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SEMESTER 1/20212022

SECP1513 – TECHNOLOGY INFORMATION SYSTEM
SECTION 02
PROJECT – PART 2 (REPORT)
[IoT - EKOKITAR MOBILE APP]

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GROUP NO: 4

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1.0 INTRODUCTION

The decade leading up to the 21st century and continuing through the years until the present day has seen the internet revolution and subsequent proliferation of electronic devices drastically changing the global attitude towards technology. As a result, advancements and innovations in the field changed how industries operated in relation to technology, i.e. the transition to Industrial Revolution 4.0. An unforeseen consequence of this shift towards technological consumption is the sheer amount of discarded parts,scraps and whole devices that end up unrecycled either in landfills, open dumps, or collecting dust. With up to 50 million tons of electronics thrown out each year, this is not only extremely harmful to the environment, but it's also disregarding the finite nature of valuable resources that went into making them. Accounting for the global recycling trends only paints a bleaker picture, with only 13.5% of all wastes collected end up being recycled.

Our team is aware of the increasing necessity to take concrete action towards tackling the issue of waste, thus we are utilising IoT in changing harmful habits that has become the norm using $Ekokitar^{TM}$, a mobile app designed to facilitate the public's participation in proper waste disposal and treatment. The existing infrastructure surrounding waste collection and disposal in most parts of Malaysia is considered lacking and insufficient in terms of sustainability and management, Malaysia having 0.98 million metric tonnes of mismanaged waste in 2015 alone. This is also partly due to a lack of public interest and participation in recycling/waste management. Thus, we prioritise ease of use in our user experience, to maximise the accessibility of our services in order to encourage social change to the masses.

The goal of this project is to set up a self-sustaining business model centred around collecting people's recyclable trash and dispose / recycle/ upcycle or repair them to turn a profit. At the same time we are giving users the initiative to sort their wastes and plan responsibly how they are to dispose of it. Through the $Ekokitar^{TM}$ app, users can opt for couriers to come and collect their specified waste (by type, material, weight and size) at convenient locations (e.g. user's address or community garbage dump) at set times of the day/week. Another key aspect of our planned operations is the drop-off collection points that are placed in logistically efficient locales. Though for certain items or remote locations, we might require a fee to cover transportation costs as well. Smartphones' ubiquitous camera, GPS and online payment functionalities allow all the parts needed for our operations to run smoothly.

We also plan on developing bilaterally beneficial collaboration with client companies and businesses that share the same vision as us and support our socio-environmental goals. Such opportunities include major food chains, shopping malls, depots, retailers etc, providing the bulk of the materials to be handled. Other collaborative efforts may involve the handling, treatment and disposal of these waste materials. Green campaigns by companies like Intel, AMD, IKEA, Nike, UNIQLO, etc might create a market for refurbished and reused materials from cotton and plastics to Nickel, Gold and Copper and everything in between.

The cloud computing infrastructure plays the most important role in the deployment of our application. Amazon Web Services (AWS), was chosen for its wide range of services that cater to every aspect of our project's development. It's most useful in handling the back-end development of the mobile application, from data storage management to networking, security features, organisational bracketisation, analytics, push notifications and user account login/creation.

2.0 DETAIL STEPS AND DESCRIPTIONS

2.1 Gantt Chart

GANTT CHART

| PROJECT TITLE | EKOKITAR MOBILE APP | GROUP NO. | 4 |
| PROJECT MANAGER | DR IZYAN IZZATI BINTI KAMSANI | DATE | 12/2/21 |

WBS NUMBER	TASK TITLE	TASK OWNER	PCT OF TASK COMPLETE
1	Project Conception and Initiation (P1)		
1.1	Research	Hasan	100%
1.1	Selection of 4th IR Technologies	Aliya	100%
1.2	Selection of Potential Client	Iqmal	100%
1.3	Proposed solution	Fikri	100%
1.4	Guidelines	Nadia	100%
1.5	Project Initiation	Fikri	100%
2	Project Definition and Planning		
2.1	Architecture Planning and Design	Hasan	100%
2.2	Summary of proposed system	Aliya, Nadia	100%
2.3	Conclusion	Nadia, Aliya	100%
3	Project Conception and Initiation (P2)		
3.1	Introduction	Hasan	100%
3.2	Description Project	Iqmal	100%
3.3	Problem Statement	Fikri	100%
3.4	Propose solution	Aliya	100%
3.5	Team Working Description	Fikri, Hasan	100%
3.6	AWS Architecture Design	Hasan	100%
3.7	Business Process Flow Diagram	Iqmal, Hasan	100%
3.8	Mock-Up Project	Fikri	100%
3.9	Reflection	Nadia, Fikri, Iqmal, Hasan, Aliya	100%
4	Project Performance / Monitoring		
4.1	Preparation Slides	Aliya, Nadia, Iqmal, Hasan, Fikri	100%
4.2	Presentation and Peer Review	Aliya, Nadia, Iqmal, Hasan, Fikri	100%
4.3	Project Video	Aliya, Nadia, Iqmal, Hasan, Fikri	100%

2.2   Problem Statement

Nowadays, with an increasing number of populations around the world, the usage of plastic and different types of waste is also increasing. This is worrying because we just dump all the waste into the ocean and landfills and can cause a lot of pollution that will affect us in the near future. Although there's a practice in recycling among society , the data shows otherwise because only 9 percent of the world's plastic has been recycled. Next, the issue itself comes from people where they are too busy or too lazy to classify the waste product.The lack of knowledge regarding who to contact and where to throw the recycled waste become a major problem for them. With this issue in mind, we've created an app that's user friendly to tackle this issue efficiently.

