

COURIER DELIVERY SERVICES COMPARISON WEB APPLICATION

By

LIM KAI SHEN

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ABSTRACT

The proliferation of online shopping has led to the expansion of the courier industry. This is because it is now much simpler and more cost-effective to provide a variety of digital services, such as order tracking and online payment. Users have to enter the same information into the websites of all of the different courier companies in order to find the most affordable price. This information includes the postcodes of the origin and destination, as well as the weight and dimensions of the package. When it comes to selecting a courier service, the decision-making process can become more difficult due to the absence of comparable features for a given weight. In addition, the specific needs of individual courier services direct the development of each company's unique physical form. It is hoped that the development of this system will make it possible for customers to make educated choices regarding the courier services they use based on a variety of factors including pricing, parcel volumetrics, and location information. Users will have access to a variety of features that were not previously available to them thanks to the incorporation of progressive web application technology into this full-stack web application.

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LIST OF ABBREVIATIONS

<i>IDE</i>	Integrated Development Environment
<i>API</i>	Application Programming Interface
<i>CSV</i>	Comma-separated values
<i>RAM</i>	Random-access memory
<i>SATA</i>	Serial AT Attachment
<i>SSD</i>	Solid-state drive
<i>HDD</i>	Hard disk drive
<i>HTML</i>	HyperText Markup Language
<i>CSS</i>	Cascading Style Sheets
<i>ORM</i>	Object-relational mapping
<i>SQL</i>	Structured Query Language
<i>ACID</i>	Atomicity, Consistency, Isolation, Durability
<i>DBMS</i>	Database management system
<i>SDLC</i>	System Development Life Cycle
<i>ERD</i>	Entity-relationship Diagram
<i>3NF</i>	3rd Normal Form
<i>PWA</i>	Progressive Web Application

CHAPTER 1: INTRODUCTION

1.1 Problem Statement and Motivation

Conventionally, if a user were to find a courier company to ship a parcel, the process would be to get on each courier company's website and enter the parcel information such as source/destination, weight and dimensions to get a price quote. This fragmentation of information sources would lead to inefficiency and time wasted in the process aforementioned and will exasperate users if multiple shipments were made. Furthermore, consumers in this age of time are pickier in their choices because the information is so widely available, and there are many choices to pick from. For the user to decide which courier company to select, it is not solely based on the price alone, and there must be multiple metrics for users to consider and base their decision on, such as parcel dimension limitations, drop off centres, etc.

Stated below are the problem statements for this project:

1. Unintuitive to compare prices from different service provider websites

The process of obtaining a quote from a courier service website is often troublesome as the user would have to enter the details of the shipment and then repeat this process for several other websites to compare prices.

If repeated several times for multiple shipments to be made, this would be highly time-consuming.

2. Lack of visibility for drop-off centres

Currently, for the user to know where to drop off their parcels for their respective courier service providers, users would either have to google the location or find it on the company website, which is unintuitive and adds another action to the entire process of shipping a parcel.

3. Insufficient comparable attributes

Price alone might not be the single factor influencing the users' decision in selecting a service, and there are other constraints the user needs to take into account, such as the

volume or dimension of the parcel for a given weight as it might differ from different service providers. A sorting and filtering function will be a helpful addition by leveraging more fields or data points to aid the user in their search.

In Malaysia and all across the globe, e-commerce has been a tremendous driving force behind the growth and emergence of freight and logistics companies [13] [14]. However, the market can be somewhat fragmented regarding visibility to the customers. This project aims to become a service aggregator platform where users in Malaysia can easily compare and make an informed decision in selecting a courier by cutting down on performing redundant actions on multiple different websites just to make a comparison as well as providing multiple data points such as dimension constraints and weight

1.2 Project Objectives

To study the existing problems in courier service web applications.

Several existing web applications on the market serve as price comparison tools such as easyParcel in Malaysia as well as standalone courier companies that provide API access to their services. These applications can be reviewed thoroughly and gap analysis to be performed to develop a more intuitive courier service comparison web application.

To develop a web application that allows users to search and compare courier services in Malaysia that solve existing problems brought to light. Several key aspects, such as interactive map implementation and third-party API integrations, need to be implemented.

To evaluate the effectiveness of the web application developed to compare courier services from the user's perspective. Once the development of the application has concluded, the effectiveness of functional and non-functional requirements will be tested to make sure the product is verified and validated.

1.3 Project Scope and Direction

The scope of the project includes the development of a full-stack progressive web application for the aggregation and comparison of courier delivery providers in Malaysia. The application will be built on a modern tech stack using visual studio as the IDE and includes a client-facing front end, back end, and a database for data storage such as customer login credentials and order information.

The system functionalities to be covered in this project include a search page where users can enter essential information such as the origin and destination postcode, weight and optimally the dimensions of the parcel to be sent, a results page with a filtering and sorting function containing the price, courier name as well as a recommended pre-paid packaging for the respective courier companies if applicable given the dimensions of the item to be shipped is provided, map integration with drop off points and integration with courier APIs to obtain price and other relevant information. Courier delivery prices and drop off locations are to be obtained from two different sources, the first one being from sandbox API available and open for public use from some courier service providers as well as simulated prices and manually obtained drop off centres for courier service providers whose API are not open for public use.

1.4 Contributions

With the development of this application, the courier services sector in Malaysia would benefit tremendously. It will also empower local SMEs by putting them on an equal playing field with a platform to demonstrate and market the services that they provide, hence increasing sales. Furthermore, by utilising comparison and filtering tools, it would provide greater transparency in terms of the products or services offered, hence increasing users' confidence in the courier service providers. Finally, the value-adding proposition to consumers saves them time and effort by eliminating the need to visit multiple websites and perform repetitive tasks just to make a simple comparison and order purchase. This is accomplished through the integration of multiple courier service APIs and other unique features that empower the users to make a better purchasing decision.

1.5 Background Information

Volumetric weight is the overall size of a parcel measured in volumetric kilograms. It can be calculated by dividing the multiple of length, width, and height of a parcel by 4000 to 6000 depending on each courier company [15]. It is common practice for courier companies to base the price of a shipment on the volumetric weight or physical weight of a particular piece of equipment or a package, whichever is higher. This is mainly because although the package might only weigh a little, the parcel size might be huge, then it takes up more space which in turn could have been utilised to hold more cargo in the transport vehicle causing a loss in taking on more shipments from the business perspective of courier companies. Similarly, with small parcels containing items with a high density or very heavy, like batteries, for example, it would use more fuel to transport the package to its destination, incurring more fuel in fuel to courier companies.

Courier companies also provide a convenient option for consumers to ship their items with the introduction of pre-paid packages ranging from envelopes to boxes with varying dimensions and weight limits which differs by the company to suit the individual needs of consumers, and with this product brings several benefits to the consumers such as the omission of printing a shipping label which offers additional convenience to the shipping experience by having all the necessary information already printed on the packaging. For example, ninja van, a Malaysian courier company, has a prepaid delivery product where customers can fit anything they want which physically fits without a weight limit [16] as well as Post-Laju, one of the more established players in the courier delivery market, has a more extensive range of pre-paid parcel packaging for their respective purposes. [17]

1.6 Report Organization

This report is divided into seven chapters: Introduction, Literature Review, System Methodology/Approach, Systems Design, System Implementation and Testing, System Evaluation and Discussion, and Conclusion and Recommendation. The first chapter contains the project's introduction, which includes the problem statement and motivation, project objectives, project scope and direction, contributions, background information, and report organisation. The second chapter is a review of the literature on several existing courier comparison platforms in the market in order to assess the strengths and weaknesses of each product. The third chapter discusses the project's system methodology/approach, including product scope and function, and is followed by diagrams such as use case diagrams and activity diagrams. The fourth chapter discusses system implementation, including the methodology used for this project, the timeline, the technologies and tools used, the issues and challenges encountered during implementation, system testing cases, and a product showcase of various modules in the system. In addition, the sixth chapter delves into system evaluation and discussion, as well as tips on the technology stack used for this application and progressive web application integration. Finally, there is a conclusion and recommendation section that includes a project review and discussion, the novelties and contributions of this project, and future work to be done.

CHAPTER 2 Literature Review

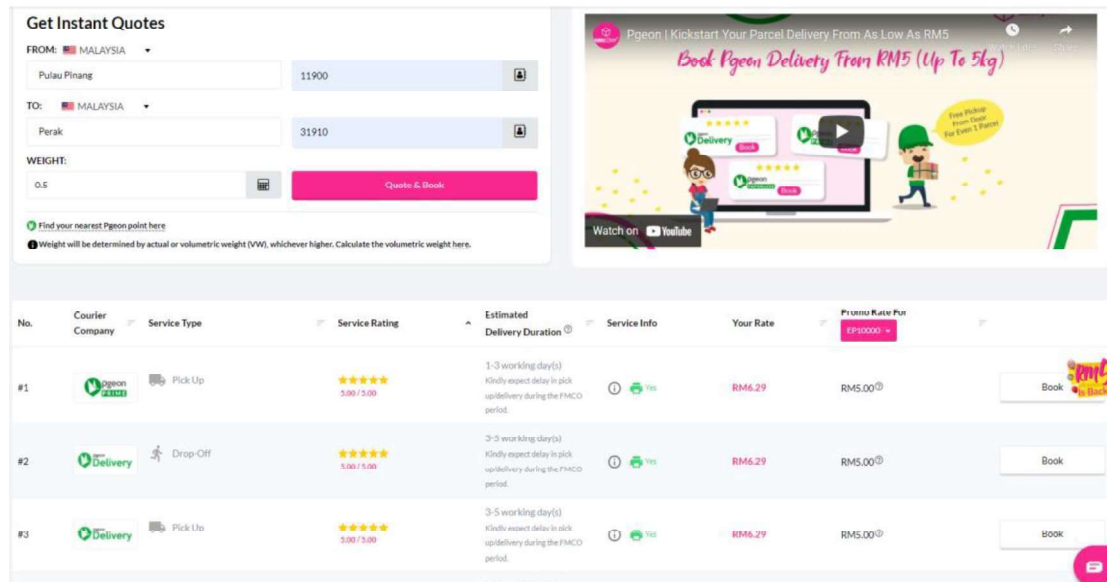
2.1 Introduction

This chapter will be dedicated to reviewing past works of other people regarding courier service comparison platforms to study their strengths and weaknesses to create an improved product. This review will be done by reviewing three existing platforms with roughly similar functions but differ in other aspects. The country of origin of these products is also quite diverse, consisting of Malaysia, the United Kingdom as well as the United States of America, namely EasyParcel [3], ParcelMonkey [1] and Easyship [2] respectively.

2.2 Previous works

2.2.1 EasyParcel

EasyParcel is a price comparison platform for courier services in Malaysia that allows users to send single or bulk parcels with many courier services and an order history allowing users to keep track of previous orders.



