideally like to have this completed by Late December/January so I can map out what functions need to be created in an order.

Once the Figma mock-ups are created and I have approval for my application, I would like to commence the main User interface implementation in Android Studio using Java and XML. I would try to get the splash screen, login page, user profile and the main page for creating a route created by January/February so that once completed I could work on the main functionality of the application which will be the hardest.

Once the main UI and basic functionality of the app is created then I could work on the functions I proposed which would be the Google maps and routing functionality as for now I am unsure how to do this so therefore I will need some time to study tutorials to figure out a way to build these features and I would aim to be doing this by February and continue working on this until March/April and then allow myself some time to test the application in a real world setting and also the obligatory presentations of the application in my second semester in April/May 2022.

14.0 Testing

Well obviously, I would go out in public and start plotting routes in certain areas of Dublin where I can and test the core functionality features of the application by going on walks myself and maybe creating a journal and logging my trips to write about the effectiveness of the application and verify that all of the functions in the application are working. I would also, in the case of the garda traffic camera routes, be making sure that when the app says I am near one that I am in fact travelling a route that is on the path of a traffic camera.

I also may or may not ask one of my friends to use the application as I have female friends that are very enthusiastic about my idea so therefore, I would let them install application on their device and allow them to use it when they can and then write about it potentially and give feedback on certain aspects of the applications design and performance.

14.1. Reflective Journals

Supervision & Reflection Template

Student Name	Eoin McDonald
Student Number	X18103880
Course	BSHC4SD – Computing (Software Development)

Month:

What?

Reflect on what has happened in your project this month?

This month I have come up with the idea for an application that I want to build for my final year project. I then made a video of my pitch and submitted it for assessment. I am still waiting feedback on whether my idea is allowed to be created for my project. I have also been assigned my project supervisor.

So What?

Consider what that meant for your project progress. What were your successes? What challenges still remain?

I am still awaiting approval of my idea so that is the biggest challenge for me now as I would like to know if I can or cannot build the app so I can prepare myself and my skills for building it or plan for contingencies for making another of the pre-defined projects set out in the modules Moodle page.

Now What?

What can you do to address outstanding challenges?

I cannot do much really but wait and see if my idea is approved or not and then go from there.

Student Signature	Eoin McDonald

Supervision & Reflection Template

Student Name	Eoin McDonald
Student Number	X18103880
Course	BSHC4SD

Month:

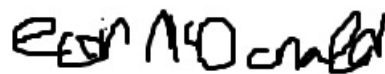
<p>What?</p> <p>Reflect on what has happened in your project this month?</p> <p>A meeting with my supervisor helped give me more clarity about my idea and it is getting approved made me able to plan accordingly how I may approach it. I have made a plan to build the demonstration with the 3 key features but have not implemented it yet as I have commitments with other modules first.</p>
<p>So What?</p> <p>Consider what that meant for your project progress. What were your successes? What challenges still remain?</p> <p>The fact I got the project approval from my supervisor helped give me more clarity and I was able to plan about what to do next and how I am going to implement the necessary technologies. The main challenges is balancing all of the other modules and trying to manage my time.</p>

Now What?

What can you do to address outstanding challenges?

I can begin to implement the demonstration next week for its due date on 21st December.

Student Signature

**Supervision & Reflection Template**

Student Name	Eoin McDonald
Student Number	X18103880
Course	Computing – BSHCSD4 – Software Development

Month:**What?**

Reflect on what has happened in your project this month?

This month I successfully completed my midpoint implementation and presentation. I developed a total of three features of my application to demonstrate to my supervisor. I implemented a Splash Screen with animation, A login and registration with firebase back end and then also a mock-up of a user profile. While doing this I also undertook the technical report to document the features and development of the application.

I also created a video presentation where I discussed my idea and demonstrated my app.

So What?

Consider what that meant for your project progress. What were your successes? What challenges still remain?

My successes were getting a start on the actual development of the application even though it was a basic implementation. It was a starting point for me. Considering I had projects and work for other modules I find it a success that I was able to implement the demo that I created given that I had to balance everything else and in such little time.

The challenges remaining are that of implementing the key features of my app which will require some research and looking up new technologies in order to implement and piece everything together and test functionality accordingly.

Now What?

What can you do to address outstanding challenges?

I can begin to list each of the features in order of appropriate implementation and thus work out a plan to implement one feature in different intervals with proper planning and sourcing new skills online in tutorials.

Student Signature



Supervision & Reflection Template - APRIL

Student Name	Eoin McDonald
Student Number	X18103880
Course	BSHC4SD

Month:

What?

Reflect on what has happened in your project this month?

I was able to get working on my project fully this month and commit all of my time to it after completing my other modules, I had a meeting with my supervisor and she helped me clarify a few things.

For now I have about 70% of my application completed but I have some issues with the core functionality of the app so I will discuss further with my supervisor.

So What?

Consider what that meant for your project progress. What were your successes? What challenges still remain?

My successes were getting back to working on the project and continuing on from where I stopped. I was able to get a good start on my apps core functionality.


The challenges that remain include getting my routing to work which I spent a week trying to figure out but to no avail so for now I am working around this and getting the other key functions of the app integrated so as to not waste too much time on the routing and having to worry about the other functions later.

Now What?

What can you do to address outstanding challenges?

I am currently working on other parts of my app so as to manage my time properly and not devote too much time to a problem I don't have a solution to just yet but hopefully I can crack the problem I am having.

Student Signature



Supervision & Reflection Template - MARCH

Student Name	Eoin McDonald
Student Number	X18103880
Course	BSHC4SD

Month:

What?

Reflect on what has happened in your project this month?

I found this month really hard as I had to focus all of my attention on Distributed Systems and Cloud application development with big projects in these modules and my job was very busy so I could not devote as much time as I would have liked to my project.

So What?

Consider what that meant for your project progress. What were your successes? What challenges still remain?

My progress wasn't great this month but working on the other areas helped me to clear a backlog of work and hopefully get back on track in April.

Now What?

What can you do to address outstanding challenges?

April is a good month as most of my work will be done so I can focus more on my project.

Student Signature

E. J. A. O. C. M. B.

Supervision & Reflection Template - FEBRUARY

Student Name	Eoin McDonald
Student Number	X18103880
Course	BSHC4SD

Month:**What?**

Reflect on what has happened in your project this month?

I mainly continued with researching my project and attending the seminars as I am finding it hard to balance all of my modules and I have not had a meeting with my supervisor for guidance.

So What?

Consider what that meant for your project progress. What were your successes? What challenges still remain?

My project progress is at a standstill at the moment and I have to focus on getting projects for other modules out of the way before I can continue with my project.

Now What?

What can you do to address outstanding challenges?

I can try to manage my time better and do one thing at a time and hopefully clear the backlog of work I have to do this semester.

Student Signature

Eoin McDonald

Supervision & Reflection Template – JANUARY

Student Name	Eoin McDonald
Student Number	X18103880
Course	BSHC4SD

Month:

What?

Reflect on what has happened in your project this month?

After doing the midpoint presentation and getting through all of my other modules, I could conduct research on what features I am going to be using and how to implement them into my project.

So What?

Consider what that meant for your project progress. What were your successes? What challenges still remain?

My successes were getting more of an insight of the main functionality of my project and how to implement them.

Obviously the challenges are combining all of these features together and balancing that with my other modules and my job.

Now What?

What can you do to address outstanding challenges?

I can try to balance my time better this semester and focus on important areas not just in this module but in my other modules too.

Student Signature