2.3   Solution

Next, due to the issue of recycling limits, we have decided to create an application named $Ekokitar^{TM}$ which enables our potential clients such as neighbours, relatives, family members, friends and the public to recycle their unwanted items through the delivery service. This application contains many features that can ease the users such as we will provide and repay by giving points according to the type and mass of items given. Here, the users need to make a verification first by taking a picture of the items before being collected by the rider through the application. The users must also select the sort of transportation delivery and pick-up time that they prefer, so that riders from any drop point centre may prepare and pick up their products on time.

Then, the application will check and approve the submission, then it will provide a QR code scan for the user to gain points. Besides, the points that have been collected by the user can also be redeemed for vouchers that are accessible at some of the companies with which we have chosen to cooperate, such as Starbucks, Tealive, and others. These features will encourage the users to keep on recycling and compete with one another, since the points will be shown on the official "EcoKitar" social media website, and the top three ranks will be granted rewards each month.

Furthermore, if the users want to drop the recyclable products at any nearby drop point centre, they can manually weigh their things before receiving a QR code from the app

depending on the categories and mass of the items to gain points. The rider then will collect the items from the drop-off location and deliver them to the warehouse. Moreover, the employees who are in charge of collecting items at the warehouse will store them first before sending them to any company such as IKEA, Nike, UNIQLO, etc that may innovate or recreate a product using the recycled items and offer it to the residents as new products.

To summarise, this application will assist users in being more flexible in recycling unwanted goods, which will have a positive impact on the globe. For instance, increasing the quantity of recycling activities can reduce incineration and save energy, which is good for the environment.

2.4   Team Working

Our group consists of 5 members which are Muhammad Fikri, Muhammad Hasan, Muhammad Iqmal, Aliya Zarena, Nadia Syafiqah. Our idea started with the idea Fikri proposed to find a way to simplify and democratise recycling using the help of a mobile application that is accessible to the mass public. Our main inspiration is from Foodpanda, Grab and TouchnGo where they use a courier service or a rider as a medium to send or retrieve food. But for this idea of ours, we decided to use the riders employed in our own company to retrieve users' recyclable items. As the originator of our team's project idea, naturally Fikri was given the position of leader of the group, especially seeing that he has done considerable research on the topic during his school years and has had first hand experience working at a local KFC thus knows how much wastefulness there is generated in a big franchise/company. This project is divided into two parts ; Part 1 and Part 2 where we explain different aspects of the project.

For part 1, we needed to create a proposal for our project. We decided to divide our work into 3 parts which are Problem Background, System Boundaries, Benefit and Proposed Solution. For Problem Background, Hasan and Iqmal worked hand in hand with Fikri to research more into the local recycling infrastructure and the need for an app like ours in the community, which we spotted as an opportunity. Iqmal came up with a few suggestions on hypothetical potential clients/shareholders for our project which includes names such as IKEA, McDonalds, KFC, Mr.DIY etc. System Boundaries was handled by Aliya and Nadia where they deliberated on the suitable 4th IR technology to support our app and the guidelines for our project. We ended up proceeding with Amazon Web Services as it offered

the most comprehensive and relevant services for an app such as ours to operate efficiently. As mentioned before, Fikri was the one who came up with the idea and proposed a solution to it, as such he is accredited with fleshing out the approach towards tackling the problem of recycling. We all offered our opinions and thoughts in the matters of the architecture planning and design related to AWS implementation, when all was decided, Hasan was tasked with creating an informative diagram showing a birds eye view of the the AWS architecture design (Figure 3.1) while Aliya did a lot of the subsequent explanation of the operations associated with each node/component. Nadia finished off Part 1 of the project with a comprehensive conclusion

In Part 2, Hasan started off by writing a one page introduction to our project that we inserted in both parts to provide an overall understanding to readers. We followed this with a project description by Iqmal who described further the details of our project, referring to what we had done so far and our plans. The problem statement for our project was developed by Fikri while Aliya reiterated our proposed solution again in Part 2. Several people were tasked to describe our team working , showcasing what each member has brought to the table for the past semester of working on this project. Iqmal and Hasan drew and described the business process flow diagram. We decided to show the user's perspective when they decide to download and open our app, what options are available and the corresponding flowchart. Fikri used his skills and know-how to create incredible mock-ups for our app in AdobePhotoshop and Canva (Figure 5.1-5.7) in order to visualise the look and feel of our app. Of course, at the end of this report we also teamed up to reflect on our project as a whole.

