Recycling Mobile Application

CENG411 - Software Engineering

Group Members

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Introduction

The recycling mobile application, developed by our group, is an application which makes recycling easier and aims to encourage individuals to recycle. The idea behind the mobile application is to connect the mobile device to recycling bins all over the individual's surrounding environment. The recycling bins would be designed with the required hardware; this would allow mobile devices to connect to recycling bins for special features that will be discussed further on in the report. To encourage recycling, the mobile application will implement a reward system.

To develop the mobile application, our group carried out the first 4 software development cycle stages, where we first planned out the software requirements, then secondly analyzed the software by creating the proper UML diagrams, then thirdly designed the interface, and lastly coded the software. Throughout this report, each stage is explained in more detail.

Impact of the Application

One of the objectives of this application is to encourage recycling, and although one should do good regardless of the reward (one of the application's features), we believe that the end result is more important in comparison; that end result is to increase recycling. Recycling is beneficial as it has an effect on the environment and community. For the environment, it reduces waste and pollution, while conserving natural resources. For the community, it creates jobs and saves energy.

Requirements

The functional and non-functional requirements for our mobile application are listed in the following table:

Functional	Non-Functional
Registration/Login User	Availability: 24/7
Show/Edit User Profile (personal information, recycling points, recycling history log)	*(LIMIT NOT INCLUDED IN IMPLEMENTATION)* Limit on daily points: 300 points ● 100 points added per recycle event ● Limit prevents abuse of point system
Display Recycling News/Information (home page)	Development Framework: Kivy
Display Recycling Locations on Map	Development Language: Python
Recycle using smart recycling bin [includes hardware]	Application Database: SQLite3
Redeem Recycling points	IDE: Any

In below tables each of the functional requirements specifications is mentioned. It should be noted that for the final implementation, not all of the specifications mentioned are implemented.

Function Name	User Registration/login
Description	In order to access the application, the user should log in their account or register if they do not have an account.
Inputs	● For log in: - username / Email. - password. ● For Registration - Enter Username. - Enter Password.

	- Re-enter Password
Source	A keyboard to enter the information
Outputs	● Logging in - The user will access their account. ● Registration - The user's information will be stored into the database.
Destination	Homepage. (the user will not be able to access the application unless they have a registered account and are logged in).
Action	Typing in the information needed whether it's logging in or registering
Requirements	● Logging in - The login in section allows the registered users to log in to the application to access all of the features that their account gives them access to. - If the user types their username and password and click submit the users credentials are validated and if the information typed in is correct they will be logged in - If the information typed in is incorrect an error message will pop up ● Registration - A new user types in all of the information needed and clicks on submit once it's validated to make sure that there is no existing user with the same information with the entered credentials. - If there is an existing user then the use will be asked to enter a new username - Usernames must consist of only alphabet letters and numbers; 3-15 characters allowed. - Passwords must consist of only alphabet letters and numbers; 6-20 characters allowed.
Pre-Condition	The user must be logged in to access the homepage. There is no Pre-condition for registration.
Post-Condition	The user will have the option to stay logged in to the account once they log in.

Side Effects	None.

Function Name	Show User Profile & Information
Description	The user is displayed a page of their profile information which includes: ● Username ● Points
Inputs	User information
Source	User registration & user recycling activity (refer to function “Recycle using Smart Recycling Bin”)
Outputs	User Profile & Information
Destination	User Profile & Information Page
Action	User clicks tab for User Profile & Information Page; user is then directed to that page; user can find all the information related to their account on that page.
Requirements	Logged In to account
Pre-Condition	None
Post-Condition	None
Side Effects	None

Function Name	Display Recycling Locations on Map
Description	The app has a function that offers nearby and overall places in the country for the user to visit in order to deposit the recycling items/things.
Inputs	1) Live location of the user 2) Previous saved location of the user
Source	Phone's built-in location.
Outputs	Nearby location of Recycling systems.

Destination	Main control loop.
Action	If the user has previously used the app, he or she has the choice of selecting the most recent location or selecting the current location from the phone's built-in location. The software displays the closest recycling system once the user selects a place, making it easier for them to drop off the recycling materials.
Requirements	To allow the app to access the live location of the user by the user.
Pre-Condition	
Post-Condition	Previous saved location gets updated with the current location.
Side Effects	None

Function Name	Recycle using Smart Recycling Bin
Description	A user drops recyclable items in a smart recycling bin, which is connected to the application.
Inputs	Recyclable Item
Source	Physical user action
Outputs	● Adds points to user stats ● Adds recycling event to user recycling history log. ● Adds recycled item/items to user recycling history log (more difficult to implement for this course, as it requires AI to identify what item or material was recycled).
Destination	User account database
Action	A user recycles while opening a connection similar to bluetooth with the smart recycling bin. When the user recycles, while being connected to the smart recycle bin, the recycle bin will first sense the object being inserted using a sensor; then it will add the event to the user’s recycling history log, along with the item recycled (if we managed to implement that feature); the user closes the connection; then the application will add points to the user’s account. ● There are flaws with this system as 2 users could be recycling at the same location and at the same time and

	that may cause complications, but this will be our model for the beginning version.
Requirements	A recyclable item & a connection between the smart recycling bin and the user's device.
Pre-Condition	● For the smart recycling bin to add the event & recycled item to recycling history log, there is NO pre-condition. ● For the smart recycling bin to add points, the daily points limit should not be exceeded.
Post-Condition	100 points added to user account
Side Effects	Not sure.