The screenshot displays the EasyParcel search interface. On the left, there is a 'Get Instant Quotes' form with the following details: FROM: MALAYSIA (Pulau Pinang, 11900), TO: MALAYSIA (Perak, 31910), and WEIGHT: 0.5 kg. A 'Quote & Book' button is visible. Below the form, there are links to find a Pigeon point and a note about weight determination. On the right, there is a promotional banner for Pigeon delivery with a 'Book Pigeon Delivery From RM5 (Up To 5kg)' offer. Below the banner is a table of search results:

No.	Courier Company	Service Type	Service Rating	Estimated Delivery Duration	Service Info	Your Rate	Pincode Rate For	Book
#1	Pigeon	Pick-Up	5.00 / 5.00	1-3 working day(s) Kindly expect delay in pick-up/delivery during the PMCO period.	🕒 Yes	RM6.29	RM5.00	Book
#2	Delivery	Drop-Off	5.00 / 5.00	2-3 working day(s) Kindly expect delay in pick-up/delivery during the PMCO period.	🕒 Yes	RM6.29	RM5.00	Book
#3	Delivery	Pick-Up	5.00 / 5.00	3-5 working day(s) Kindly expect delay in pick-up/delivery during the PMCO period.	🕒 Yes	RM6.29	RM5.00	Book

Figure 2.1 EasyParcel Search Page

CHAPTER 2

Strengths

- Dashboard for a summary of details regarding posting status
- Bulk orders can be performed with an excel file
- Allows for API integration for e-commerce platforms

Weakness

- Lack granular filter and sorting mechanism
- No visibility on drop off or shipment centres

2.2.2 Easyship

The screenshot displays the EasyshipSearch interface. At the top, there's a 'Ship From' section with a toggle for 'An existing address' (set to 'Yes') and a 'Sender Address' dropdown menu containing the text '2088 Stace St Apt 1 Idaho Falls 83401 Idaho - aby.gan abc123def 0100100110 kaishen142253@lutar.my'. Below this is the 'Ship To' section with fields for 'Country' (United States), 'Zip Code' (98447), 'City' (Tacoma), and 'State' (Washington). The 'Order Summary' section includes 'Item Category' (Crafts), 'Box' (Custom Box), 'Dimensions' (5 x 5 x 5 in), and 'Weight' (5 lb). There are also checkboxes for 'Insurance' and 'Residential Address', both currently set to 'No'. A green 'GET A QUOTE' button is positioned below the form.

Courier	Delivery Time	Tracking	Rating	Service Options	Remarks	Import Tax & Duty	Total Cost
USPS - Priority Mail Next Value	1 - 3 working days	Regular	3.0 / 5 256 votes	Drop-off Free Pickup		Not required	\$8.12
USPS - Priority Mail Signature	1 - 3 working days	Regular	3.0 / 5 256 votes	Drop-off Free Pickup		Not required	\$10.82
UPS 2nd Day Air®	1 - 2 working days	Excellent	4.0 / 5 < 50 votes	Drop-off Free Pickup		Not required	\$13.62

Figure 2.2 EasyshipSearch Page

CHAPTER 2

Strengths

- Simple and easy to use user interface
- multiple useful details regarding courier such as delivery time, tracking and service options
- support for bulk orders by manual entry or excel/CSV
- API and e-commerce store integration option
- analytics dashboard

Weakness

- less user friendly for individual users who would just want to get a quick price quote

2.2.3 ParcelMonkey

The screenshot displays the ParcelMonkey search results page. At the top, there is a purple header with the ParcelMonkey logo. Below the header, a purple banner contains a COVID-19 safety notice. The main content area is titled 'Your Comparison Results' and features a navigation bar with filters: SAME DAY (from £4.32), POPULAR (from £6.29), NEXT DAY (from £6.29), PRIORITY (from £11.09), DROP OFF (from £7.24), and OFFSHORE UK (from £11.09). A summary bar indicates 'We've found 36 services from £6.29' with a 'View Unresponsive' button and a 'Refine Search' button. The results are presented in a table with columns for the courier logo, service name, price, rating, and booking details. Each row includes a 'Book Now' button.

Courier	Service	Price	Rating	Booking Info
DHL	DHL Parcel UK Next Day Tracked & Signed For	£6.29 £7.55 inc VAT	4.5 stars	Book within 59 hours for collection Monday
dpd	DPD Pickup 1-2 days drop off service	£7.24 £8.69 inc VAT	4.5 stars	Drop off your parcel today
DX	DX Next Day Driver brings the label	£7.35 £8.82 inc VAT	4.5 stars	Book within 8 hours for collection Monday
Express-Force	Express 48 Drop at post office	£7.40 £8.88 inc VAT	5 stars	Drop off your parcel today
Express-Force	Express 24 Drop at post office	£8.20 £9.84 inc VAT	5 stars	Drop off your parcel today
Express-Force	Express 48 Collection service	£9.25 £11.10 inc VAT	5 stars	Book within 59 hours for collection Monday
Express-Force	Express 24 Collection service	£9.95 £11.94 inc VAT	5 stars	Book within 59 hours for collection Monday

Figure 2.3.1 ParcelMonkey Search Page

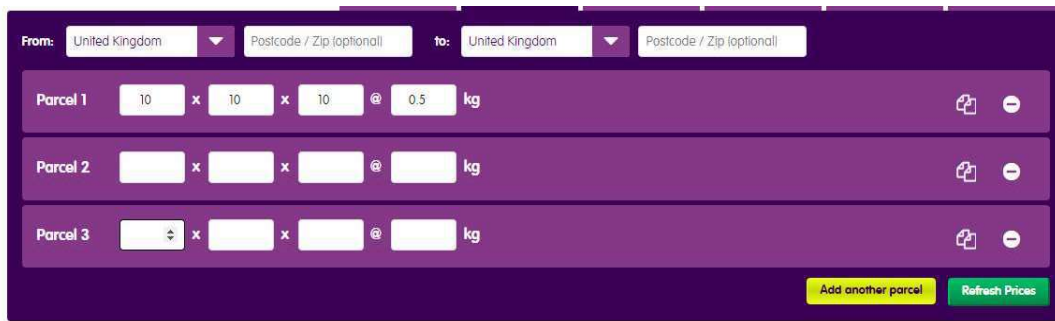
The image shows a web interface for ParcelMonkey's multiple parcel search. At the top, there are two dropdown menus for 'From:' and 'to:', both set to 'United Kingdom', and two input fields for 'Postcode / Zip (optional)'. Below this, there are three rows for parcels. 'Parcel 1' has input fields for dimensions (10 x 10 x 10) and weight (0.5 kg). 'Parcel 2' and 'Parcel 3' have empty input fields for dimensions and weight. Each row has a plus icon and a minus icon. At the bottom right, there are two buttons: 'Add another parcel' (yellow) and 'Refresh Prices' (green).

Figure 2.3.2 ParcelMonkey Multiple Parcel Search

Strengths

- Many different options for shipping (next day, priority, drop off)
- Able to add multiple parcels during the search
- user friendly for individual customers rather than businesses

Weakness

- Complete lack of filter or sorting for results
- No visibility on drop off or shipment centres
- lack of external integration options for businesses

2.3 Comparison of previous systems




			
Sorting feature	✓	X	✓
Filter feature	X	X	X
Volumetric weight option	✓	✓	✓
Multiple parcel search	X	✓	X
Bulk order feature	✓	X	X
Map view for drop off centres	X	X	X
Courier rating	✓	✓	✓

Table 2.1 Platform Comparison Table

As shown in the comparison table above, all the three courier comparison platforms had some features while others did not, overall, Easyship was the best out of the three with its modern and simple user interface and abundance of features while ParcelMonkey was lacking behind the most with limited features apart from the primary price quote function. For the sorting/filter of results, although EasyParcel and Easyship both had a built-in sort on the attribute itself, it lacks more granular fine-tuning of the parameters such as filter by brand, price range, etc.

2.4 Proposed Solutions

The proposed solutions for the project to solve the weaknesses discussed above will be to develop a progressive web application that allows users to access the website through the web on a desktop or mobile environment in both browser and locally installed web application [9]. The platform will allow users to make informed decisions about their courier services by comparing many attributes, such as the price of the courier service by brands and their drop off centres nearby. More detailed information such as the parcel dimension and volume allowed by each courier service provider will be shown to the user to evaluate whichever service fits their parcel dimensions shipping needs.

CHAPTER 3: SYSTEM METHODOLOGY/APPROACH

3.1 Product Scope

Courier service comparison system should facilitate the following operations:

1. Compare courier services
2. Interactive map view of drop off centres
3. Provide suggestions for pre-paid packaging

3.2 Product Function

Feature ID	Feature	Description	Accessible Role
F001	Search courier services	To return a list of courier services with their respective information after the user enters shipment data.	User
F002	Sort courier result list	Sorts and returns the result list based on the selected sorting field	
F003	Filter courier result list	Filters and returns the result list based on the selected filter field	
F004	Pre-paid packaging suggestion	Recommends the ideal pre-paid packaging from each respective courier company based on the dimension of item entered	
F005	Sort packaging result list	Sorts and returns the result list based on the selected sorting field	
F006	Filter packaging result list	Filters and returns the result list based on the selected filter field	
F007	Search drop off centers on map	Allows users to see nearby drop off centers on the interactive map on the	

		result page	
F008	Go to current location on map	Requests for user permission to access current location and if approved, brings user to current location on map	
F009	Search drop off centers on selected point	Loads all the drop off centers around the point user selected on the interactive map	

Table 3.1 Product Function Table

3.3 Functional Requirements

3.3.1 [F001] Search courier services

3.3.1.1 Functional Requirement Listing

Functional Requirement ID	Functional Requirement Description
REQ_F101	System should validate the input of source/destination postcode, weight and parcel dimensions
REQ_F102	System should display error message in case of invalid input
REQ_F103	System should prompt for re-input of postcode and weight in case of invalid input

Table 3.2.1 Functional Requirements Table [F001]

3.3.1.2 Use Case Description

Use Case ID	UC001	
Use Case	Compare courier services	
Purpose	To display courier list with respective relevant information when user submits parcel source/destination and weight	
Actor	User	
Trigger	User Selects the search button on-screen	
Precondition	User inputs the source and destination postcode as well as the weight of parcel	
Scenario Name	Step	Action
Main Flow	1	User selects the search button on screen
	2	System validates the fields input by the user
	3	Get price quote via external API
	4	System redirects to result page
	5	System loads result list
Alternate Flow - invalid postcode	2.1.1	User inputs a postcode in source and or destination postcode field that is invalid
	2.1.2	System validates the option
	2.1.3	System displays an error message “Invalid postcode” above the respective postcode field
Alternate Flow - invalid weight	2.2.1	User inputs weight amount that is beyond bounds

	2.2.2	System validates the option
	2.2.3	System displays an error message “Invalid weight” above the weight field
Alternate Flow - invalid dimensions	2.3.1	User inputs dimension figure that is beyond bounds
	2.3.2	System validates the option
	2.3.3	System displays an error message “Invalid dimension” above the dimensions field
Alternate Flow - no couriers found	3.1	No matching results returned for getting price quotation for parcel delivery
	3.2	System redirects to result page
	3.3	System loads result page with empty table
Author	Lim Kai Shen	

Table 3.2.2 Use Case Description Table [F001]

3.3.2 [F002] Sort courier result list

3.3.2.1 Functional Requirement Listing

Functional Requirement ID	Functional Requirement Description
REQ_F201	System should sort the result by fields based on results

Table 3.3.1 Functional Requirements Table [F002]

3.3.2.2 Use Case Description

Use Case ID	UC002	
Use Case	Sort courier result list	
Purpose	To sort the courier result list according to user selection of field to be sorted.	
Actor	User	
Trigger	User selects on sorting field	
Precondition	Result page is loaded	
Scenario Name	Step	Action
Main Flow	1	User selects on sorting field
	2	System sorts results list
	3	System returns sorted result list
Alternate Flow – no results to be sorted	1.1	No sorting is performed
Author	Lim Kai Shen	

Table 3.3.2 Use Case Description Table [F002]

3.3.3 [F003] Filter courier result list**3.3.3.1 Functional Requirement Listing**

Functional Requirement ID	Functional Requirement Description
REQ_F301	System should filter result list by courier company

Table 3.4.1 Functional Requirements Table [F003]**3.3.3.2 Use Case Description**

Use Case ID	UC003	
Use Case	Filter courier result list	
Purpose	To filter the result list according to user selection of filter field	
Actor	User	
Trigger	User selects on filter field	
Precondition	Result page is loaded	
Scenario Name	Step	Action
Main Flow	1	User selects on filter field
	2	System filters result from filter list
	3	System returns filtered result list
Alternate Flow – no results to be filtered based on selected company	1.1	No filtering is performed
Author	Lim Kai Shen	