All five of us worked on the preparation of the slides we used in our presentation as well, it took considerable effort to design the slides itself, not to mention we had to also record ourselves and produce a 2-in-1 video for both the presentation and the project. We had to find time in our semester-end schedule to coordinate and work together to finish this crucial step of the project. We feel that we created a worthy final-product with the best of our capabilities, and each of us did carry our weight in the team. We are excited to have reached the end of our work and look forward to utilise what we have learned in the future.

3.0 AWS ARCHITECTURE DESIGN
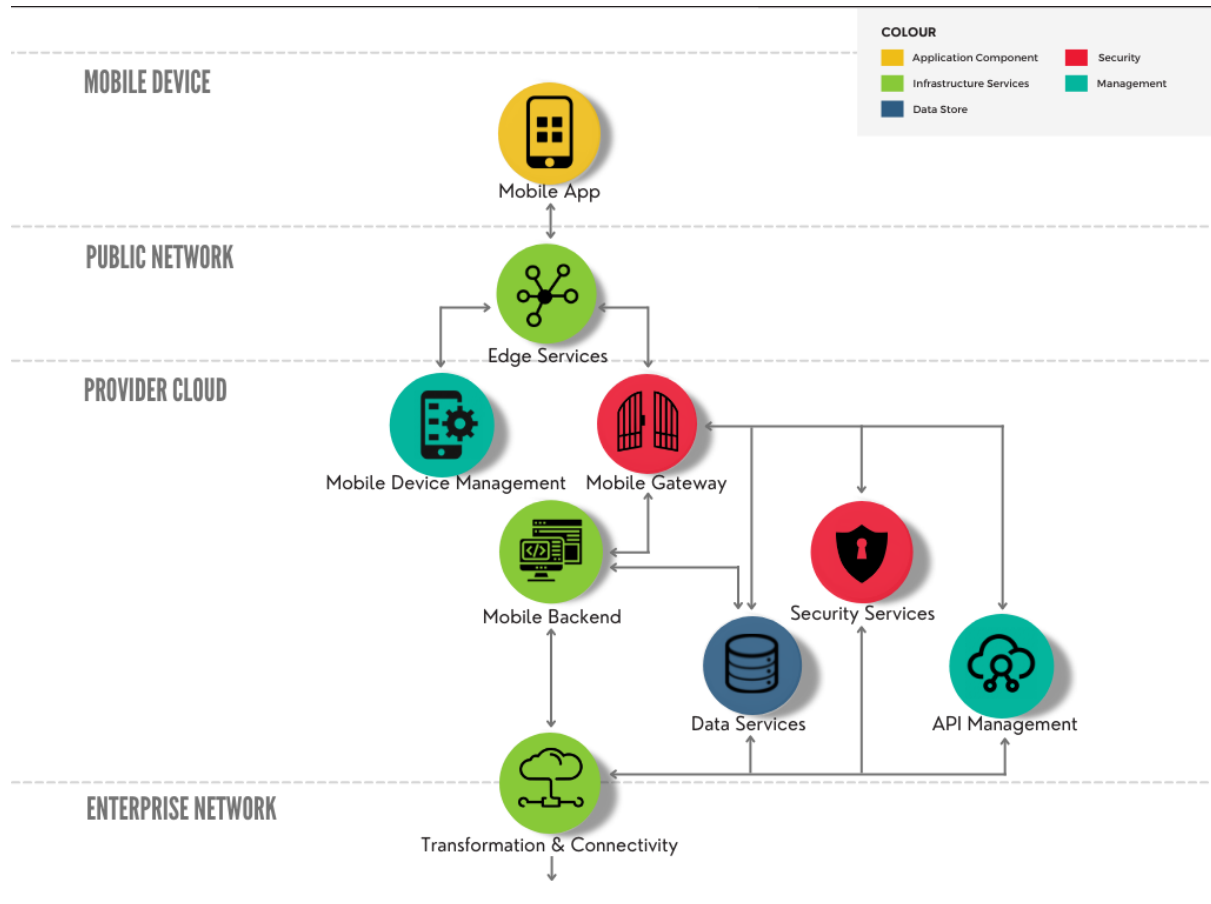
Figure 3.1 : Represents the whole structure of interrelated networks for our mobile app

Our architecture consists of 5 components that will integrate and link each other to make sure the project runs smoothly and efficiently. The 5 components are :

1) Mobile Devices which consist 2 components such as Mobile Application as the front-end and System Development Kits (SDKs) as the back-end

2) Public Network which is Edge Services that consist of Firewall, Domain Name System and Content Delivery Networks

3) Mobile Gateway which consist of Authentication/Authorization and Policy Enforcement

4) Storage is included as Back-end Provider which consist of AWS Services such as Amazon DynamoDB and Amazon S3

5) Security (back-end) services which consist of Amazon Cognito

6) Management (back-end) software such as Mobile Device Security, Device Management, Enterprise App Distribution and Device Analytics

7) API Management

8) Data Services that consist of Mobile App Data and Caches

9) Enterprise Network which contain Transformation & Connectivity component

The architecture we mentioned will be explained in further detail in the next segment :

3.1 Mobile Devices

3.1.1 Mobile Application

This is the main component of this architecture as this will be our head where it will engage with the user. This application will consist of many interactive buttons that will display the required information and also record any data based on what the user presses.The proposed application will be connected to backend systems to make this system work efficiently.