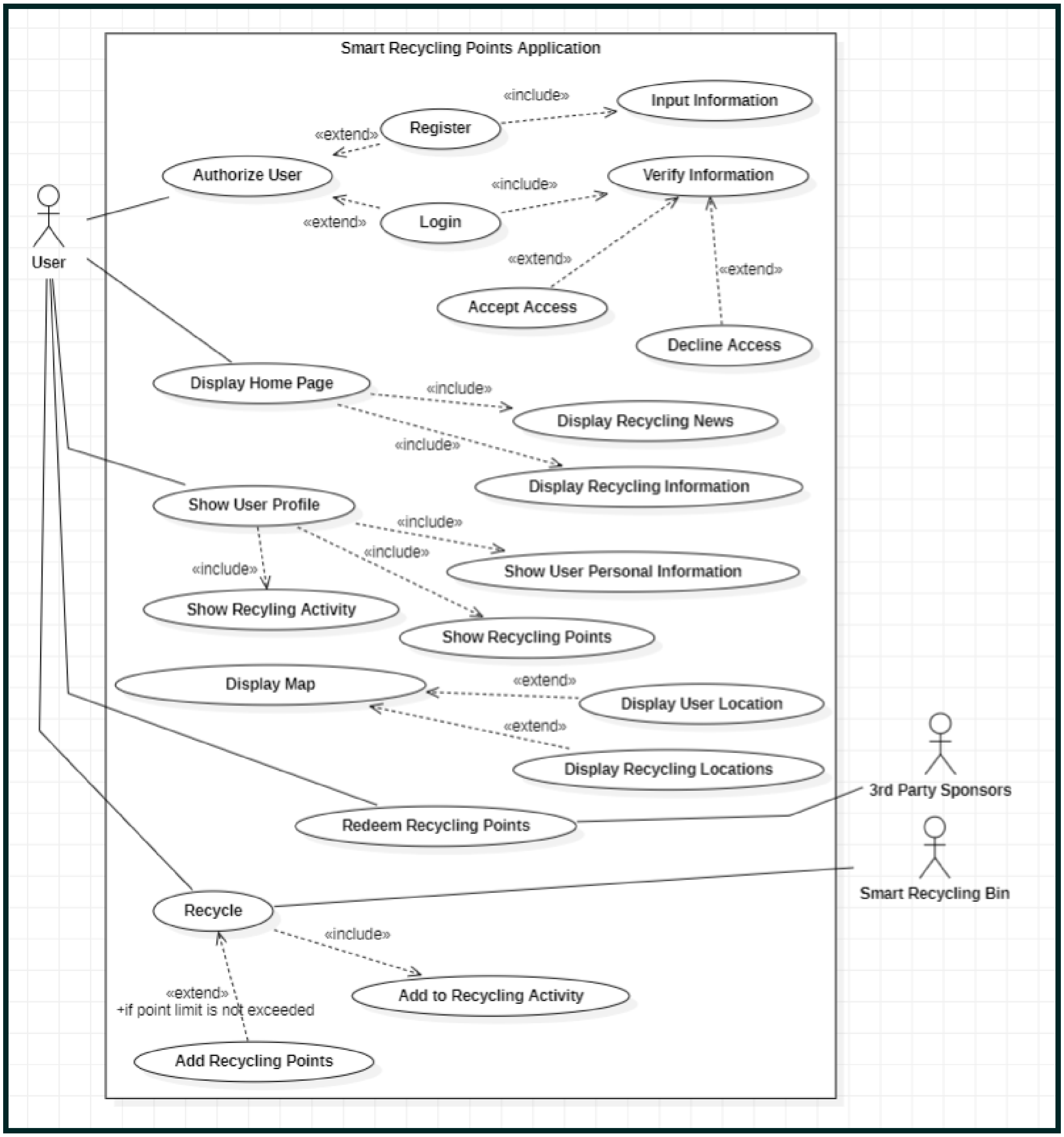
Function Name	Redeem Recycling Points
Description	Redeem user account points on rewards.
Inputs	User account points
Source	User account
Outputs	User rewards
Destination	Many possibilities which depend on the type of reward.
Action	User chooses an unlocked reward (based on how many points the user has); the user receives the reward.
Requirements	User authentication & verification of reward request
Pre-Condition	To redeem a certain reward, you must have the amount of points required.
Post-Condition	Reduction of points in account depending on how many points were used.
Side Effects	Not sure.

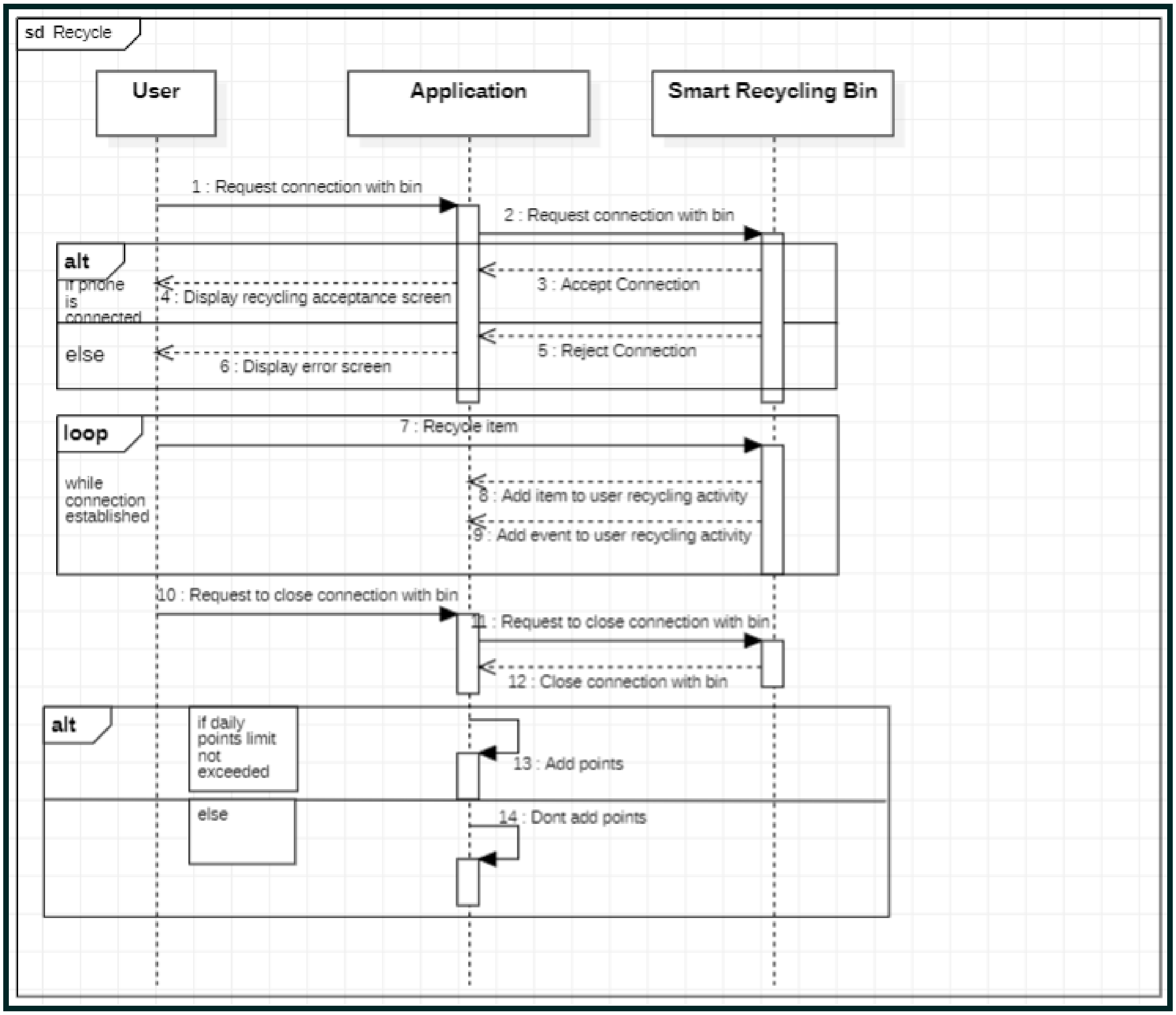
Function Name	Display recycling news/information homepage
Description	Shows the latest news, technology and other information on