Table 3.4.2 Use Case Description Table [F003]**3.3.4 [F004] Provide suggestions for pre-paid packaging**

3.3.4.1 Functional Requirement Listing

Functional Requirement ID	Functional Requirement Description
REQ_F406	System should determine the best packaging (if available) for a given dimension of the object to be shipped
REQ_F406	System should allow the user to be linked to the source of pre-paid packaging to be purchased

Table 3.5.1 Functional Requirements Table [F004]**3.3.4.2 Use Case Description**

Use Case ID	UC004	
Use Case	Provide suggestions for pre-paid packaging	
Purpose	To provide a pre-paid packaging suggestion from the respective courier company given the parcel dimensions	
Actor	User	
Trigger	User Selects the search button on-screen	
Precondition	User inputs the source and destination postcode, weight of parcel and dimension of item	
Scenario Name	Step	Action
Main Flow	1	User selects the search button on screen
	2	System validates the dimension fields input by the user
	3	System calculates volumetric weight
	4	System redirects to result page

	5	System loads result list with recommended pre-paid packaging(s)
Alternate Flow - invalid weight	2.1.1	User inputs weight amount that is beyond bounds
	2.1.2	System validates the option
	2.1.3	System displays an error message “Invalid weight” above the weight field
Alternate Flow - invalid dimensions	2.2.1	User inputs dimension figure that is beyond bounds
	2.2.2	System validates the option
	2.2.3	System displays an error message “Invalid dimension” above the dimensions field
Alternate Flow - no pre-paid packaging suggestions	3.1	Dimensions or weight fields do not have any compatible pre-paid packaging
	3.2	System redirects to result page
	3.3	System loads result page with empty table
Author	Lim Kai Shen	

Table 3.5.2 Use Case Description Table [F004]

3.3.5 [F005] Sort packaging result list

3.3.5.1 Functional Requirement Listing

Functional Requirement ID	Functional Requirement Description
REQ_F501	System should sort the result by fields based on results

Table 3.6.1 Functional Requirements Table [F005]

3.3.5.2 Use Case Description

Use Case ID	UC005	
Use Case	Sort courier result list	
Purpose	To sort the packaging result list according to user selection of field to be sorted.	
Actor	User	
Trigger	User selects on sorting field	
Precondition	Result page is loaded	
Scenario Name	Step	Action
Main Flow	1	User selects on sorting field
	2	System sorts results list
	3	System returns sorted result list
Alternate Flow – no results to be sorted	1.1	No sorting is performed
Author	Lim Kai Shen	

Table 3.6.2 Use Case Description Table [F005]

3.3.6 [F006] Filter packaging result list**3.3.6.1 Functional Requirement Listing**

Functional Requirement ID	Functional Requirement Description
REQ_F601	System should filter result list by courier company

Table 3.7.1 Functional Requirements Table [F006]**3.3.6.2 Use Case Description**

Use Case ID	UC006	
Use Case	Filter packaging result list	
Purpose	To filter the result list according to user selection of filter field	
Actor	User	
Trigger	User selects on filter field	
Precondition	Result page is loaded	
Scenario Name	Step	Action
Main Flow	1	User selects on filter field
	2	System filters result from filter list
	3	System returns filtered result list
Alternate Flow – no results to be filtered based on selected company	1.1	No filtering is performed
Author	Lim Kai Shen	

Table 3.7.2 Use Case Description Table [F006]

3.3.7 [F007] Interactive map view of drop off centres**3.3.7.1 Functional Requirement Listing**

Functional Requirement ID	Functional Requirement Description
REQ_F701	System should show all drop off centres around user location
REQ_F702	System should show drop off center name when user clicks on the icon
REQ_F703	System should ask permission for browser to access user current location

Table 3.8.1 Functional Requirements Table [F007]**3.3.7.2 Use Case Description**

Use Case ID	UC007	
Use Case	Interactive map view of drop off centres	
Purpose	To display drop off centres of all relevant courier companies	
Actor	User	
Trigger	Result page on load after the user submits search	
Precondition	User inputs a valid source and destination postcode as well as the weight of parcel	
Scenario Name	Step	Action
Main Flow	1	Result page on load after the user submits search
	2	System prompts request to access user's location through the browser

	3	Map location pans to current location of user
	4	Map loads with drop off centres around location
Alternate Flow - user denies location access	2.1	User denies system prompt permission for access to user location
	2.2	Map location defaults to a predefined location in the system
Alternate Flow - no drop off centers in proximity	3.1	Map loads without any pin drops
Author	Lim Kai Shen	

Table 3.8.2 Use Case Description Table [F007]

3.3.8 [F008] Go to current location on map**3.3.8.1 Functional Requirement Listing**

Functional Requirement ID	Functional Requirement Description
REQ_F801	System should ask permission for browser to access user current location
REQ_F803	System should allow the user to go to current location on map

Table 3.9.1 Functional Requirements Table [F008]**3.3.8.2 Use Case Description**

Use Case ID	UC008	
Use Case	Go to current location on map	
Purpose	To allow user to go to current location on the map.	
Actor	User	
Trigger	User selects "pan to current location" button	
Precondition	Map is loaded on the results page	
Scenario Name	Step	Action
Main Flow	1	User selects "pan to current location" button
	2	System prompts request to access user's location through the browser
	3	Map pans over to user location on the map
	4	Nearby drop off centers are loaded on map

Alternate Flow - user block access to location	2.1	Unable to obtain users current device location
	2.2	Map location defaults to users previous location on map
Alternate Flow - no drop off centers in proximity	3.1	Map loads without any pin drops
Author	Lim Kai Shen	

Table 3.9.2 Use Case Description Table [F008]

3.3.9 [F009] Search drop off centers on selected point

3.3.9.1 Functional Requirement Listing

Functional Requirement ID	Functional Requirement Description
REQ_F901	System should allow the user to drop the pin on the map
REQ_F902	System should allow the user to search drop off centres

Table 3.10.1 Functional Requirements Table [F009]

3.3.9.2 Use Case Description

Use Case ID	UC009	
Use Case	Search drop off centers on selected point	
Purpose	To allow users to search a particular area for drop off centers on the map by double clicking on a desired point.	
Actor	User	
Trigger	User selects double clicks on map	
Precondition	Map is loaded on the results page	
Scenario Name	Step	Action
Main Flow	1	User double clicks on desired point on map
	2	System zooms into predefined value
	3	System searches for drop off centers information
	4	System loads map with drop off centers around dropped pin

Alternate Flow - no drop off centers found for selected point	3.1	No results returned from system
	3.2	System loads map without drop off centers around dropped pin
Author	Lim Kai Shen	

Table 3.10.2 Use Case Description Table [F009]