3.1.2 System Development Kits (SDKs)

To provide developers with necessary tools to add any functionality that mobile applications needed. It will also enable them to build standard components such as location services, logging in and many more. This will make the application more interactive and fast as SDKs usually come in all-in-one products, so there's no need to integrate with other components as it will slow down the development process.It is also an important tool for developers to access backend systems.

3.2 Public Network

A public network is one to which anyone, i.e. the general public, has access and can connect to other networks or the Internet through it. Users should be mindful of possible security concerns when using a public network because it has little or no restrictions. For instance, edge services is one of the public network components which also includes several services.

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3.2.1 Edge Services

A component that is exposed to the public internet is known as an edge service. It serves as a hub for all other services, which we will call platform services. Edge services are required to link the mobile device and it's apps to the appropriate mobile gateway over the Internet, whether over Wi-Fi or mobile provider networks. These include :

I.   **Firewall** which is a device that restricts communication access to and from a system, allowing only traffic that complies with a set of policies to pass through and blocking traffic that does not. Firewalls can be implemented as standalone hardware, as a component of other networking gear like a load balancer or router, or as part of an operating system's software.

II. **The Domain Name System (DNS)** is an integral component of modern networking because it converts human-readable domain names to the underlying Internet Protocol (IP) addresses that linked devices use to communicate with one another.

III. **Content Delivery Networks** refers to a geographically distributed set of servers that collaborate to provide rapid Internet content delivery and minimise response time for serving resources to geographically distributed users, ensuring that material is highly available and delivered with minimal latency.

3.3 Mobile Gateway

The Mobile Gateway is the point where a mobile app connects to the solution's mobile-specific services, which often include a set of internet-accessible Application Programming Interfaces (APIs). A mobile getaway may be implemented by a common getaway to access all channels into an API ecosystem which provides authentication/authorization and policy enforcement.

3.3.1 Authentication/Authorization

Authentication/Authorization allows security services to identify, authenticate, and authorise users using a number of methods and token types. Mobile authentication services can handle a variety of token kinds, including biometric technology like voice authentication.

3.3.2 Policy Enforcement

Policy enforcement is typically handled by software or hardware serving as a gateway, proxy, firewall, or other centralised point of control in the network. Policies must first be defined, along with one or more actions that will be taken if a violation occurs.

3.4 Storage (Backend-provider)

For our app to run smoothly, we need sufficient capability and capacity to store all the data that is generated from our users and our internal operations. Suitable methods of organising relevant data are chosen in order to optimise efficiency and speediness.

3.4.1 Amazon DynamoDB

This AWS service will solve all our storage needs. The service provides a highly resilient and scalable NoSQL database manager which can support any level of data traffic and retrieve any data that is required. It does so seamlessly, scaling to meet our actual usage amounts automatically, without performance degradation nor any downtime needed. Its range of features removes any of the administrative burdens of operating and scaling a distributed database so that we don't have to worry about hardware provisioning, setup and configuration, replication, software patching, or cluster scaling associated with managing our own databases.

3.4.2 Amazon S3

We also use Amazon S3 hand in hand with Amazon DynamoDB in providing cost-efficient cloud storage solutions for the entirety of our needs. We can store our data as objects (up to 5 terabytes in size) within resources called "buckets". S3 features extensive configurations, we can enforce data access controls, secure data against unauthorised users, run big data analytics, monitor data at the object and bucket levels, and view storage usage and activity trends across our organisation (analytics) through its sub-services such as S3 Inventory, S3 Access Points, S3 Storage Lens, S3 Storage Class Analysis, etc . We can customise it to support our specific use case, enable cost efficiencies, enforce security, and meet compliance requirements.

3.5 Security Services (Backend)

User data in any application can differ, but if the data is stolen and leaked, it can cause irreversible damage. So, that's why our application also provides security services. Security services modify management of access in order that solely approved users will firmly access mobile cloud services. This element additionally provides protection of knowledge across mobile devices and cloud services, and allows visibility to own unjust counterintelligence across cloud and enterprise environments.

3.5.1 Amazon Cognito

Amazon Cognito is an AWS service that helps you to create completely unique and steady sign-up, sign-in, app authentication and get entry to manipulate on Internet and cellular apps for users. This carrier is well suited with websites that require sign-ins which include Facebook, Google, Amazon, etc.

3.6 Management (Backend)

Mobile Device Management (MDM) is designed to enhance employee productivity while simultaneously maintaining corporate security by empowering our enterprise workforce with the power of mobility. For instance, it also will help to keep record of enterprise owned devices and monitor devices that connect to corporate networks by using the management agents on the device. Besides, MDM software can also help to limit the risk of data loss, restrict unapproved software installation, and block malicious access to business data and networks via the mobile devices. There are some features that MDM software can provide:

3.6.1 Mobile Device Security

Here, the software will specify enterprise security policies that must be applied to devices by engaging with the Security Services. This comprises regulations for gaining access to corporate networks, password standard, encrypted documents and some other things. It also will protect your network by granting different levels of access to different devices to provide a secured access network.