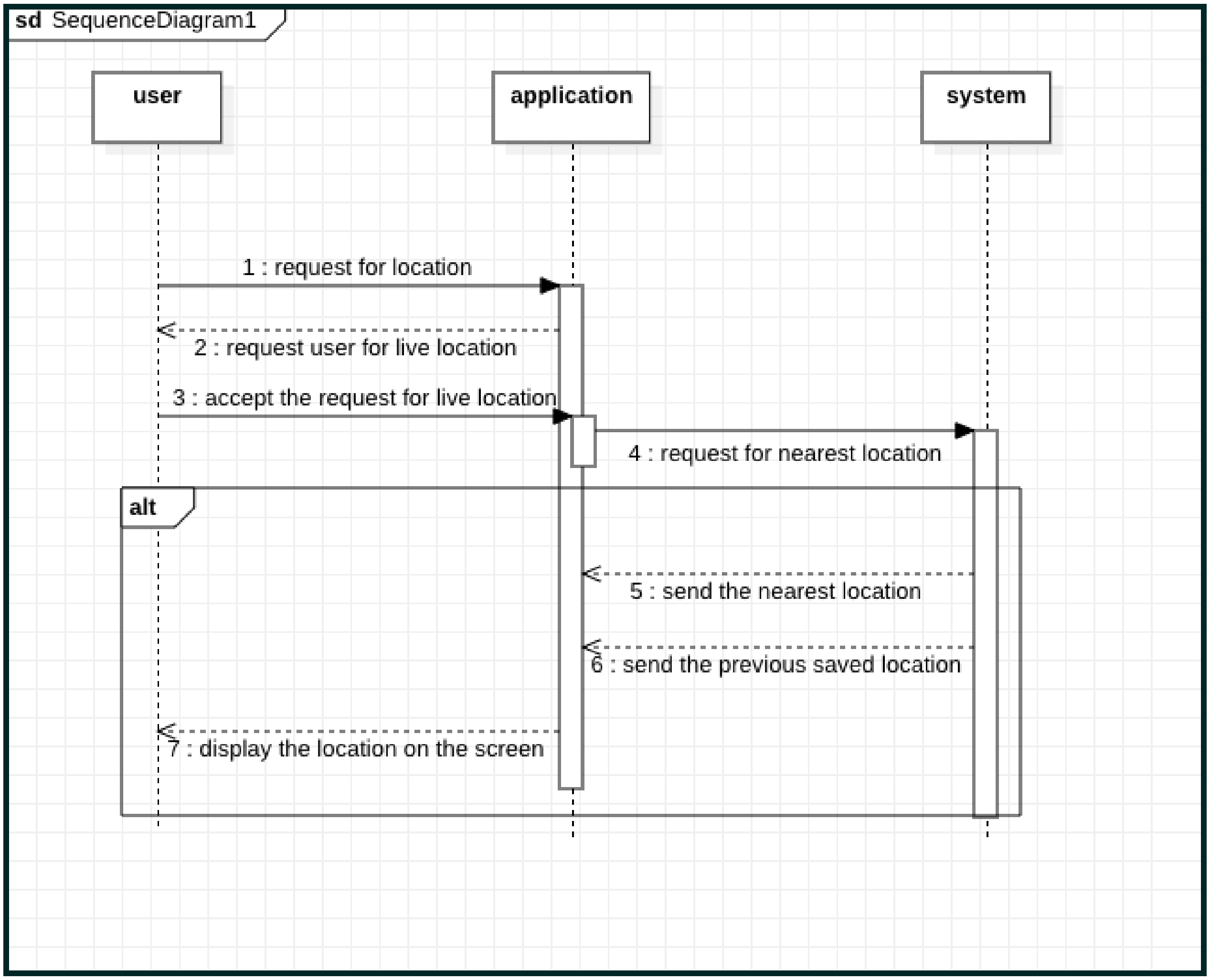
	recycling, the environment and climate change.
Inputs	Environment news from around the world.
Source	Websites, blogs, research papers, media streaming platforms.
Outputs	News and information in the form of text.
Destination	Homepage
Action	Environmental news and other facts are curated and added to a list where the user can choose to view. The user is shown a link to news sources for further information.
Requirements	User login
Pre-Condition	User is at the homepage
Post-Condition	User returns to the homepage
Side Effects	None

