Human Movement Project Overview

Background (Quoted from Client):
"Research from a wide range of studies indicate that engaging in regular physical activity (PA) has positive effects on health outcomes. Travel, particularly commuting, consumes a significant proportion of the daily activity in which people engage. Driving, in general, is the least physically demanding travel mode and contributes to modern sedentary lifestyles and the associated health problems. Using public transport, as well as walking and cycling, provides opportunities for individuals to increase their levels of PA on a regular basis.

The goal of this study was to test and evaluate the role of wearables (smartwatches) in combination with data collection instruments such as activity diary to gain an in-depth understanding of travel-related PA."

Problems (Quoted from Client):
"Smartwatches provide an accurate spatial and temporal account of daily activities (GPS tracks of the movements), as well as supplementary contextual data (e.g. heart rate, pace/speed, calories, temperature) not commonly collected in travel studies. Additional benefits refer to the use of devices that passively collect data, thus reducing the respondent burden, while shifting the load to the analysts who integrate and calibrate these data sources. Yet, the participant compliance is key, and most of the smartwatches require the user to activate a widget prior to undertaking the activity. There are also situations when the battery or indoor activities prevent collecting full data 24/7. This means that in most situation, some data is missing or is incomplete, and the analyst needs to integrate the data from other sources, such the diary. "

Problem Statements:
Full 24/7 data is hard to be obtained with current assets (smartwatches) because:
1. GPS tracks of the movements are not commonly collected by smartwatches during travel.
2. Smartwatches require user to activate a widget prior to undertaking an activity.
3. Smartwatches widget drains power too fast.
4. Due to the problems above, a lot of important data are not collected.

Project Description:
This project includes two software.
1. Tracker App runs in respondent's mobile phone to automatically collect and upload data for research use.
2. Tracker App will prompt for respondent's information and frequent places on first launch.
3. Tracker App will ask permission from respondent to collect location data automatically in background.
4. Tracker App comes with Activity Diary feature to allow respondent to write light activity diaries.
5. Tracker App will upload and delete data periodically.
6. Data Integrator runs in researcher's PC. Researchers download the data online from the cloud storage manually and use the Data Integrator to integrate and process data.

Value of the project:
1. With permission, Tracker App can get record respondent's GPS track 24/7, including traveling time.
2. Reduce respondent burden by have a Tracker App that run automatically in the background to collect respondent's location data.
3. Help reduce battery issue as smartwatches have much longer battery life than smartwatches.
4. Allow researcher to better understand respondent's mode of transport.
5. Allow researcher to gain respondent's travel-related PA via Tracker App's activity diary feature.
6. Help integrate Tracker App's data and smartwatch's data via Data Integrator software.

Resources:

- Human Resources: 5 person and 12 weeks.
- Software Resources: Flutter SDK, Dart language, Android Studio, XCode, Python library, SQL
- Coding Resources: LinkedIn Learning, YouTube, Udemy and other online sources.
- Project Management Resources: Lectures, Lecture Slides, Textbook, and other online sources.
- Hardware Assets: Each member has a smartwatch borrowed from client and a personal computer.

Project Risk:

1. Misunderstanding Project Requirement

Prevention: Good communication with Client. Ask when in-doubt. Never assume.

2. Incomplete Minimum Viable Product (MVP):

Prevention: Project planning. Set practical due dates. Stick to the due dates. Set margin of error for delays.

3. One of the group members leaves our group or the assigned task did not get completed on time.

Prevention: Organize our group work well and make sure everyone knows each other's task. If someone leaves team, another team member can take on that task. Setting earlier due date.

4. Risk of using new programming language that most group members are not familiar

Prevention: Fully consider everyone's ability and make good project planning.

Technology Chosen:
(Refer "Implementation and Justification" at https://github.com/Hanchooi/CITS5206-Human-Movement)

1. Android & Smart & React native & Flutter
There are varieties of different tools for us to build a mobile application. Including Android Studio, XCode, React native and flutter. We analyze the complexity and time consumption for each tool, we find out that we do not have enough time to develop a mobile application separately for Android and IOS devices. Although react native is also a solution for cross platform development. However, react native community provides limited support for problems and issues encountered within the development phase.