3.6.2 Device Management

The software will give the enterprise the ability to view device usage across the organisation, and will also allow administrators to perform actions such as add, remove, and erase across all of those devices. In addition, the software can also ensure that users' devices are compliant with policies by configuring users' profiles to enact policies for Wi-Fi, VPN, and other parameters. It is used to troubleshoot issues on users' devices where it concludes on remotely controlling and viewing mobile devices during the real-time.

3.6.3 Enterprise App Distribution

In MDM software, the enterprise app distribution will give the ability to the host enterprise and to distribute enterprise apps to mobile devices. If the enterprise apps are not being deployed into the public app stores such as iOS, Android, macOS and so forth, the enterprise catalogues will be required, so then it will be easier to manage app distribution that is easier to access.

3.6.4 Device Analytics

This mobile device analytics will improve data quality by ensuring that identities and other essential data components regarding those entities are correct and consistent across the organisation. It will boost the MDM solution's capabilities by delivering comprehensive and vital data to optimise device performance, user productivity, and uptime. In addition, mobile device analytics can also act like a virtual reflection showing device performance.

3.7 API Management

API management capabilities publicise the mobile gateway's access to available services endpoints. It offers API discovery, catalogues, connections between supplied APIs and service implementations, and administration tools like API versioning. Moreover, an API management system allows a company to ensure that both the public and internal APIs it develops are usable and safe. The majority of API management systems will allow the users to perform the following tasks such as API Discovery/Documentation and Management.

3.7.1 API Discovery/Documentation

Allows mobile developers to find and use APIs in a secure manner. Most APIs have discovery documentation available for certain versions. The Discovery Document for each API specifies the API's surface, how to access it, and how API queries and answers are organised. API-level features such as an API description, resource schemas, authentication scopes, and methods are included in the information provided by the discovery document.

3.7.2 Management

API management will provide a management perspective of API usage by mobile apps, based on data from the mobile gateway, backend, and other sources. APIs should be managed from start to finish, from design to implementation through retirement.

3.8 Data Services

Data is often stored in a format that allows mobile apps to access it quickly, and it may include extracts of business data which are possible to be modified.   As   for   this application, data services will operate as a middleware, discovering and delivering data from a variety of sources where the programme demands independently. For instance, data services play   an   important   role   in   governance   by   centralising   metrics,   monitoring,   version management, data reuse, and enforcing data visibility and access regulations.

3.8.1 Mobile App Data

Designed with consideration for the demands and constraints of the devices and also to take advantage of any specialised capabilities they have. Moverover, mobile app data is simply data stored in a format that mobile apps can consume quickly and conveniently. The database that mobile apps use is usually MySQL which is an open source, multi-threaded and easy to use SQL database. There are general criteria to select the right mobile app such as speed and scale, data modelling, data security and others.

3.8.2 Caches

The goal of caches is to provide the ability for mobile apps to cache data for faster access. The information (caches data) will get cached on your devices after you visit an application, and the developers to improve your online experience. In fact, most devices are described by a so-called computer memory hierarchy, which describes how they store and access data. This cache memory will benefit the users in terms of improving speed and performance of the users' data, securing data by restricting the hackers from conducting an assault that puts data security at risk and protecting users' data privacy by clearing cached data.

3.9 Enterprise Network

An enterprise network is made up of physical and virtual networks and protocols that connect all users and systems on a local area network (LAN) to data centre and cloud applications while also allowing access to network data and analytics. It also provides end users and applications with quick and dependable connectivity.

3.9.1 Enterprise Transformation & Connectivity

The enterprise transformation and connectivity component provides a secure connection to enterprise systems as well as the ability to filter, combine, or modify data or its format as it moves between mobile and enterprise components. When the native format of enterprise data isn't suitable for transfer to mobile devices, data transformation may be required.