3.4 Use Case Diagram

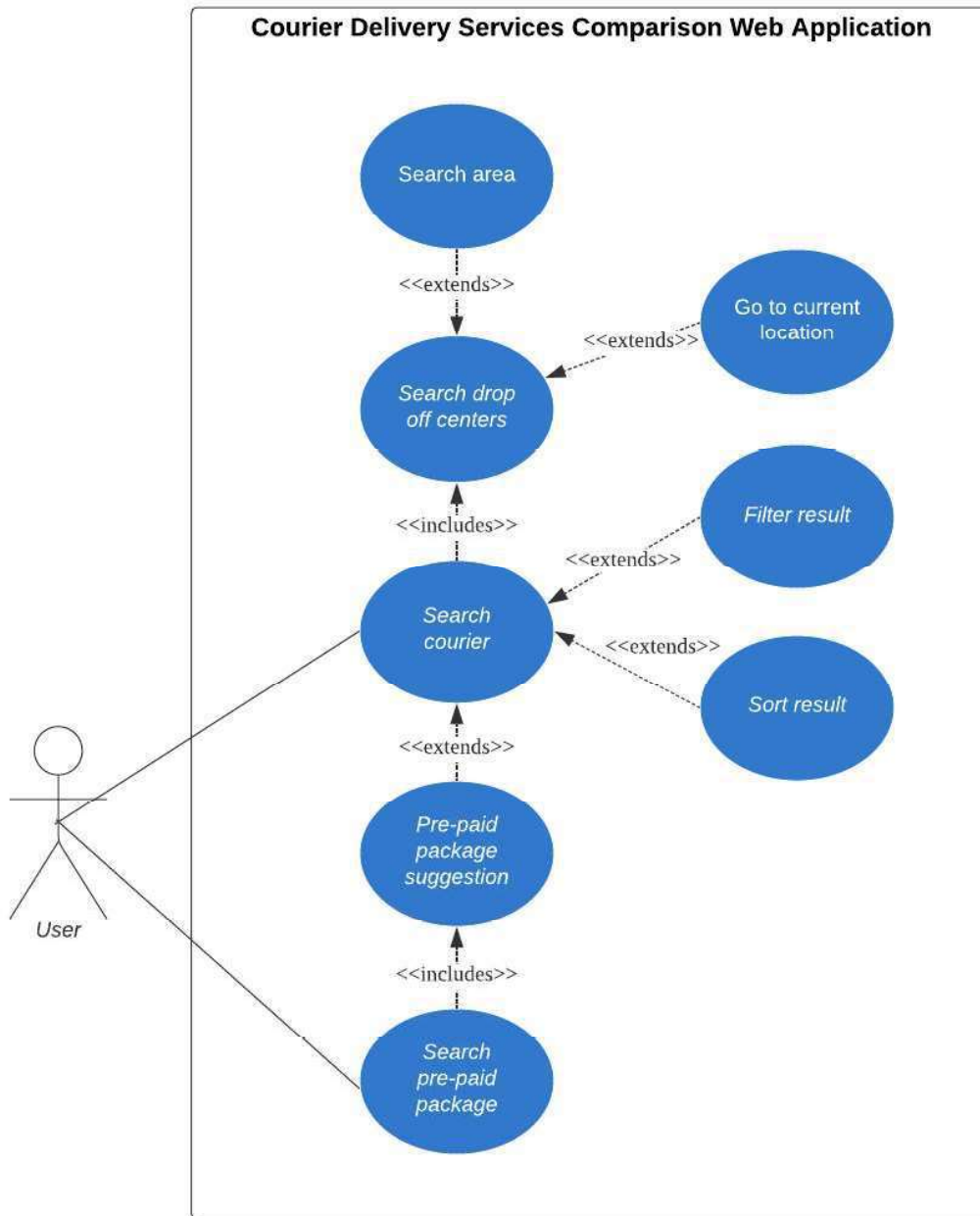


Figure 3.1 Use Case Diagram

3.5 Activity Diagram

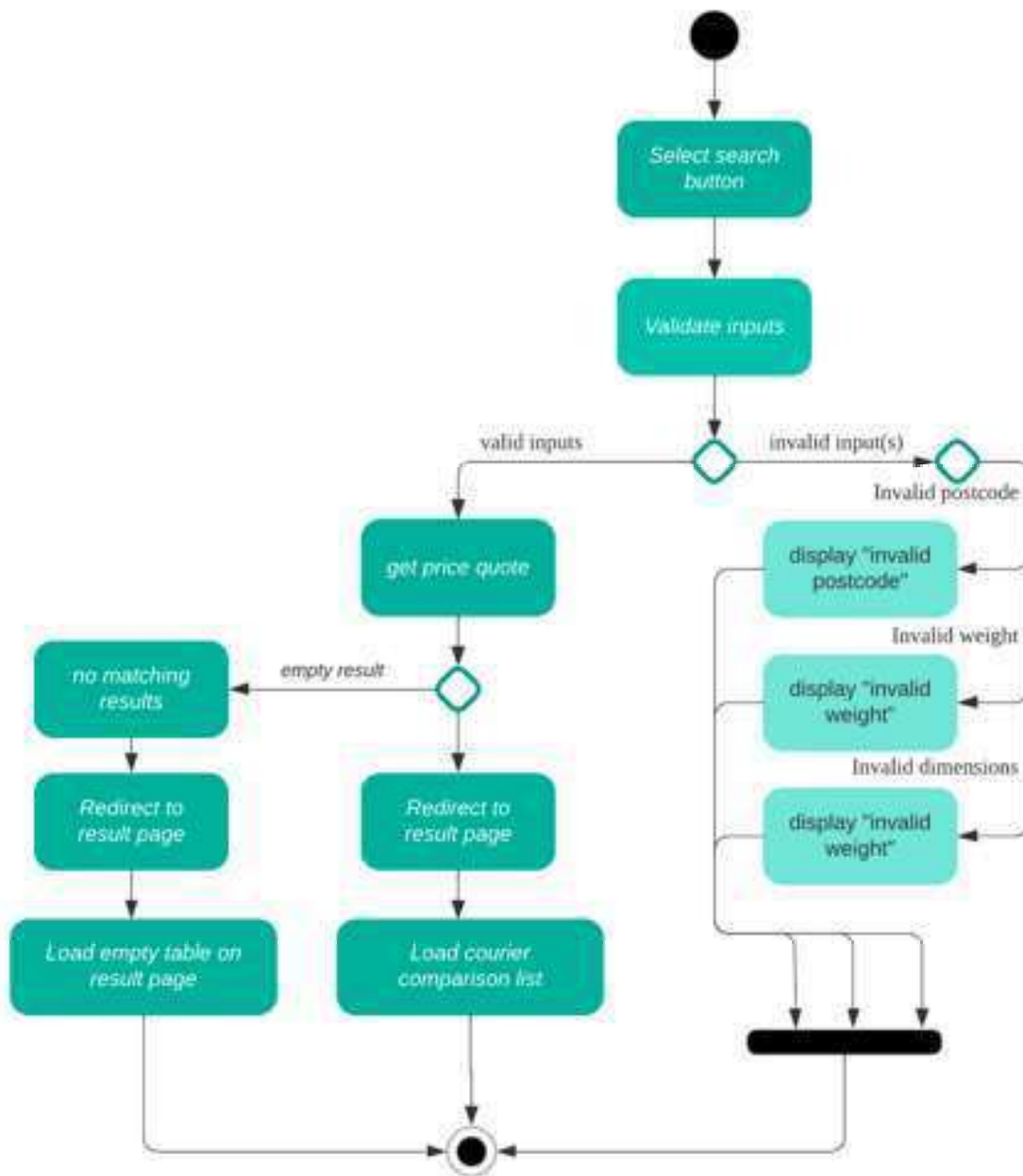


Figure 3.2 Activity Diagram [F001]

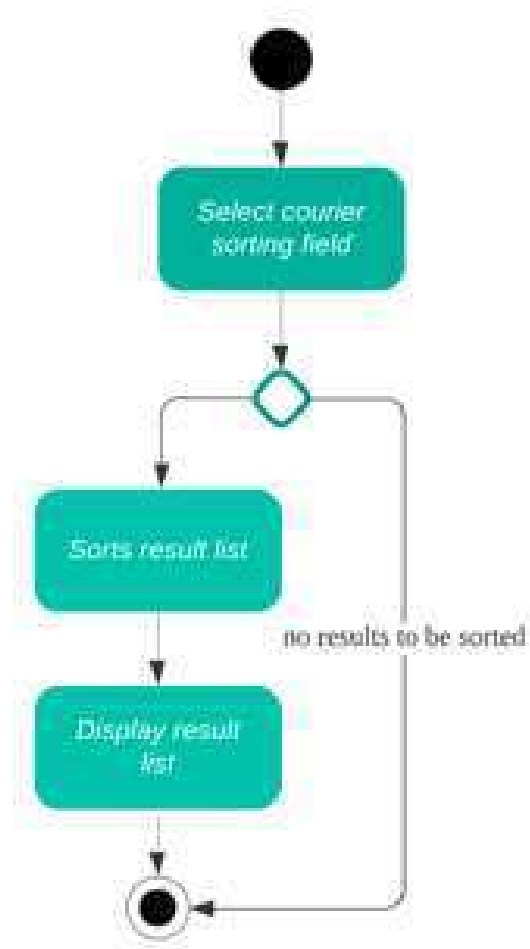


Figure 3.3 Activity Diagram [F002]

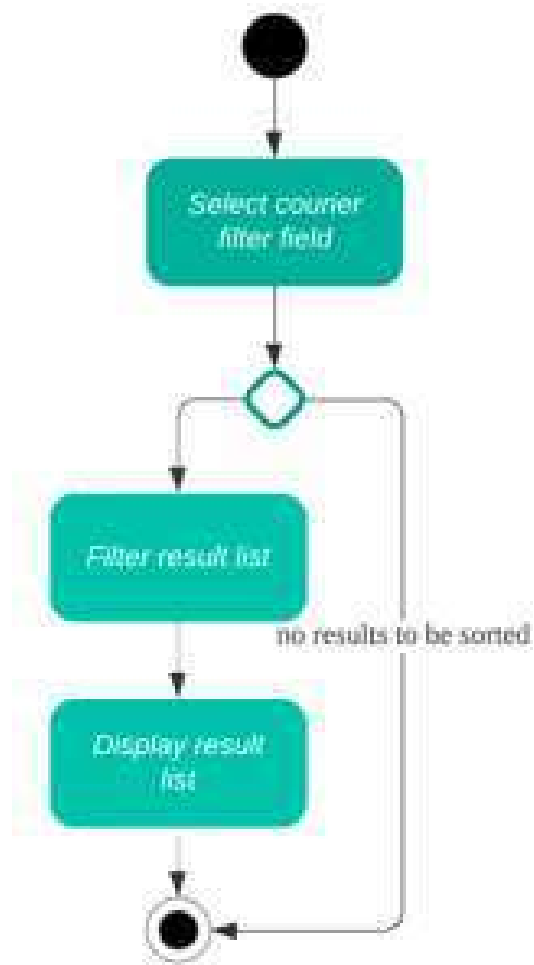


Figure 3.4 Activity Diagram [F003]

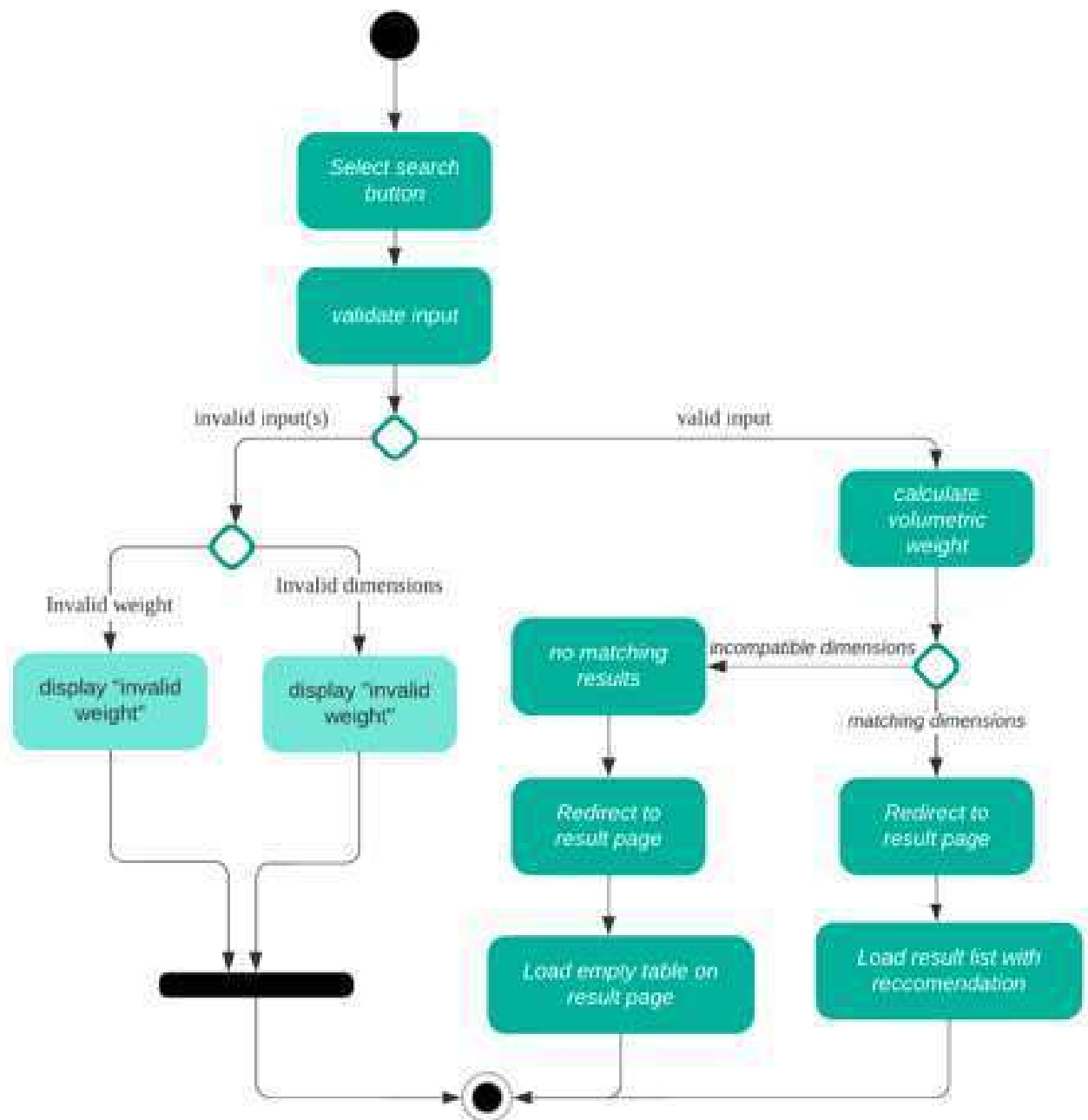


Figure 3.5 Activity Diagram [F004]

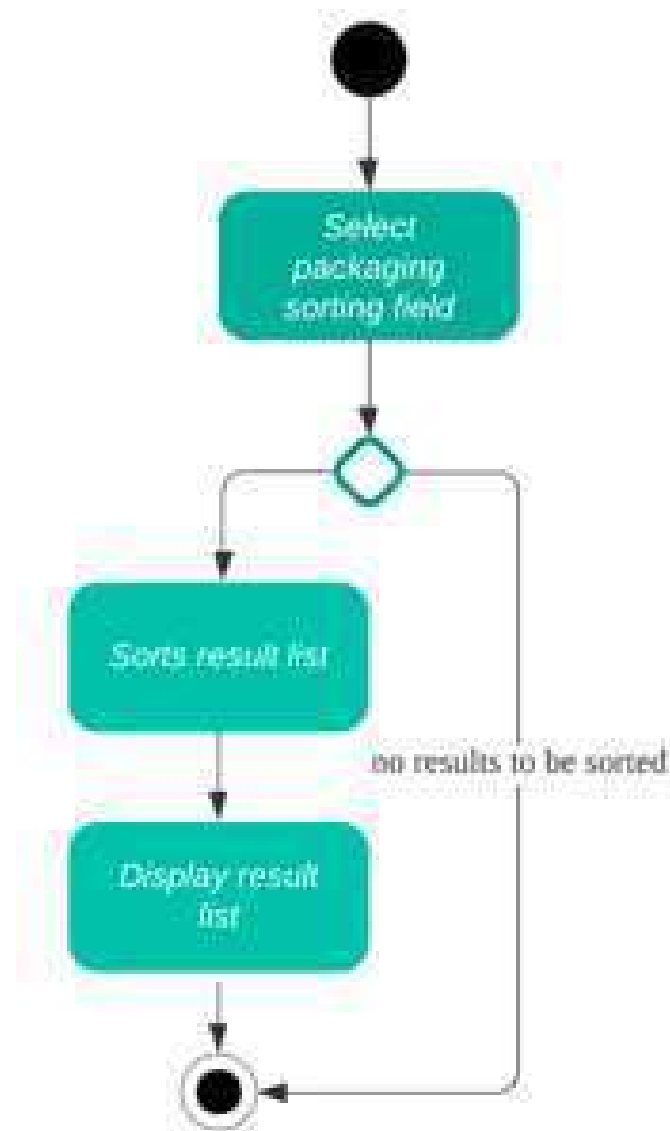


Figure 3.6 Activity Diagram [F005]