We decided to use Flutter as our development tool. The main reasons are:
1. It supports fast mobile app development.
2. It contains a rich set of customizable widgets to build interface.
3. It uses Dart language, like OO language we are familiar with.
4. Support multi-platform.
5. Easy to learn for team members without experience in App Development.
6. Most comfortable language and tools for team member with experience in App Development.

2. Data Integrator in PC: Python vs Java & R studio

In phase 2, the project is focusing on dealing with file processes, including data combination, data cleaning, data merging and providing GUI for researchers to further process. Therefore, we decide to choose a language good at those characters.

We decided to use Python as our second phase developing tool. The reasons are:
Fully considered our group members' programming skills, most group members are more familiar with Python.

3. Server:

We consider build a mobile application server for our project. It aims to collect data needed for this project, provide confidentiality and security for our users to protect their personal privacy. It also allows us to build dynamical processes for the data collected.

After researching, we find out it is overly complex to build a mobile application server based on Flutter. It might need to use other language or framework to build a mobile server. None of our team members have these kinds of skills. To minimize the risk of building a server, we decided to not build a server instead of an off-line mobile application.

4. Cloud Storage: Firebase Storage vs Email

Due to incapable to build a server. Team decide to generate data collected from mobile application by cloud storage or email. In Flutter, using email function require email package, and building email widget interface. It is more complex than connecting to a Firebase cloud storage. Also, Email does not allow the team to manage the data file directory, which may cause risk for later process.

Comparing to email, Firebase Storage is backed by google cloud storage. It allows for storing data files generated by mobile app users. Flutter is also made by Google. Therefore, it is quite easy to access the Firebase Storage using Flutter by import specific packages. Therefore, we decided to use Firebase Storage.

Stakeholders

1. Researcher (Product user)

Role: Project Client. Require tools to help collect more data with better quality and help integrate the data collected.

2. Research Respondent (Product user)

Role: Require tools to reduce burden on respondent to activate/deactivate widget and to write daily activity diaries.

3. App Test Volunteer

Role: Act as a research respondent help test the usability during development.

User Stories

1. As a researcher, I would like to know what the mode of transport is the survey participants use, so that I can look for the correlation of of fitness and usual mode of transport.

2. As a researcher, I would like to have as little missing data as possible so that I can do my research more accurately.

3. As a researcher, I would like to know what type of activities the respondent is doing so that I can include these factors into my research.

4. As a research respondent, I would like to have efficient interaction with the app as possible so that I can provide a maximum information with minimum effort.

5. As a research respondent, I would like to have good privacy policies and data management so that my data will be shared to the researcher securely.