4.0 BUSINESS PROCESS FLOW DIAGRAM
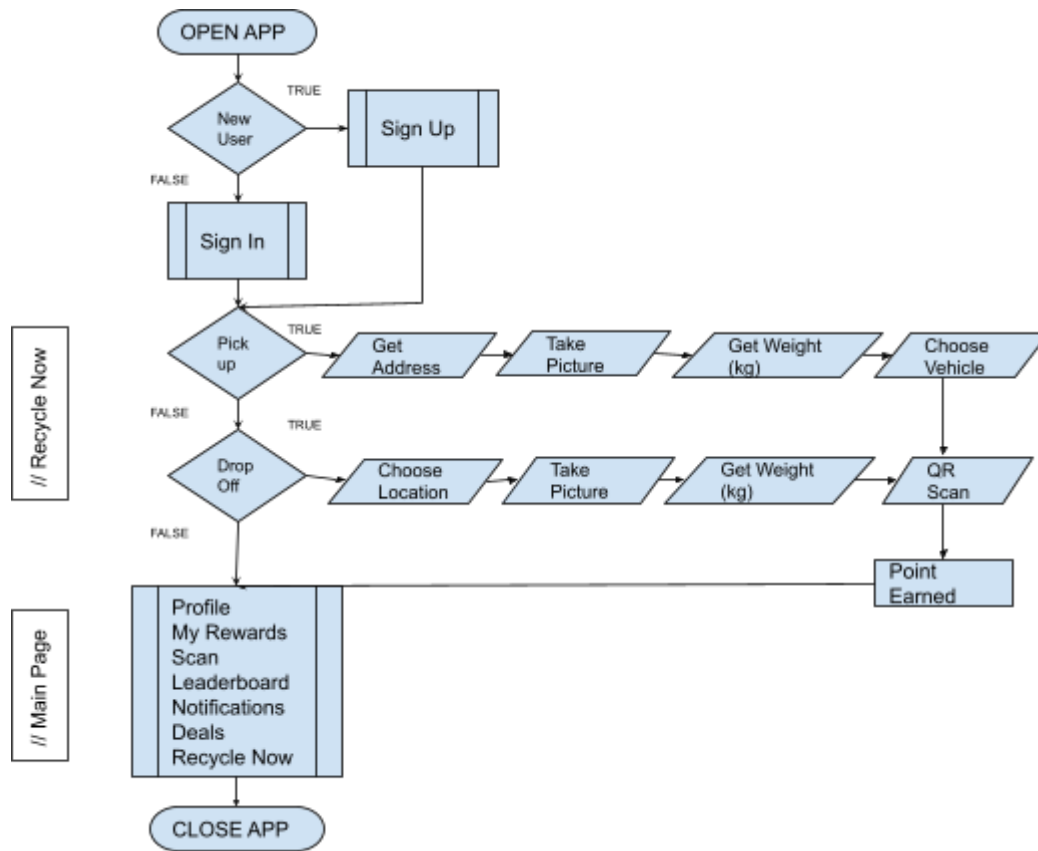
Figure 4.1 : Business Flow Diagram

The flow start with user opening the applications of *Ekokitar*^{TM} that can be downloaded from Google Playstore for Android users and App Store for IOS users. First time users will be greeted with a welcome page where they can either sign into their account or sign up to create a new one. From there, the user will be given a choice whether to opt for the rider to pick up the recycled items ("Pickup") or the user drop the items themselves at designated areas listed in the app ("Drop off"). If the user chooses Drop off as their choice, the application will ask the user to pick the nearest collection centre in the state for the user to drop the recycled items. After that, the user will be required to take a picture of the items at said facility as proof and also to proceed weighing the item(s) at the location . Next, the user will scan the qr code given for them to receive their reward points.

If the user requests Pickup as their choice, the application will ask the user to put their address for the rider to identify and go to that place to pick the items, the user may also use

GPS functionality to pinpoint their current location. The user will need to take a picture of the item(s) and weigh them beforehand before submitting the request. Then, the user will have to choose the most suitable type of vehicle to pick the item(s). The user will be advised to pick a van as a choice if the recycled items are heavy and big. While small items can be picked using a motorcycle or even a car. Only after the rider has come and collected the item(s) successfully will the user be able to scan the QR code from the rider to claim their reward points. The user has the option to use their collected points to redeem vouchers and other rewards, it can also be regarded as a competitive match between friends and other users by comparing their personal accumulated points i.e how much they have recycled.