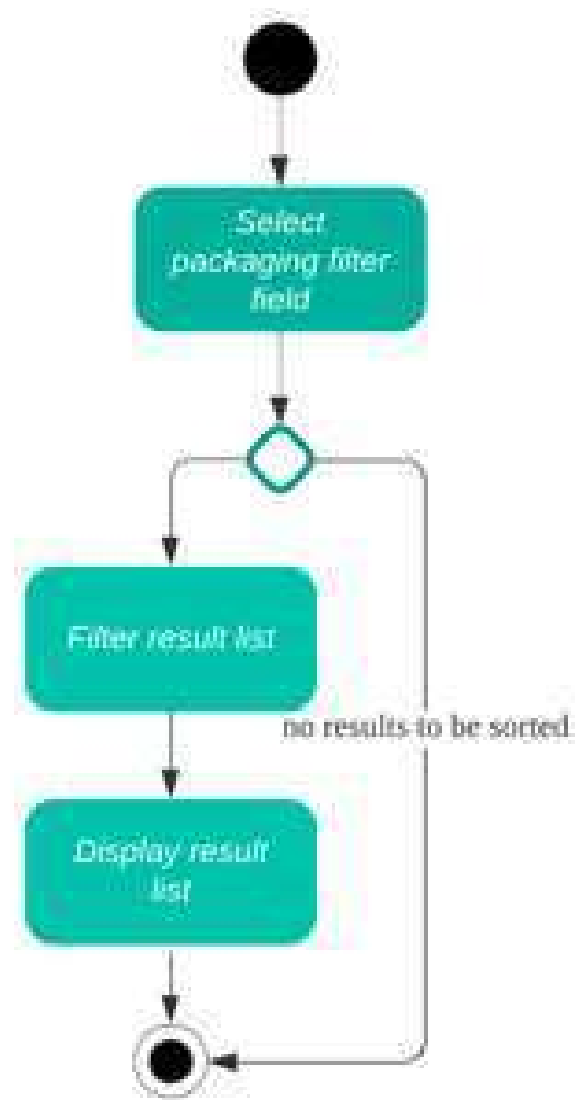


Figure 3.7 Activity Diagram [F006]

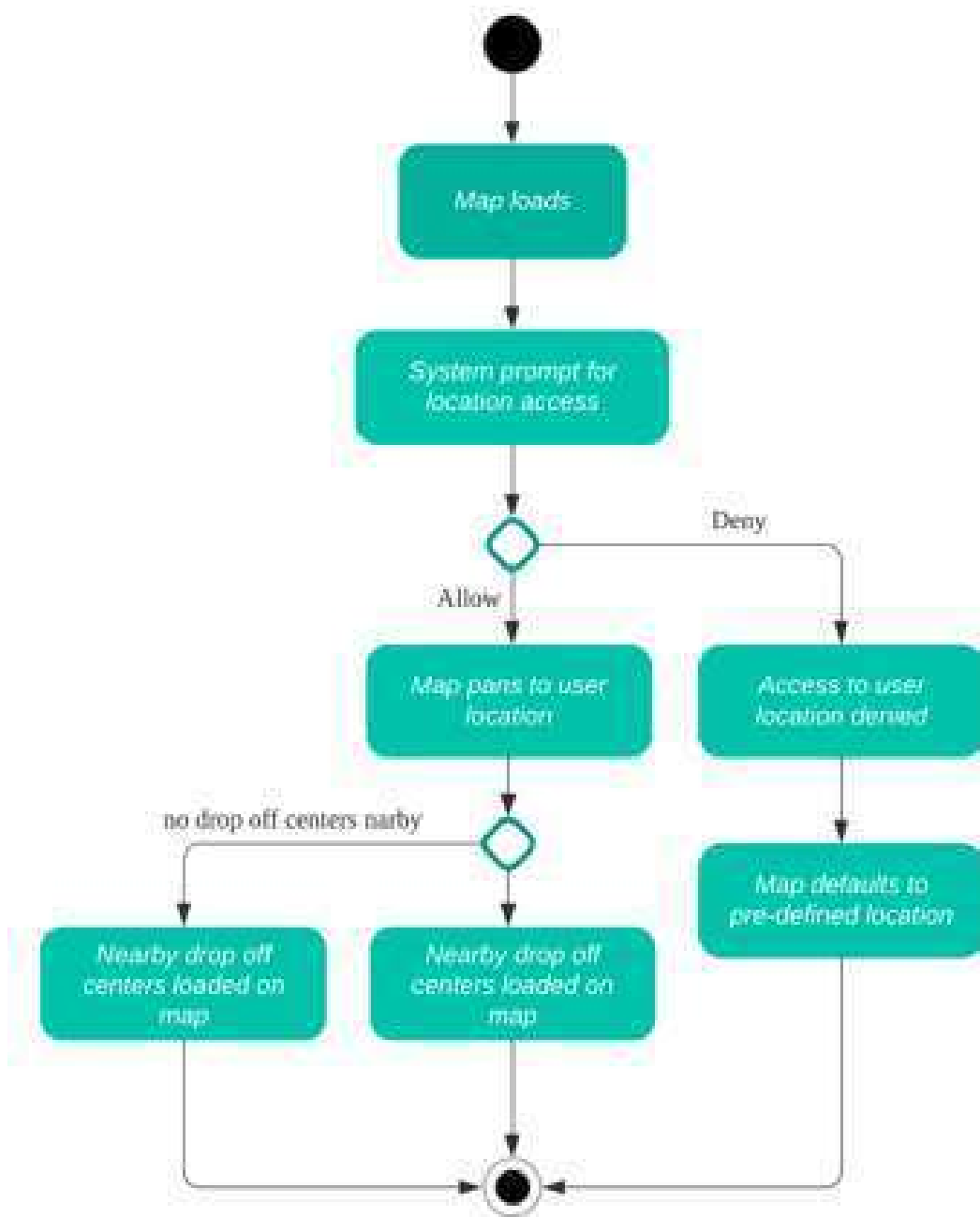


Figure 3.8 Activity Diagram [F007]

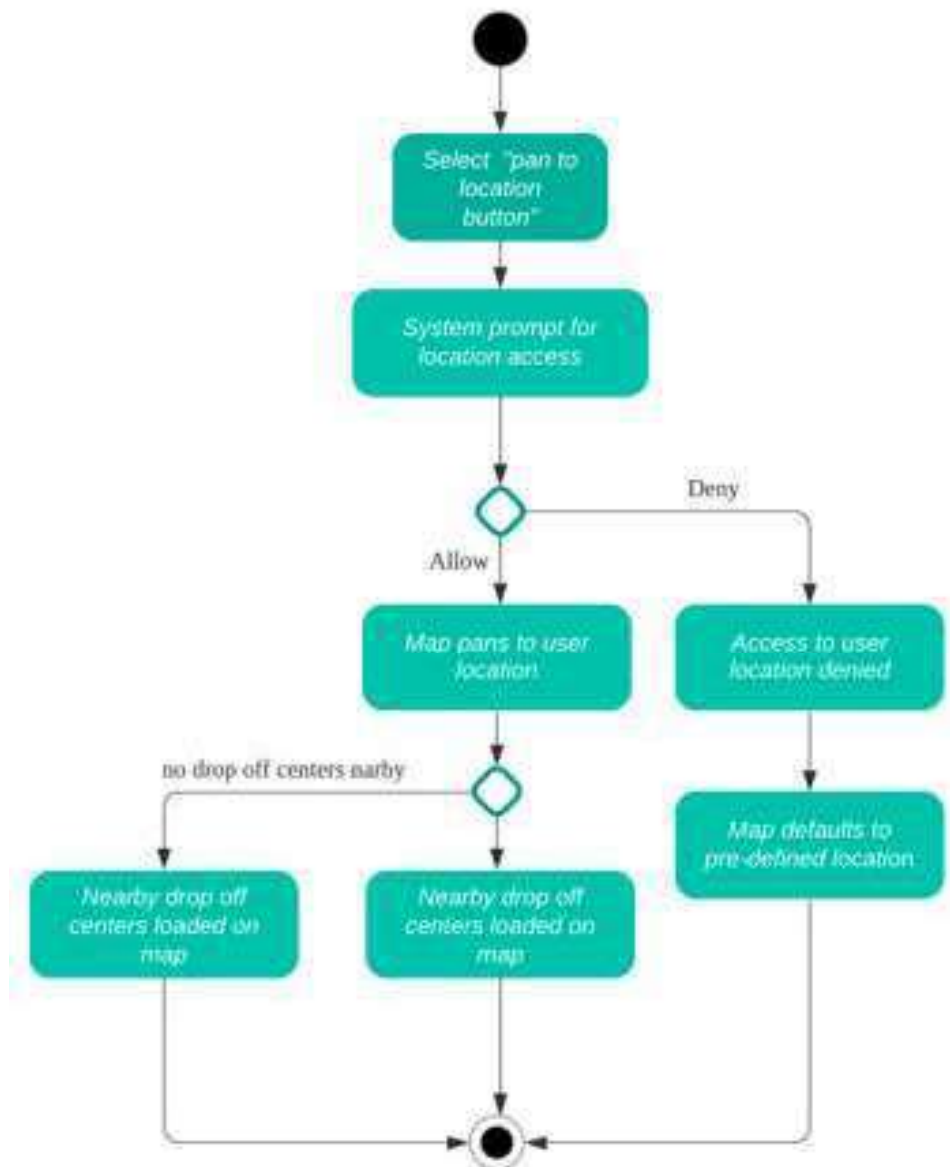


Figure 3.9 Activity Diagram [F008]