Use Case Diagram
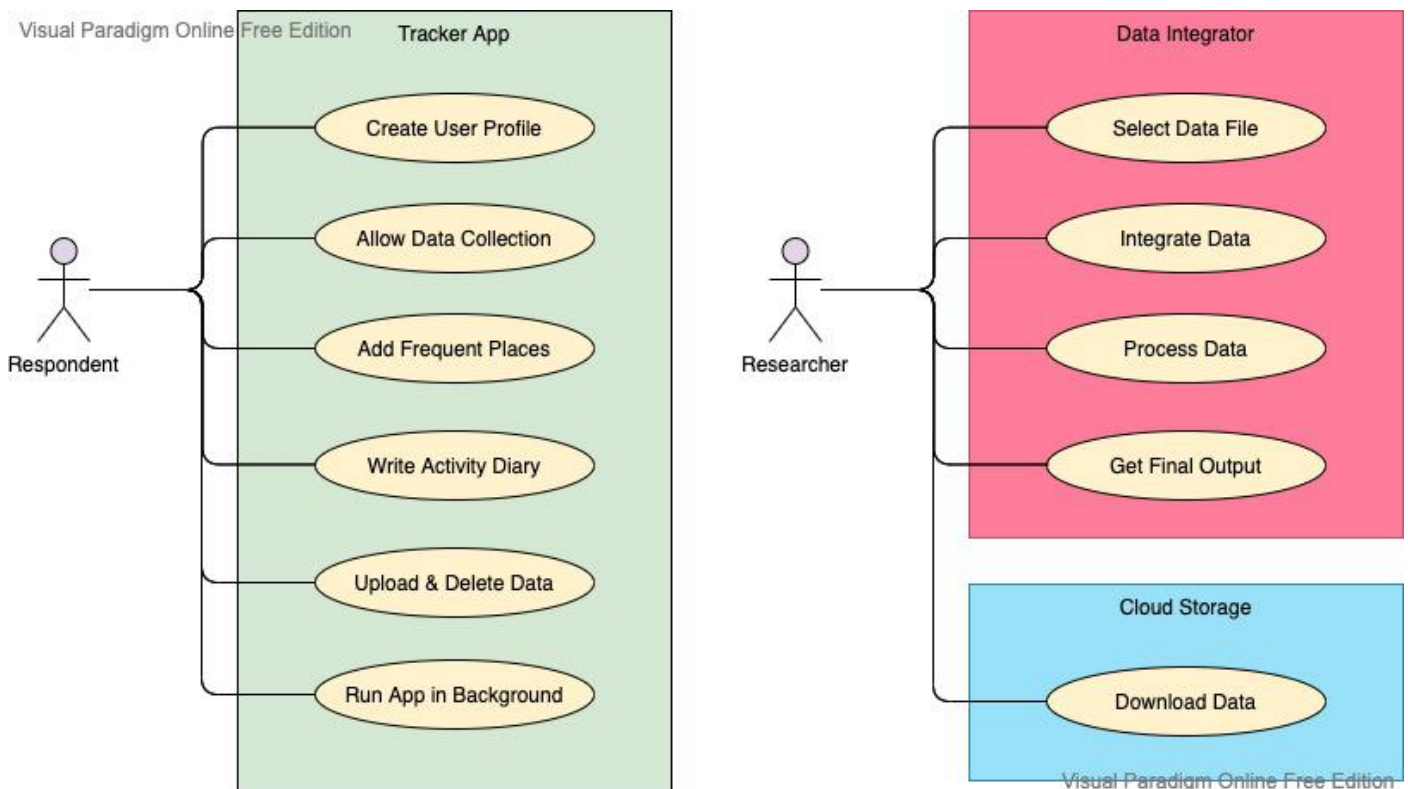
Use Cases

Use Case 1: Participate in Research - 1ˢᵗ Tracker App launch

Use Case for Research Respondent.

Flow of events:

1. The Respondent download the Tracker App via the link we provide.
2. The Respondent create profile by submitting their email address, name, gender, and Garmin account.
3. The Respondent agree to share data for research purpose, allowing the app to run in the background.
4. The Respondent complete a one-time survey form to label location he/she visited frequently.
5. The Respondent exit the Tracker App and let it to run in background.
6. The Tracker App will continue to record location data in background.
7. The Tracker App will delete and upload location data periodically in background.

Sequence Diagram for Use Case 1

Respondent

Tracker App

Cloud Storage

The Respondent open the App for the first time.

Open App

Show App and ask Respondent to fill up User Profile

The Respondent open User Profile.

Click "User Profile

Show User Profile Form

The Respondent fill up User Profile Form and press "Save".

Fill Up and Save Profile

Upload User Info

Show "Profile Saved"

The Respondent press "Home".

Press "Home"

Show Homepage and ask for permission to access location data

User press "Agree"

Prompt Respondent to go "Frequent Places" tab

The Respondent press "Frequent Places".

Respondent press "Frequent Place"

Prompt Respondent to add Frequent Places and details

The Respondent key in Frequent Places with various details

Fill up details and add Frequent Places

Upload Frequent Places and details

Show "Success" and return Home

Respondent close the App

App continue to run in background

App upload data daily

Use Case 2: Download, Integrate and Process Data
Use Case for Researcher.

Flow of events:

1. The Researcher download data from cloud storage.
2. The Researcher open Data Integrator
3. The Researcher choose data files/folder. (Smartwatch data and Tracker App's data)
4. The Researcher click "Integrate and Process Data".
5. The Researcher close the Data Integrator.

Key Functional Features

Phase 1:

1. MOBILE: The system shall allow respondents to Create User Profile.
2. MOBILE: The system shall record GPS trace in background with respondents' permission.
3. MOBILE: The system shall prompt respondents to add Visited Locations for a list of activities on first launch.
4. MOBILE: The system shall allow respondent to add more Visited Locations.
5. MOBILE: The system shall send data to researcher periodically in background.

Phase 2:

6. PC: The system shall label modes of transport between locations.
7. PC: The system shall label significant places and types of activities for these places.
8. PC: The system shall identify and log any anomalies in the data.
9. PC: The system shall integrate the above streams into a data set output.