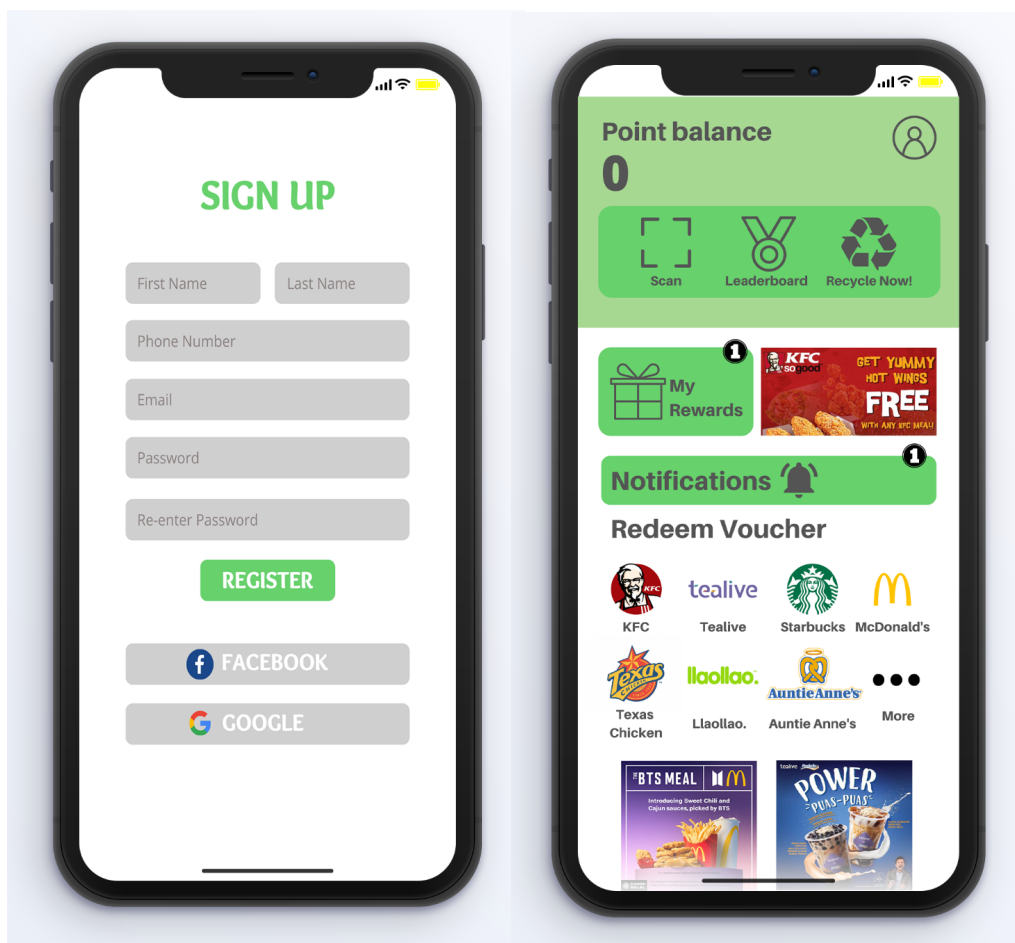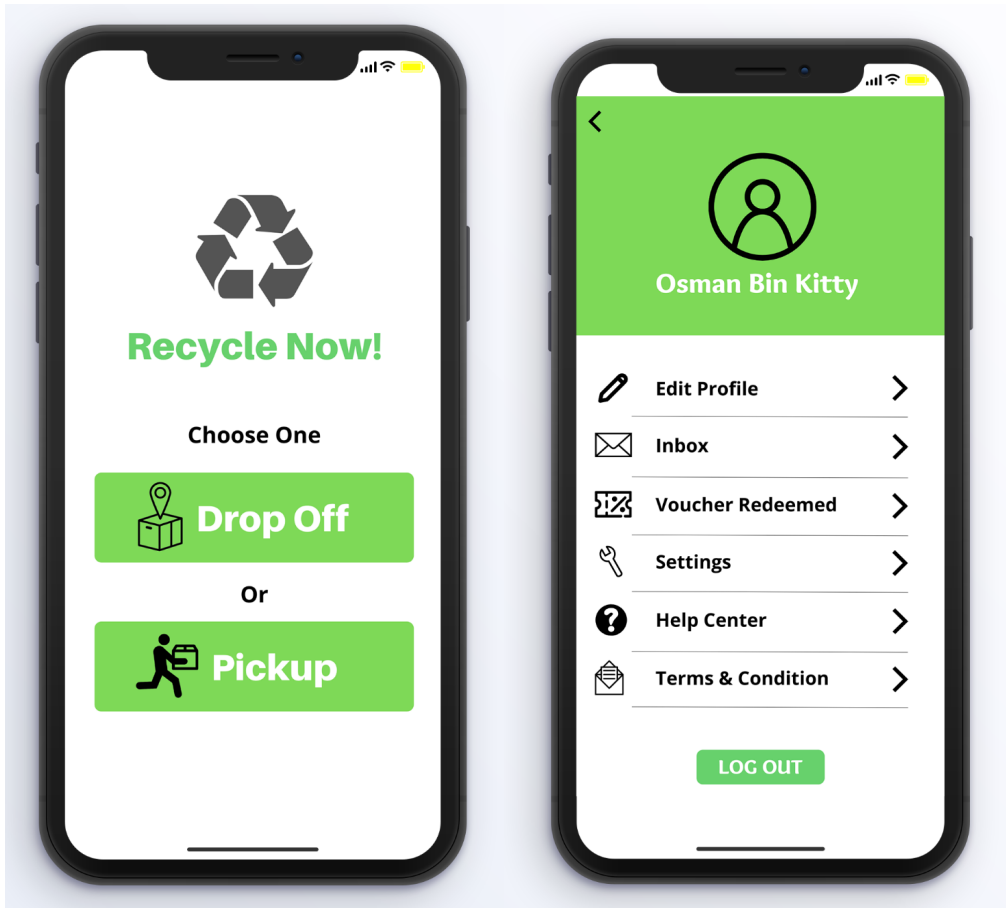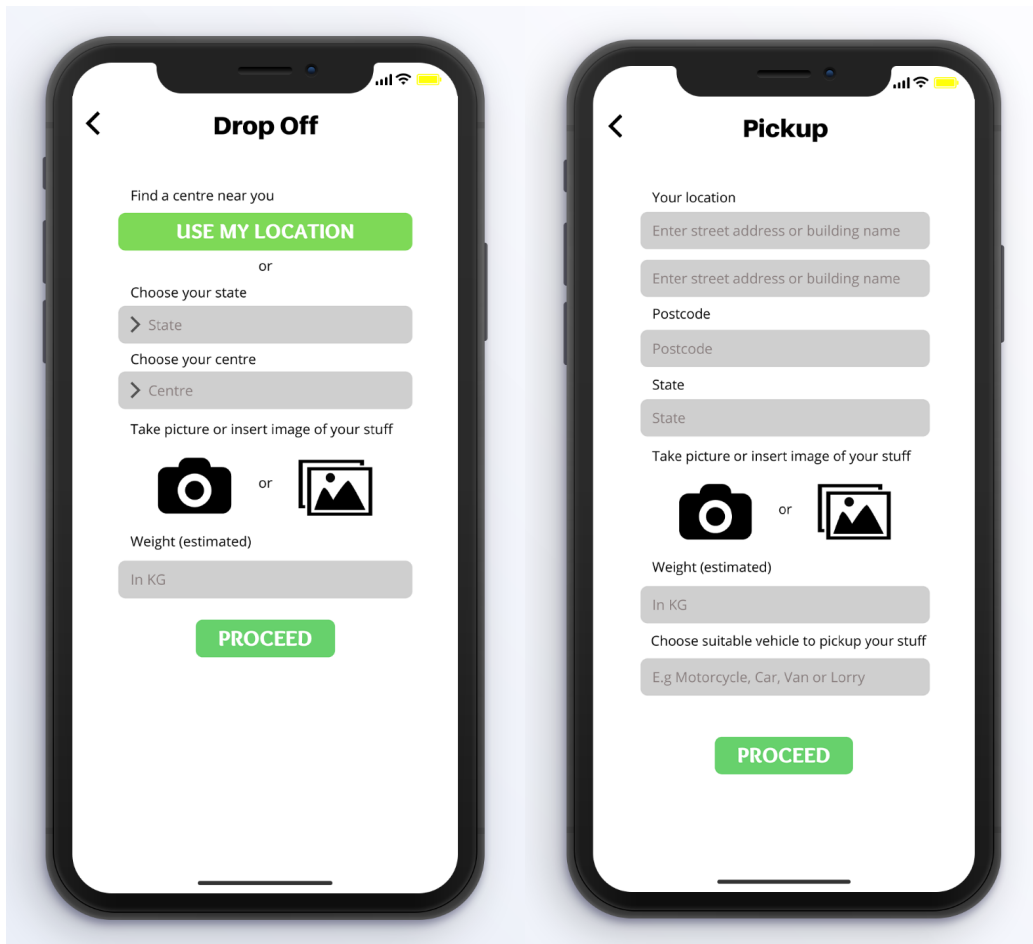## 5.0 LOW-FIDELITY MOCK-UPS