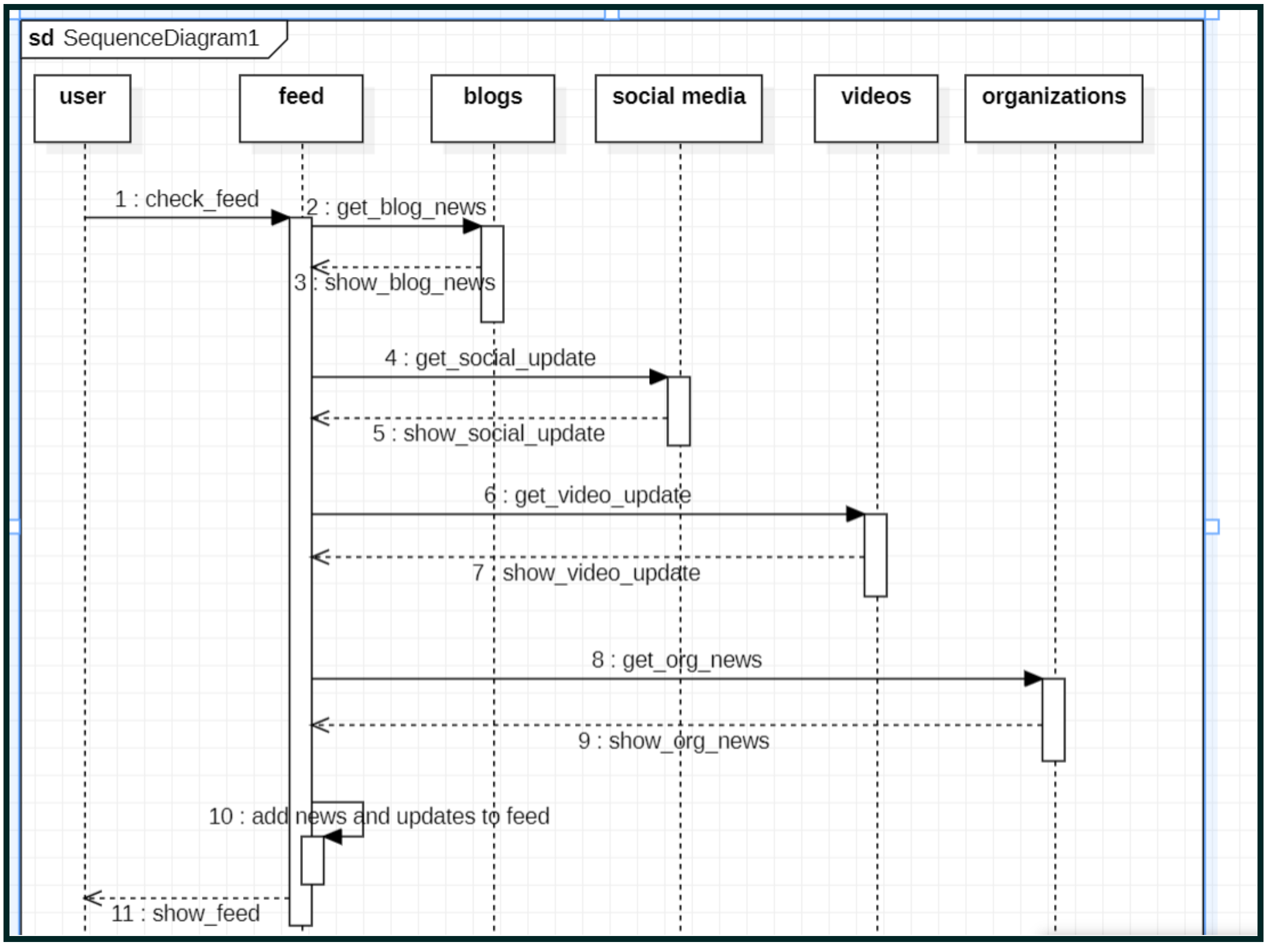
Analysis

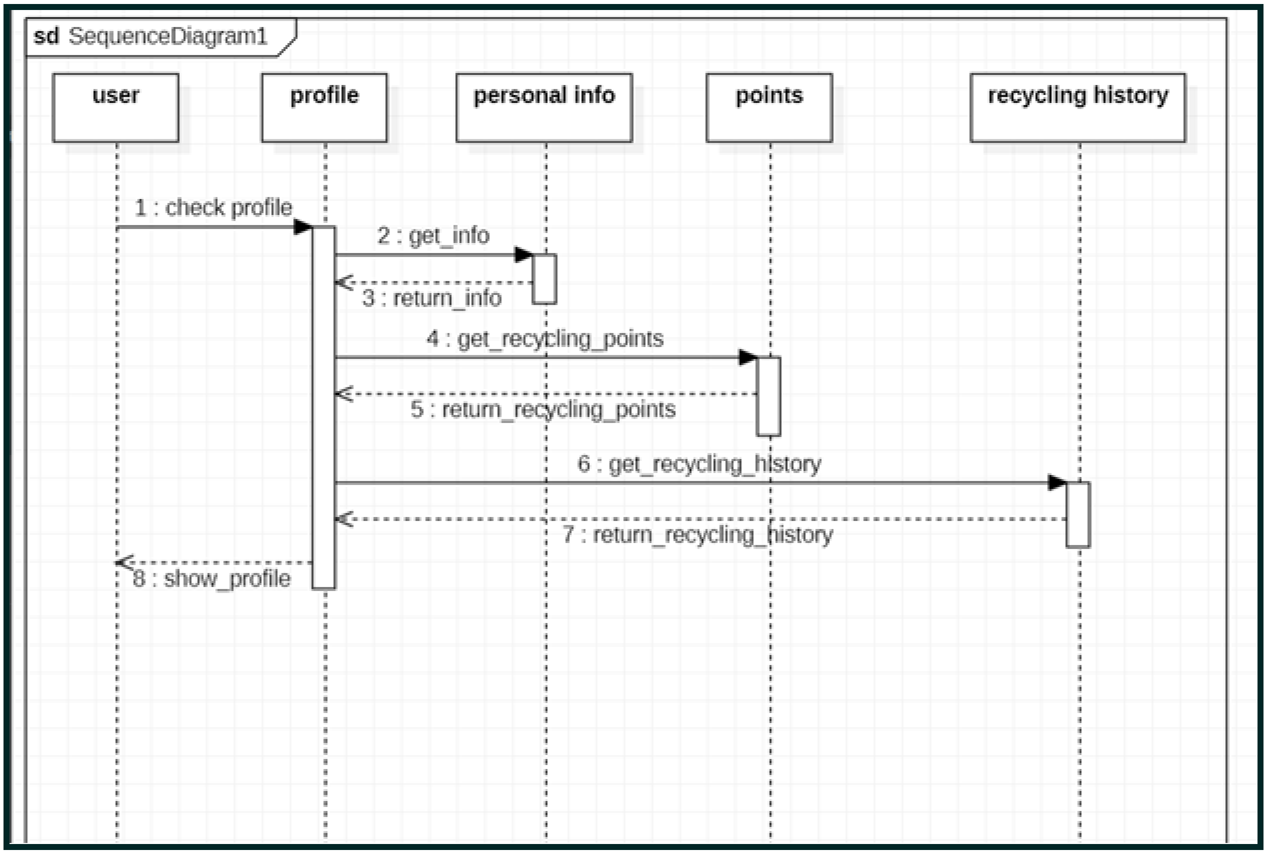
For this section, all the UML diagrams, used to analyze our mobile application, will be provided:

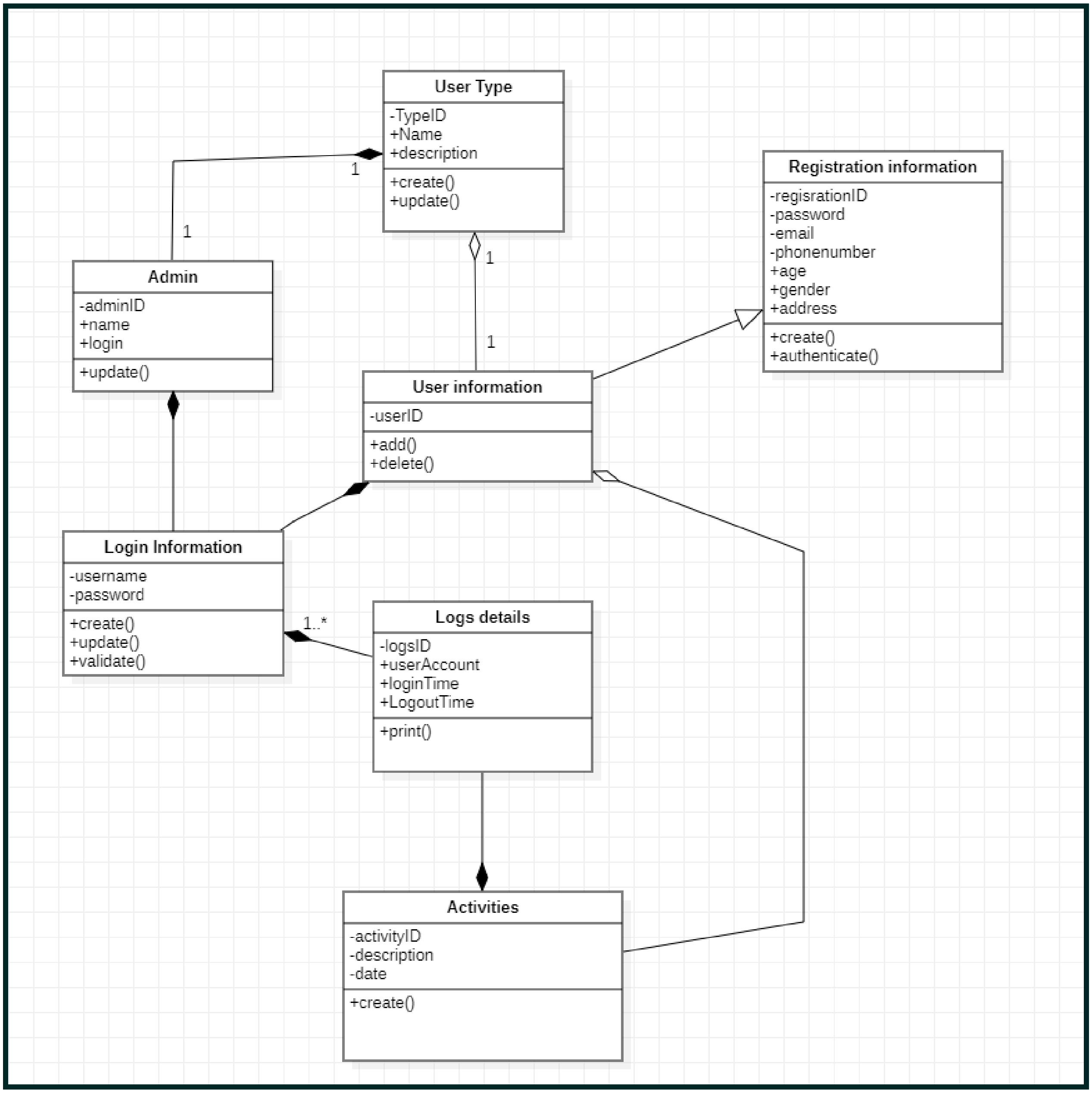



sd Recycle
User
Application
Smart Recycling Bin
1 : Request connection with bin
2 : Request connection with bin
alt
if phone is connected
3 : Accept Connection
4 : Display recycling acceptance screen
else
5 : Reject Connection
6 : Display error screen
loop
while connection established
7 : Recycle item
8 : Add item to user recycling activity
9 : Add event to user recycling activity
10 : Request to close connection with bin
11 : Request to close connection with bin
12 : Close connection with bin
alt
if daily points limit not exceeded
13 : Add points
else
14 : Dont add points


sd SequenceDiagram1
user
application
system
1 : request for location
2 : request user for live location
3 : accept the request for live location
4 : request for nearest location
alt
5 : send the nearest location
6 : send the previous saved location
7 : display the location on the screen


sd SequenceDiagram1
user
feed
blogs
social media
videos
organizations
1 : check_feed
2 : get_blog_news
3 : show_blog_news
4 : get_social_update
5 : show_social_update
6 : get_video_update
7 : show_video_update
8 : get_org_news
9 : show_org_news
10 : add news and updates to feed
11 : show_feed


sd SequenceDiagram1
user
profile
personal info
points
recycling history
1 : check profile
2 : get_info
3 : return_info
4 : get_recycling_points
5 : return_recycling_points
6 : get_recycling_history
7 : return_recycling_history
8 : show_profile