Extra Features (Only if time allow)

1. MOBILE: The system shall prompt user to add Visited Locations when user visits new location for > 30 mins.
2. MOBILE: The system shall display a labeled map of activities for the respondents.
3. MOBILE: The system shall display summary information about respondents' activities.
4. MOBILE: The system shall allow respondent to sign-up and login.
5. MOBILE: The system shall allow researcher to get real time update from Tracker App.

(Refer "Implementation and Justification" at https://github.com/Hanchooi/CITS5206-Human-Movement)

Project Calendar

	Due Dates
Phase 1	31/08/2021
Phase 2	19/09/2021
Phase 3	17/10/2021

(Refer "Project Tasks and Timeline" at https://github.com/Hanchooi/CITS5206-Human-Movement)
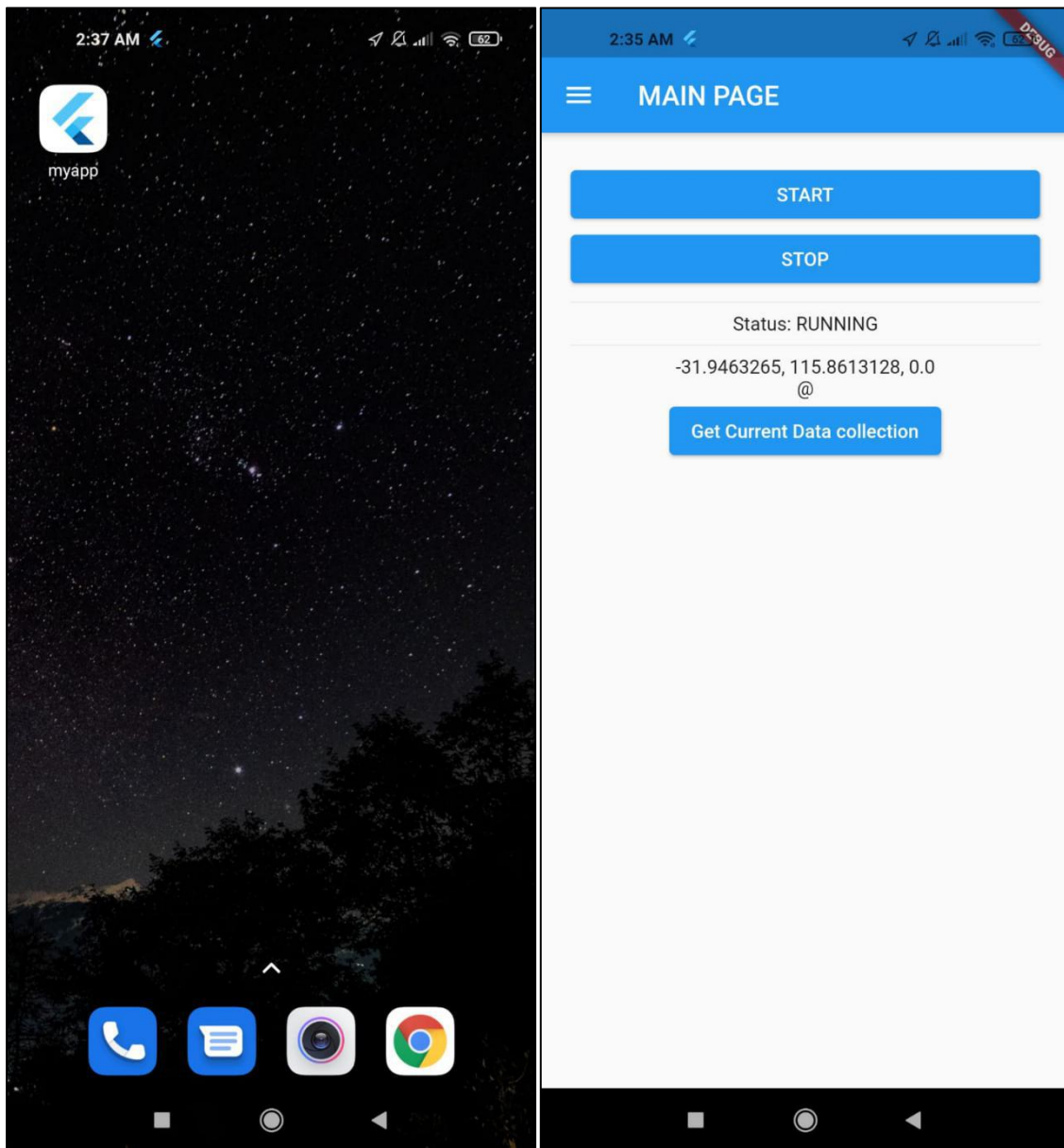
Tracker App
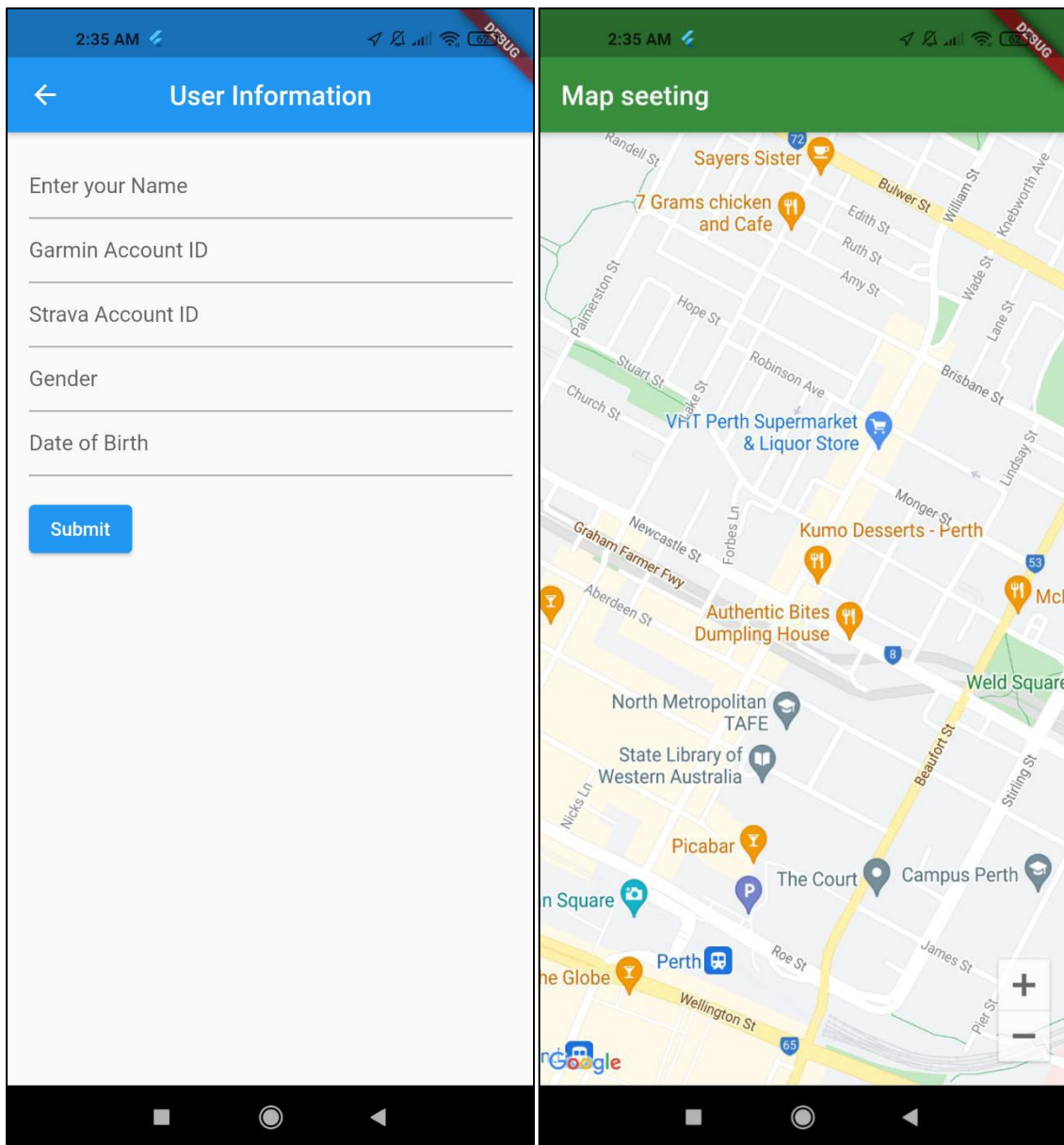
Tracker App
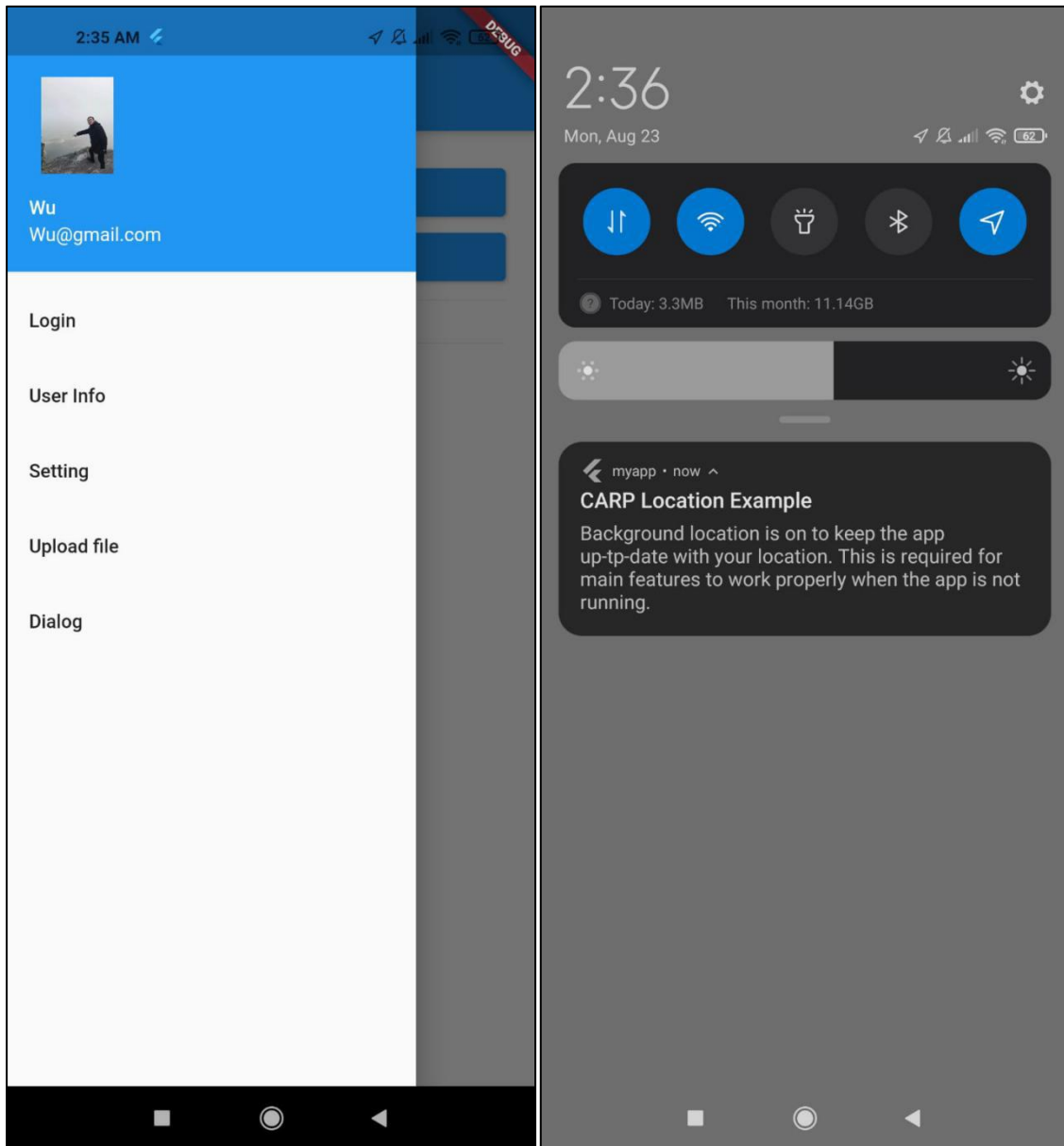
Tracker App