Figure 5.1: EkoKitar app icon

Figure 5.2: Sign up page   **Figure 5.3:** Main page

Figure 5.4: Recycle Now page

Figure 5.5: Profile page

Figure 5.6: Drop Off page   **Figure 5.7:** Pickup page

6.0 REFLECTION

a. What have you learned and your motivation to complete this project?

b. What issues and solutions are implemented to make the project a success?

c. What is your direction after completing this project?

d.What is the improvement necessary for you to improve your potential in the industry?

6.1 Reflection

Recycling is crucial to the future health of our planet and it is very important in today's world if we want to leave this planet for our future generations. It is good for the environment since our services are making new products from the old items which are no longer used. The fact that recycling helps in creating new job opportunities is not a surprise at all. In order to run these services, at least a few workers are required, with at least one worker for each step of the process. Thus, our services (recycle application) benefits not only the environment, but also people by offering a viable source of income.

Next, in response to the difficulty in recycling activities, we decided to address the problem by developing an IoT application that allows users to easily recycle their waste. The Internet of Things (IoT) is one of the Industry 4.0 technologies where it refers to the process of connecting all physical components and objects throughout the Internet. This will benefit us such as improving the productivity of employees and minimising human labour, resulting in routine tasks that can be automatically done and lower corporate operating costs. Additionally, our company can fetch the important, real-time data that helps us to define strategic actions by using the IoT. All of these uses of IoT help us to deliver the best customer service with the computerised system that is able to monitor all of the operational tasks which can maintain the most exceptional quality of our services.

Aside from that, our project management involves all work requiring influence, such as guiding subordinates toward optimal performance in order to fulfil group activities. Directing includes putting approved and desired ideas into action and carrying them out in order to fulfil deadlines. We also examine a few project management activities, such as establishing effective work processes, ensuring consistent interference design for optimal usability, communicating quality control standards throughout all stages, and developing a project quality strategy. As a result, the aspects of our project are focused with human interactions, in which it fosters cooperation and harmony among group members while

dealing with organisational problems or difficulties, and it initiates action, which is recognised as the essence of management-in-action.

In conclusion, through this project, we can identify our weaknesses where it can help us to create a plan of action in improving our performance or personal development skills to form a professional employee in the future. We have learnt how to do task scheduling, planning task length estimation, and prioritising the goals of the project, so we can improve our efficiency of our applications and activities including avoiding miscommunication in the team. Moreover, the problem-solving ability is also important because it helps us to create strategic and tactical plans to handle challenging or surprising situations. On the other hand, we note that as skilled problem-solvers, we must remain calm when confronted with challenges and assess all their options to find the best solution. Finally, we expect that our mobile application can provide users with more seamless and excellent services.