User Type
-TypeID
+Name
+description
+create()
+update()
Registration information
-regisrationID
-password
-email
-phonenumber
+age
+gender
+address
+create()
+authenticate()
Admin
-adminID
+name
+login
+update()
User information
-userID
+add()
+delete()
Login Information
-username
-password
+create()
+update()
+validate()
Logs details
-logsID
+userAccount
+loginTime
+LogoutTime
+print()
Activities
-activityID
-description
-date
+create()
1
1
1
1
1..*

Design

Technical Choices

The mobile application was developed using Kivy, an open source cross-platform GUI development framework which uses the Python programming language. We chose Kivy due to its simple installation, syntax, and wide community support, which made looking for answers much more easier.

For the database connected to our application, we went with the simplest option: SQLite. SQLite comes packaged with Python, therefore, there was no complex process of installing and connecting to the database.

In terms of the integrated development environment (IDE), it was up to personal preference of our group members, as the Kivy framework can be used on, probably, any IDE. Some of the IDEs used were: Visual Studio Code, PyCharm, and Sublime.

Database Design

The database required for our mobile application is very simple, including only 3 data values: username, password, and points. The 'username' and 'password' values are of type 'TEXT', while the 'points' value is of type 'INTEGER'. SQLite, also, automatically creates an 'id' data value, so that means the database has 4 data values instead of just 3 data values. The following example illustrates the database in use:

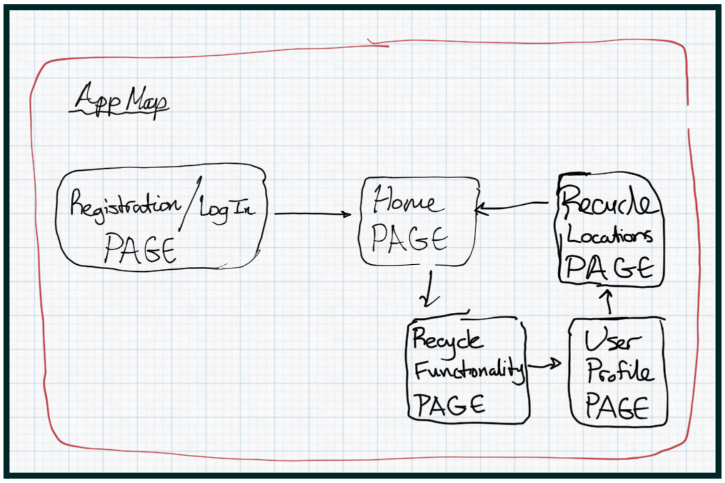
id	username (TEXT)	password (TEXT)	points (INTEGER)
1	idris2435	password1	5000
2	sai560	password2	4900
3	ibrahim2929	password3	5100
4	abduljaleel1432	password4	5600
5	mounta7458	password5	3800

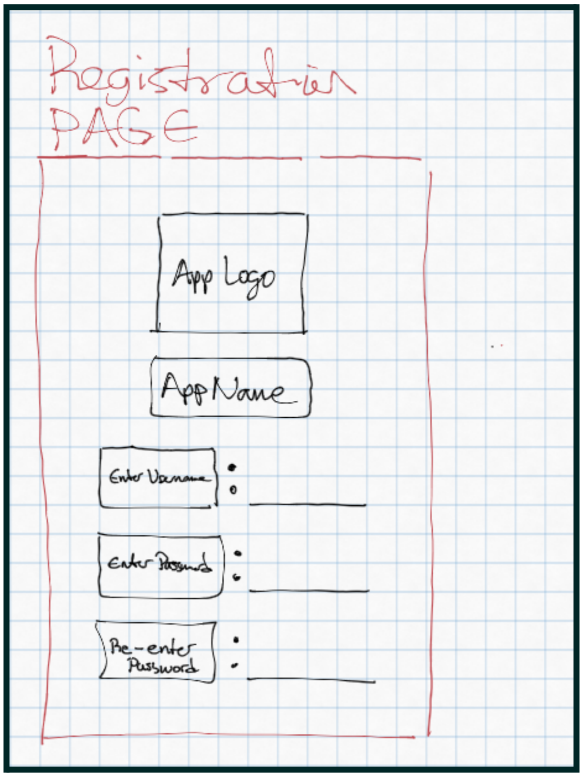
Graphical User Interface (GUI) Design

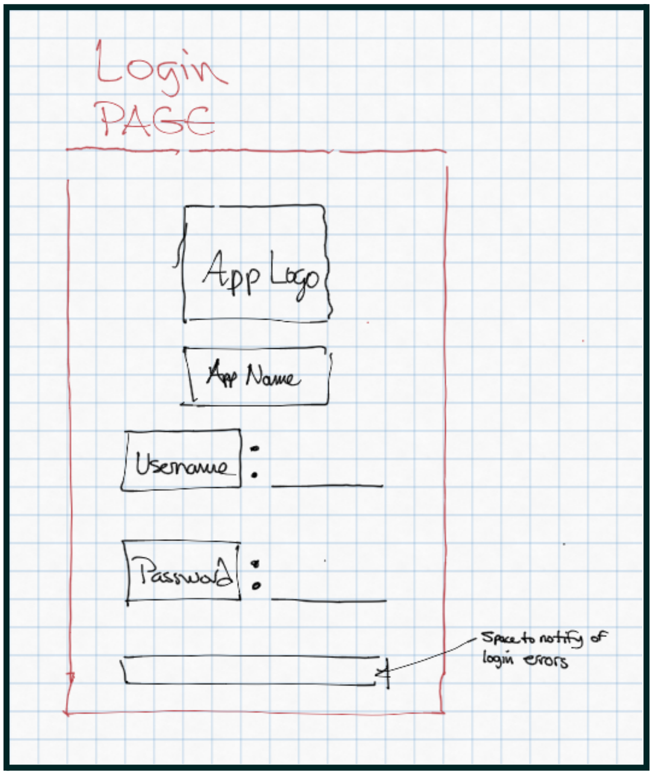
For the color scheme used in our application, we saw that it was fitting to have a green color scheme as it went with the recycling theme of our mobile application; we used the following colors:

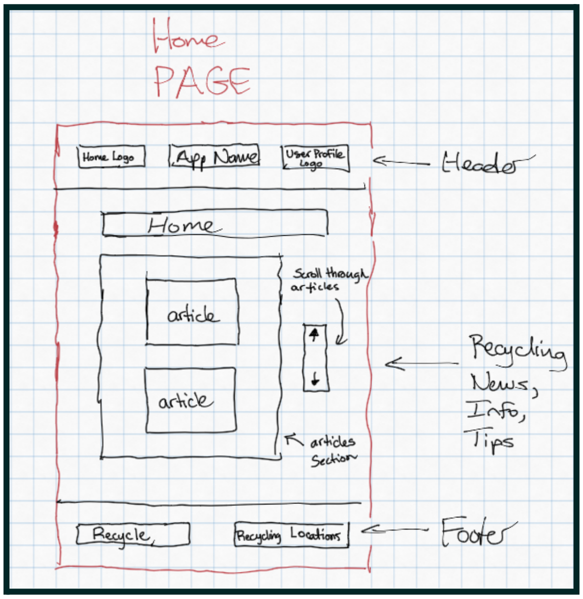
Color Name	RGB Value	Color
Jade	42, 170, 138	🟩
Dark Jungle Green	0, 38, 38	⬛
White	255, 255, 255	⬜
Roman Silver	139, 148, 163	▨

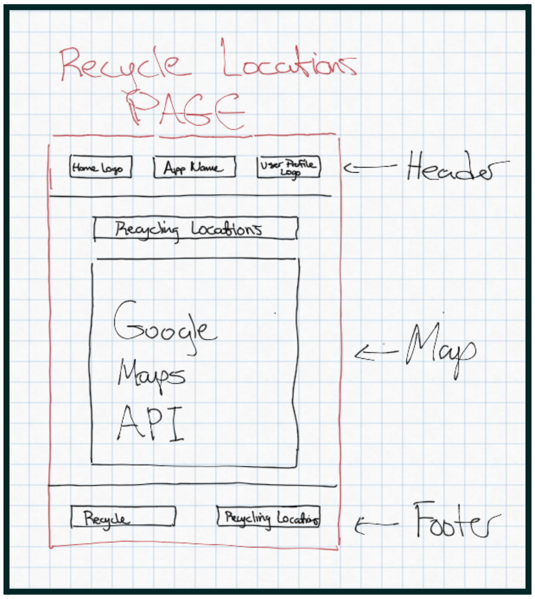
Our process for the GUI design wasn't stable; this was mainly due to the framework we used. Because we were new to the framework, we were only able to use what we learned from the resources we gathered up in the time period we had. As a result, we had to change our initial design plan to fit the framework knowledge we gathered. The following illustrations are of our initial GUI design plan:

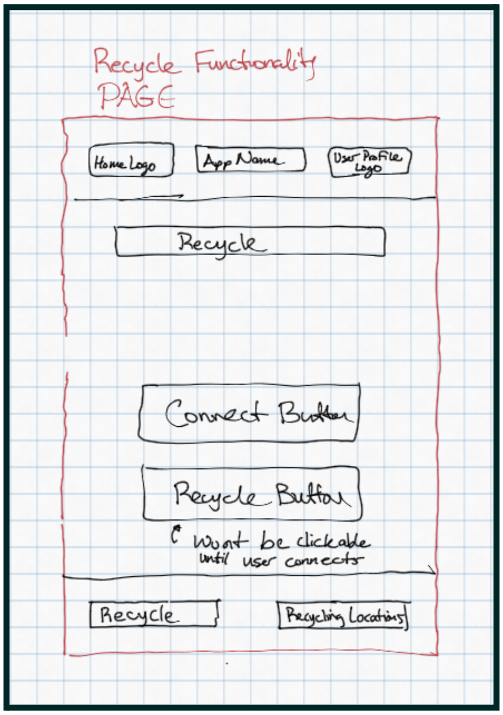


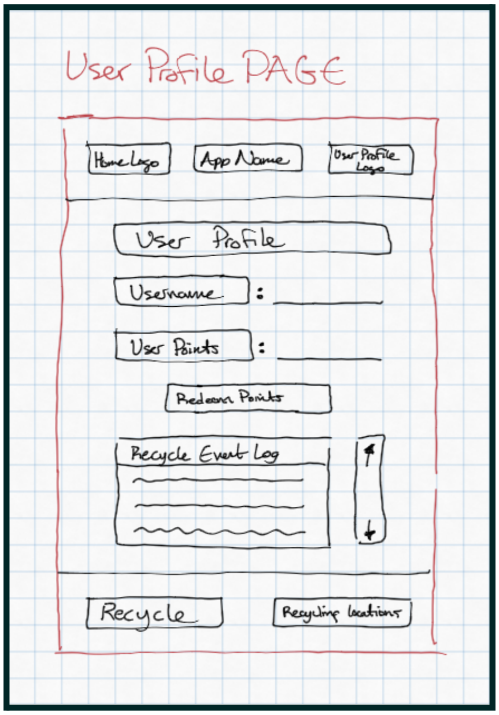

Registration PAGE
App Logo
App Name
Enter Username :
Enter Password :
Re-enter Password :


Login PAGE
App Logo
App Name
Username :
Password :
Space to notify of login errors