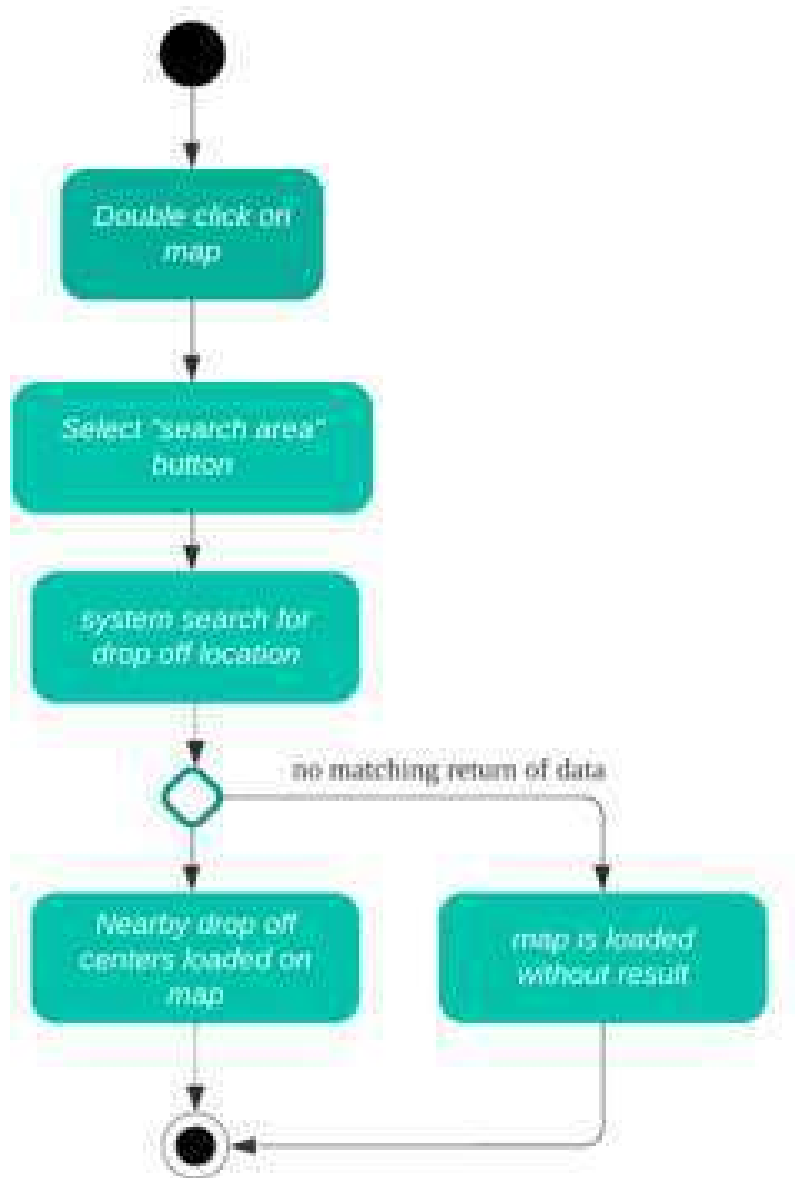


Figure 3.10 Activity Diagram [F009]

CHAPTER 4 : SYSTEMS DESIGN

4.1 System Architecture

The proposed architecture for the system is 3 Tier Layered Architecture using the PERN stack, consisting of Postgres, Express.js, React.js and NodeJS [8]. A high-level diagram is shown below where the client-facing front end uses a react-bootstrap framework [12] for interactive websites and the standard suite of languages like HTML/CSS and javascript. The back end handles the system's business logic and interacts with both the user requests and data transactions in the database management system. Sequelize is an ORM for SQL databases which is also applicable for PostgreSQL for an added abstraction layer. The system also calls a third party API of courier services. Express will handle all the API calls and relay them to the front end. The DBMS of choice for this project is PostgreSQL. This relational database management system is free and open-source, and it complies with the ACID standard.

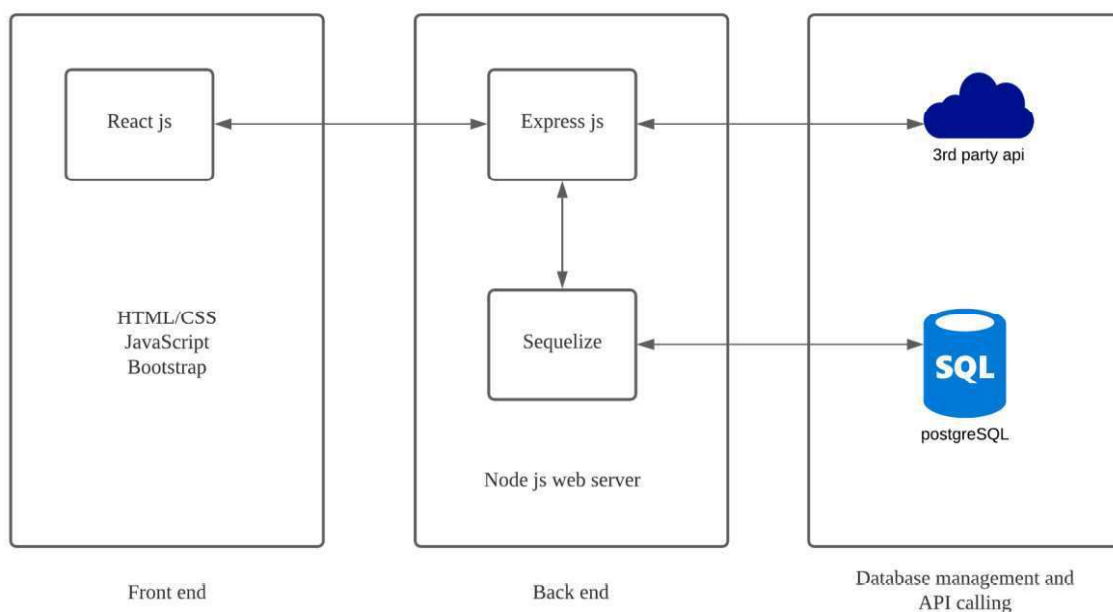


Figure 4.1 High-level Architecture Diagram

4.1 Wireframe

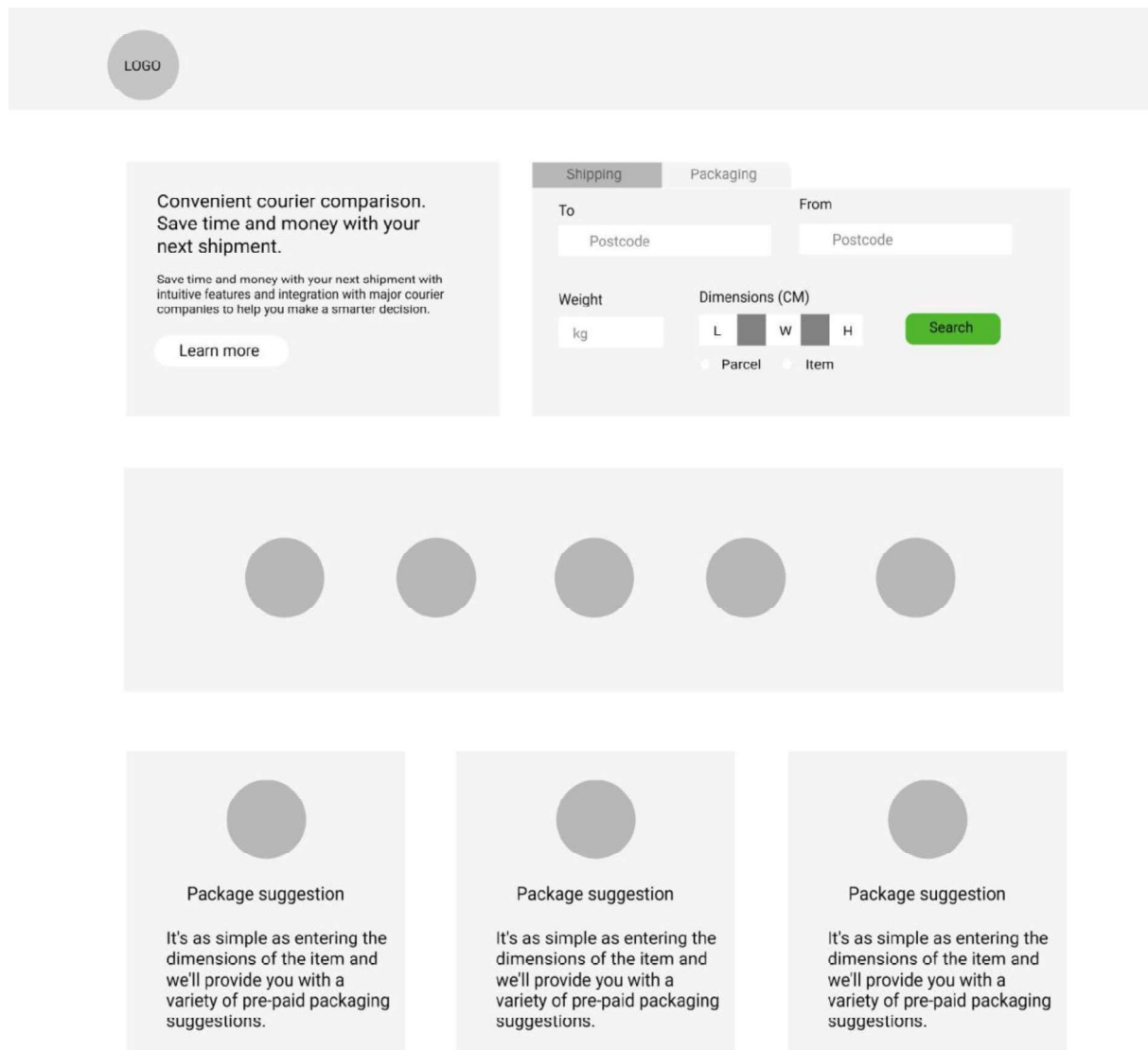


Figure 4.2.1 Landing Page Wireframe

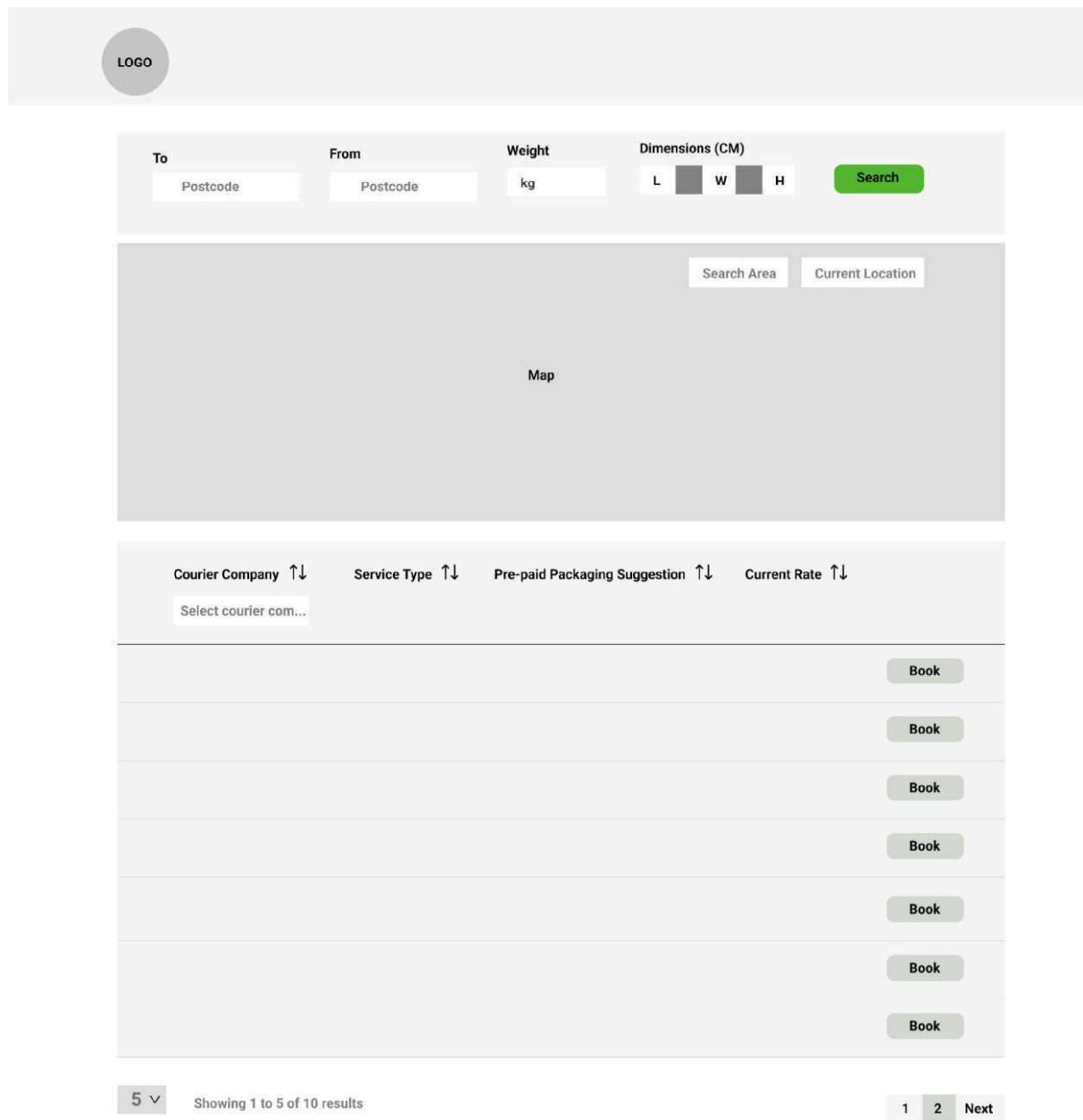


Figure 4.2.2 Courier Results Page Wireframe

LOGO

Dimensions (CM) Weight

L W H kg Search

Courier Company ↑↓ Weight Limit ↑↓ Package Type ↑↓ Package Dimension ↑↓ Current Rate ↑↓

Select courier com...