Tracker App - Activity Diary (Will be combined with "Visited Locations")

Activity Diary - Review Diary

Date :	14 / 08 / 2021

Activity 1   ✎
Time : 11:00 - 14:00
Activity Name :
Location Name :

Activity 2   ✎
Time : 15:00 - 16:00
Activity Name :
Location Name :

⊕ Add Activity 3

◄   OK   ►

Tracker App - Activity Diary (Will be combined with "Visited Locations")

Activity Diary - Write Diary

Date :   15 / 08 / 2021

⊕ Add Activity 1

No activities recorded for the day.

◀   OK   ▶

Date :   15 / 08 / 2021

Activity 1   🗑

Start Time   [   ]

End Time   [   ]

Enjoyment Rating   [1 - 10   ⬍]

Activity Name

[   ]

Activity Location

[🗺]

Location Name

[   ]

Mode of Transport

[   ]

Comment

[   ]

◀   OK   ▶

Tracker App - Activity Diary (Will be combined with "Visited Locations")

Activity Diary - Write Diary

Date :	15 / 08 / 2021

⊕ Add Activity 2

◀ [OK] ▶

Date :	15 / 08 / 2021

Activity 2 🗑

Start Time [   ]

End Time [   ]

Enjoyment Rating [1 - 10 ⬍]

Activity Name

[   ]

Activity Location

[🗺]

Location Name

[   ]

Mode of Transport

[   ]

Comment

[   ]

◀ [OK] ▶

Data Integrator Screen

Update Locations Name

| Select Location Name data files >>>>>> | Select |

| | Update Locations |

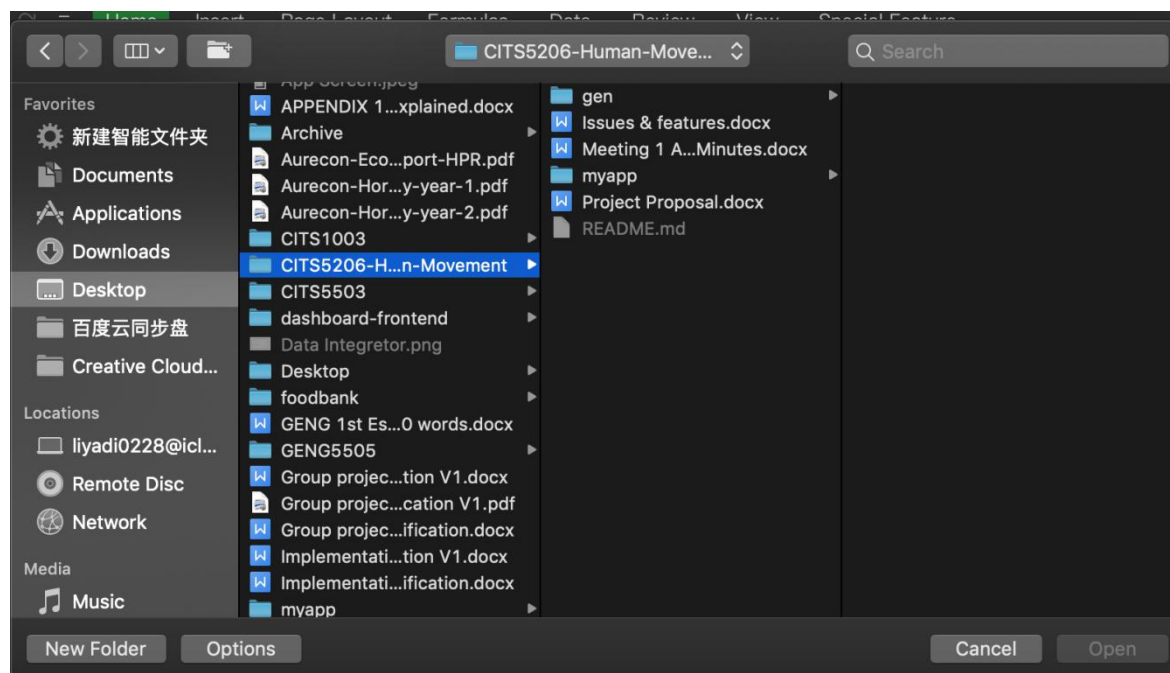Integrate and Process Data

| Select Tracker App data files >>>>>> | Select |

| Select Garmin data files >>>>>> | Select |

| | Integrate & Process |

"Select" leads to OS default file selection window (For example: IOS)

Data Output

User ID	Date	Time	Longitude	Latitude	Location	Activity

(Has more columns/fields. Refer "Data Format" at https://github.com/Hanchooi/CITS5206-Human-Movement)