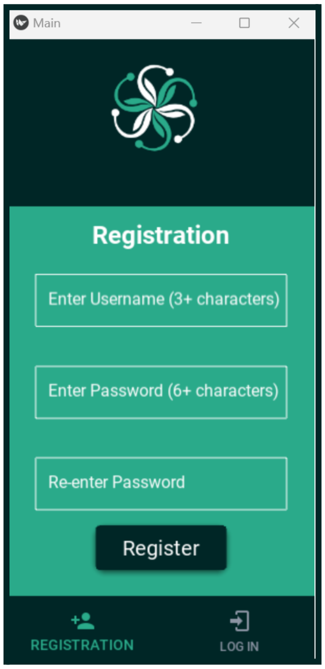

Home PAGE
Home Logo
App Name
User Profile Logo
Header
Home
article
article
Scroll through articles
articles Section
Recycling News, Info, Tips
Recycle
Recycling Locations
Footer

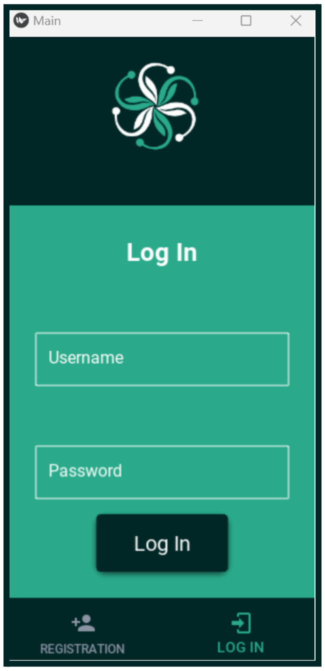

Recycle Locations PAGE
Home Logo
App Name
User Profile Logo
Header
Recycling Locations
Google Maps API
Map
Recycle
Recycling Locations
Footer

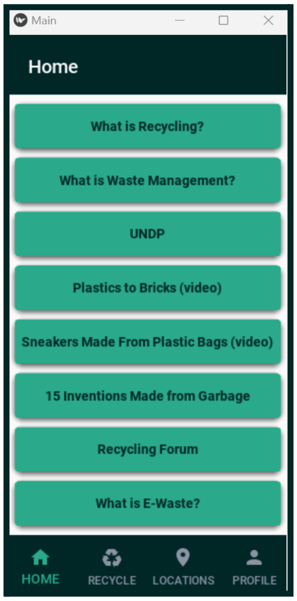


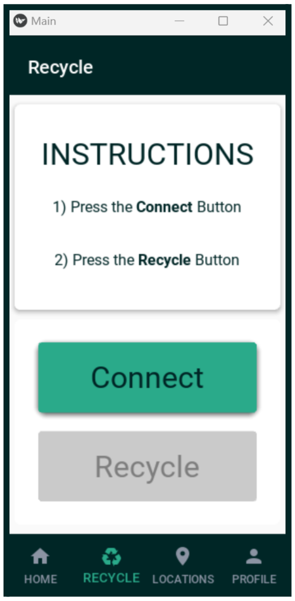


During the process of developing the application, however, we were forced to modify/remove certain elements of our initial GUI design. As explained before, this was dictated by the framework we used, as it made implementing certain features and visuals much more simpler than others. We also used a Canva template for our application logo, with the colors modified, to match our theme. The 6 pages are distributed into 2 main screens: registration and login pages in one screen, the others in the other screen. Navigating between pages in a screen is done through the bottom navigation, while navigating between screens was done through more complex code logic. Our final GUI design can be illustrated by the following:


Main
Registration
Enter Username (3+ characters)
Enter Password (6+ characters)
Re-enter Password
Register
REGISTRATION
LOG IN



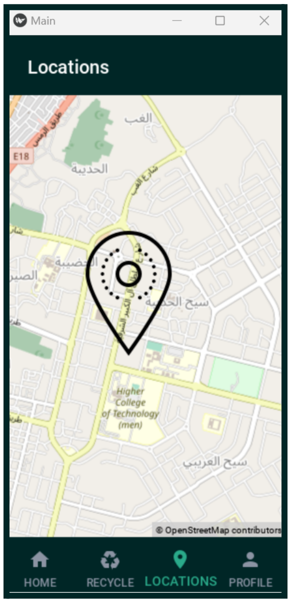

Main
Home
What is Recycling?
What is Waste Management?
UNDP
Plastics to Bricks (video)
Sneakers Made From Plastic Bags (video)
15 Inventions Made from Garbage
Recycling Forum
What is E-Waste?
HOME
RECYCLE
LOCATIONS
PROFILE

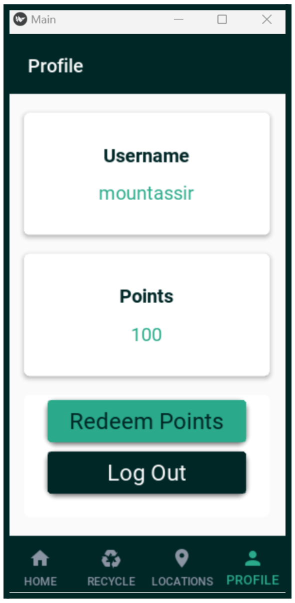


INSTRUCTIONS

1) Press the **Connect** Button

2) Press the **Recycle** Button


Main
Locations
E18
Higher College of Technology (men)
© OpenStreetMap contributors
HOME
RECYCLE
LOCATIONS
PROFILE



Username
mountassir

Points
100

Conclusion

For this project, our group was able to create a community service-based mobile application. The main objective from this mobile application was to ease and encourage the recycling process. Our group followed the software development stages, where we came up with the functional and non-functional requirements, analyzed the software, designed the software, and finally developed the software. Our software was developed using the Kivy framework, while using the SQLite database.

Resources

1. Kivy: Cross-platform Python Framework for GUI apps Development
2. KivyMD 1.2.0.dev0 documentation
3. https://youtube.com/playlist?list=PLCC34OHNcOtpz7PJQ7Tv7hqFBP_xDDjqg
4. SQLite Databases With Python - Full Course - YouTube
5. Kivy Tutorial #9 - Navigation Between Multiple Screens - YouTube
6. Regular Expressions in Python - YouTube
7. The U.S. Recycling System | US EPA