Book

Book

Book

Book

Book

Book

Book

5 ▾ Showing 1 to 5 of 10 results 1 2 Next

Figure 4.2.3 Pre-paid Packaging Results Page Wireframe

4.2 Database Design

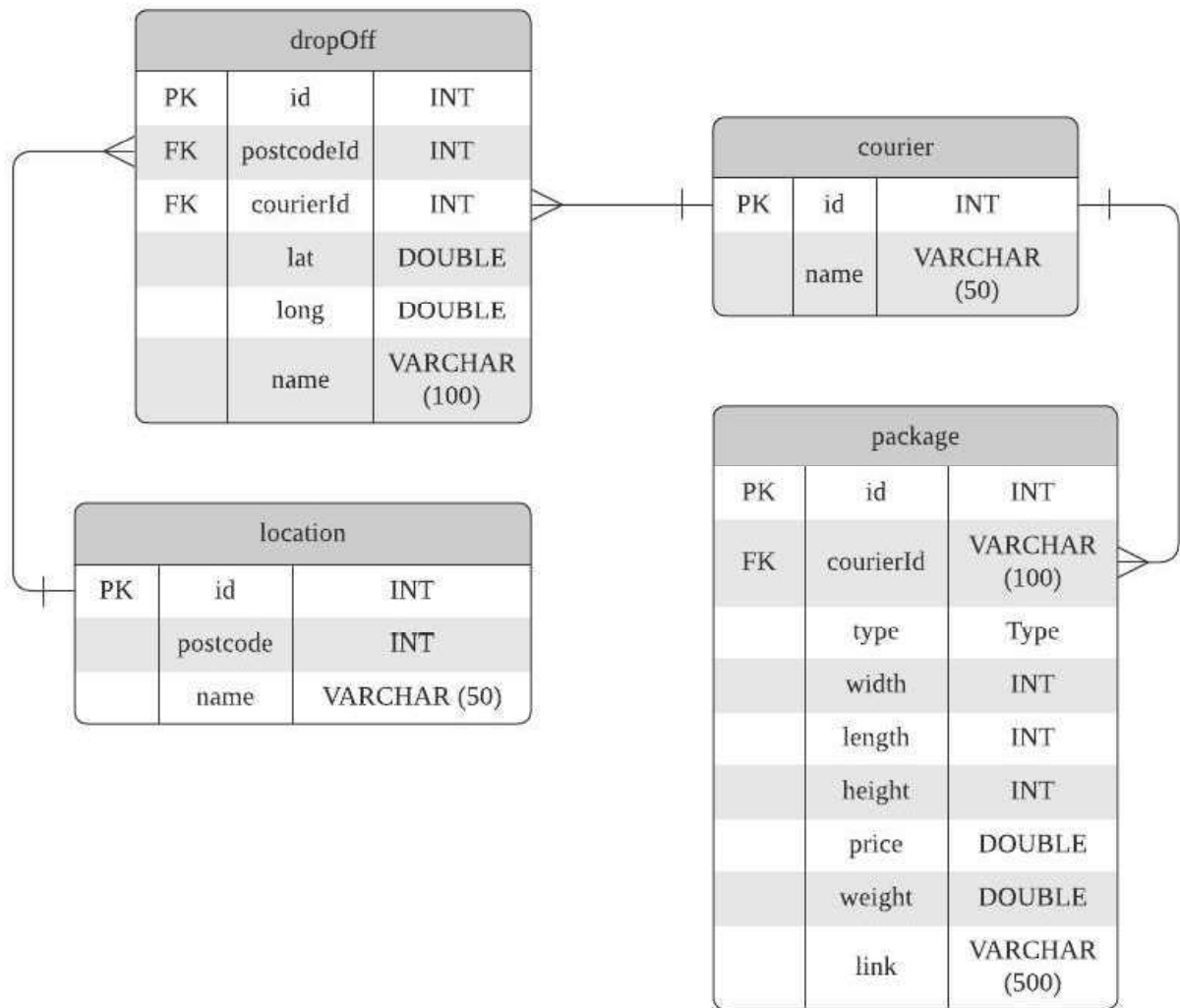


Figure 4.3 Entity Relationship Diagram

CHAPTER 5 : SYSTEM IMPLEMENTATION

5.1 System Methodology

To successfully complete the proposed system, a suitable methodology should be set in place with stipulated guidelines to abide by. The waterfall model in the system development life cycle (SDLC) [7] is chosen to achieve the proposed objectives and sub-objectives discussed above.

As this final year project is run on a tight deadline and drastic changes to the requirements are not encouraged to occur, requirements have to be well established before the project can begin with a clear picture of the final product in mind. And with that, it would be hard to accommodate changes or additions to the project [10], which is an ideal trait in this situation.

With requirements set in place, deliverables expected from the project can be easily gauged and planned for smooth development progression without ambiguous requirements causing changes in the deliverables and timeline.

The waterfall model's linear and sequential approach ensures that there are no overlapping work and all tasks are done one before the other. As this project is to be completed by a single person from design to implementation, there will be no need to consider many people contributing to the project and the risk of completion of different rates and one relying on the other work to start [11].

The waterfall model also requires extensive documentation of the system, with each phase being extensively documented, including the task done, steps taken, and requirements taken into consideration. This is an ideal trait as this final year project requires a thorough report on how the system is developed, documentation on the work done is crucial in achieving the requirement of the project report.

CHAPTER 5

There are four main phases in the system development life cycle (SDLC), which will be discussed below:

1. Requirements/Analysis
2. Design
3. Implementation/Coding
4. Testing

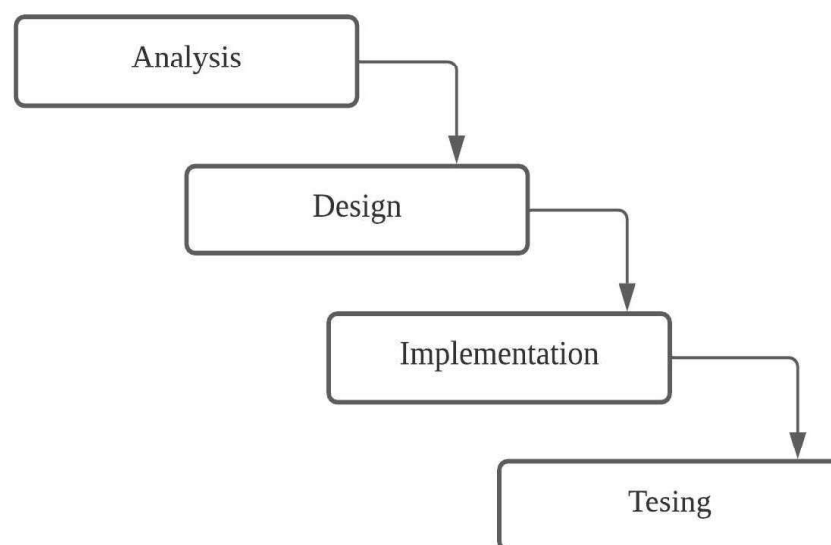


Figure 5.1 Waterfall model of SDLC

Phase 1: Requirements/Analysis

Several literature reviews have been done to understand better the system that will be developed by cross-referencing existing products and solutions to compare and contrast their benefits and flaws. Then, requirements for the project are gathered and established in the form of a user requirement document and resolving any ambiguities among the requirements and getting an idea of the form and purpose of the system being developed and the problem being solved to obtain a strong understanding of the system before moving on in the development process. Furthermore, a class and use case diagram are to be derived from the user requirement document after careful analysis

CHAPTER 5

Phase 2: Design

In the design phase, a detailed software architecture plan is made, including all the hardware, software, technologies, and system requirements. Namely, as this project will be using a SQL database, which is a relational database, the database design, including the ERD model, will be developed according to the class diagram made in the previous phase, all the tables in the model will be in 3NF which uses normalisation principles to reduce redundancy, ensure referential integrity and simple design. Furthermore, a low-fidelity prototype, also known as clickable wireframe, will be created, allowing users to experience the look and feel on top of the structural and visual hierarchy provided by wireframing.

Phase 3: Implementation/Coding

In the implementation phase of the software development life cycle, software architecture and design established in the above step is then broken down into sub-modules to be translated into code. Finally, integrating all the different parts completed into one working system. In the context of this project, it could be separated into the front end, back end, and database parts to be completed one after the other

Phase 4: Testing

There will be three main phases of testing applied to the developed system: unit testing, component testing, and system testing. Unit testing will be performed on the system's individual components in isolation to detect defects within the code that outputs a result that is incorrect or abrupt termination of the process. Once unit testing is passed, component testing will be conducted, which tests the interaction of different objects in composite components by accessing the functionalities of the objects, errors including parameters in wrong order, incorrect assumption of the behaviour of the component, as well as synchronisation errors. Finally, system testing is the integrated system consisting of all the components working together. In this test, the interaction between components is tested to see if interactions are correct by transferring of right data through their interface at the correct timing. This is done by use-case testing by identifying system interaction based on intended use to test the emergent behaviour of the system.

5.2 Project Timeline

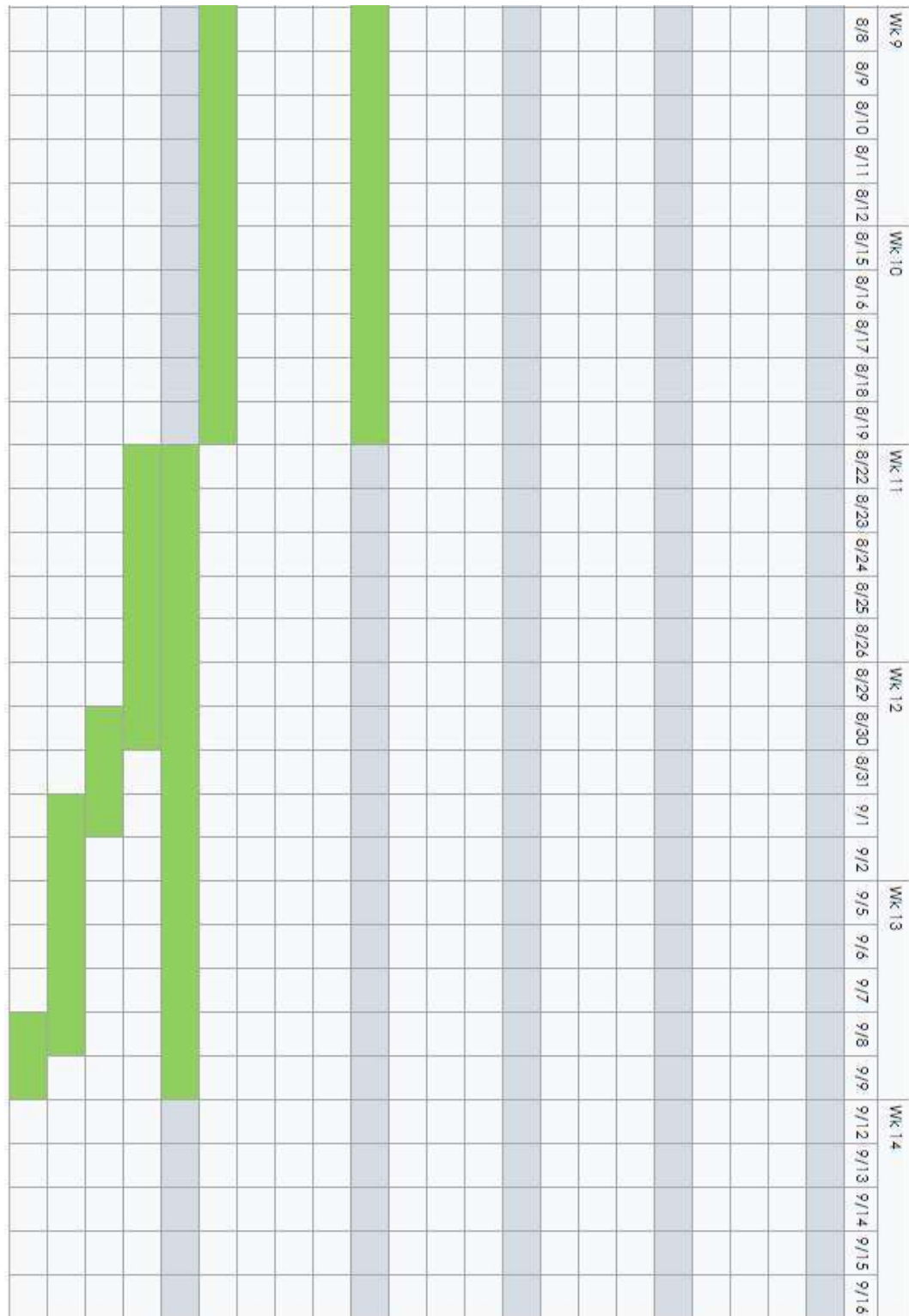
TASKS	START	END	DAYS	WK 1							WK 2							WK 3																		
Front End Development	06/13	06/24	10	6/13	6/14	6/15	6/16	6/17	6/20	6/21	6/22	6/23	6/24	6/27	6/28	6/29	6/30	7/1																		
Develop React project structure including routes and components	06/13	06/18	5																																	
Implement Redux store for state management	06/17	06/22	4																																	
Progressive web application integration	06/22	06/24	3																																	
Back End Development	06/24	07/08	11																																	
Develop and configure express back end	06/24	06/29	4																																	
Develop API interface routes	06/29	07/05	5																																	
Develop API interface services	07/05	07/08	4																																	
Database Development	07/08	07/19	8																																	
Design database schema	07/08	07/11	2																																	
Develop and populate database on postgres/postbird	07/11	15/07/2022	5																																	
Develop object relational model	07/15	07/19	3																																	
Integration & Testing	07/19	08/21	24																																	
Integrate database with backend by interfacing with ORM	07/19	07/24	4																																	
Connect frontend to back end through API interface	07/24	07/29	5																																	
Perform use case testing	07/29	08/04	5																																	
Fix bugs and incremental improvements	08/04	08/21	12																																	
FYP2 Report	08/21	09/10	15																																	
Document product in report including screenshots	08/21	08/30	7																																	
Create poster	08/30	09/01	3																																	
Finalize FYP2 report with required documents and formatting	09/01	09/08	8																																	
Submission of project	09/08	09/10	2																																	

Figure 5.2 FYP2 Timeline

CHAPTER 5

Wk 4	
7/4	
7/5	
7/6	
7/7	
7/8	
Wk 5	
7/11	
7/12	
7/13	
7/14	
7/15	
Wk 6	
7/18	
7/19	
7/20	
7/21	
7/22	
Wk 7	
7/25	
7/26	
7/27	
7/28	
7/29	
Wk 8	
8/1	
8/2	
8/3	
8/4	
8/5	

CHAPTER 5



5.3 Technologies and Tools Involved

The hardware involved in this project is a desktop computer with a monitor, keyboard, and mouse. The computer is responsible for compiling the written code from development to testing to deployment.

5.3.1 Hardware

Description	Specifications
Monitor	Dell SE2222H 1980 x 1080 x 60 Hertz
Processor	Intel Core i5-6500
Operating System	Windows 10
Graphic	NVIDIA GeForce GTX 1050 Ti
Memory	16GB DDR4 RAM
Storage	128GB SATA SSD, 2TB SATA HDD

Table 5.1.1 Hardware Specification Table

5.3.2 Software

Description	Specifications
IDE	Visual Studio Code 1.59.0
API development	Postman
Displaynd	React v17.0.2
Back-end	Express.js
Runtime Environment	Node.js v14.17.0
Database	PostgreSQL v13

Low-fidelity prototyping	Figma
Diagramming tool	Lucidchart

Table 5.1.2 Software Specification Table

5.4 Progressive Web Application

Progressive web applications, also known as PWA is a term used to describe the technology applied to a web application that allows it to look and behave like a mobile app. This technology was created by Google back in 2015, ever since, progressive web apps have grown in popularity due to the increased growth of mobile adoption and consumption [4]; therefore, with the project being developed with progressive web application technology, it will allow for better usability of the proposed application, especially on mobile (android) and desktop (macOS and Microsoft) [5]. Five key attributes make this PWA implementation significant [6].

1. Availability during offline mode

Traditionally, websites cannot display the content without an internet connection because it cannot be loaded without access to the application server that provides the application with the code and data needed to be displayed. Progressive web apps mitigate this problem by caching the files needed to display content so that even without an internet connection, content that was cached before can be pulled to display content for the user, which increases user interactions with the system thanks to the improved availability and access.

2. App-like behaviour

Progressive web apps allow users to enjoy the user experience of an app on their phone, giving the same look and feel as what a comparable native mobile application would, simultaneously inheriting the performance and responsiveness of websites with database access. Furthermore, PWA websites are also indexable by web browsers to be easily searched for and, therefore, a more significant audience exposure than a native mobile app.

CHAPTER 5

3. Easy Installation

With just a click of an icon and the progressive web app will be installed on the desktop or mobile device which is an easy and fast process that is very intuitive and reduces friction, increasing adoption rates.

4. No app store submission

This streamlined procedure apart from encouraging user adoption, also reduces the extra complexity of developers having to publish a mobile app on the Apple App Store and Google Playstore, respectively, which is a tedious process subject to additional requirements imposed by the respective app stores.

5. Able to access hardware

Push notifications are one of the many features that can be added to PWAs. This feature can help businesses reach out to their customers and engage them. Aside from these, PWAs can also be used to integrate multiple hardware features such as GPS that can further enhance user experience.

5.5 Implementation Issues and Challenges

The majority of courier service providers that offer APIs to acquire real time pricing data are restricted to the public and for developers to interact with, which presents one of the primary problems in delivering the most accurate and comprehensive price comparison service. Getting the actual cost information given the shipping specifics might be difficult because of this restriction. Pgeon is the only courier company that currently has an open developer sandbox API, which allowed us to integrate and call their API for pricing information while the others had to be simulated. Furthermore, in order to be considered for access to their respective API, a lengthy application process as well as a registered company is required. There is just one exception to this rule, and that exception is Pgeon. Pgeon is the only courier company that currently has an open developer sandbox API.

In addition, the information regarding the collection points has to be manually scraped off of Google Maps for a specific region, which is a process that is both time-consuming and resource-intensive. For the time being, only selected regions of the map are covered, which reveals drop-off centres when the particular region is searched for the purpose of demonstrating this project.

5.6 System Testing

Compare courier services				
Test Case Filename: CourierResult			Date Created: 13/08/2022	
Tester: Lim Kai Shen				
Transactions: CourierResult.js				
Purpose of Test Case: To test displaying courier info when user submits parcel source, destination and weight				
Step No.	Input Value	Expected Results	Actual Results	Pass/Fail
1.	Zip length less than 5	Display error of incorrect input length	Display error of incorrect input length	Pass
2.	Zip length more than 5	Display error of incorrect input length	Display error of incorrect input length	Pass
3.	Zip field is left empty	Display error of required field	Display error of required field	Pass
4.	Zip data consists of characters	Display error of invalid zip	Display error of invalid zip	Pass
5.	Weight is a negativie value	Display error of positive number required	Display error of positive number required	Pass
6.	Weight field is left empty	Display error of required field	Display error of required field	Pass
7.	Length field is a negative value	Display error of positive number required	Display error of positive number required	Pass

8.	Width field is a negative value	Display error of positive number required	Display error of positive number required	Pass
9.	Height field is a negative value	Display error of positive number required	Display error of positive number required	Pass
10.	No courier info found	Display empty table	Display empty table	Pass

Table 5.2.1 Compare Courier Services Test Case Table

Filter courier result list				
Test Case Filename: CourierResult		Date Created: 13/08/2022		
Tester: Lim Kai Shen				
Transactions: CourierResult.js				
Purpose of Test Case: To test filtering of table information based on courier companies				
Step No.	Input Value	Expected Results	Actual Results	Pass/Fail
1.	User selects on courier company in dropdown	Table returns only information of selected company	Table returns only information of selected company	Pass
2.	User selects on courier company in dropdown not in result table	No filtering is performed	No filtering is performed	Pass

Table 5.2.2 Filter Courier Result List Test Case Table

Sort courier result list				
Test Case Filename: CourierResult		Date Created: 13/08/2022		
Tester: Lim Kai Shen				
Transactions: CourierResult.js				
Purpose of Test Case: To test sorting of table information based on courier companies				
Step No.	Input Value	Expected Results	Actual Results	Pass/Fail
1.	User selects sort on courier company field	Table returns information sorted by company	Table returns information sorted by company	Pass
2.	User selects sort on courier company field in empty table	No sorting is performed	No sorting is performed	Pass
3.	User selects sort on prepaid packaging field	Table returns information sorted by prepaid packaging	Table returns information sorted by prepaid packaging	Pass
4.	User selects sort on prepaid packaging field in empty table	No sorting is performed	No sorting is performed	Pass
5.	User selects sort on current rate field	Table returns information sorted by current rate	Table returns information sorted by current rate	Pass
6.	User selects sort on current rate field in empty table	No sorting is performed	No sorting is performed	Pass

Table 5.2.3 Sort Courier Result List Test Case Table

Compare prepaid package suggestion				
Test Case Filename: PackageResult		Date Created: 13/08/2022		
Tester: Lim Kai Shen				
Transactions: PackageResult.js				
Purpose of Test Case: To test displaying prepaid package suggestion info when user submits package dimensions and weight				
Step No.	Input Value	Expected Results	Actual Results	Pass/Fail
1.	Weight is a negativie value	Display error of positive number required	Display error of positive number required	Pass
2.	Weight field is left empty	Display error of required field	Display error of required field	Pass
3.	Length field is a negative value	Display error of positive number required	Display error of positive number required	Pass
4.	Length field is left empty	Display error of required field	Display error of required field	Pass
5.	Width field is a negative value	Display error of positive number required	Display error of positive number required	Pass
6.	Width field is left empty	Display error of required field	Display error of required field	Pass
7.	Height field is a negative value	Display error of positive number required	Display error of positive number required	Pass
8.	No suggestions info found	Display empty table	Display empty table	Pass

Table 5.2.4 Compare Prepaid Package Suggestion Test Case Table

Filter Prepaid Package Suggestion Result List				
Test Case Filename: PackageResult		Date Created: 13/08/2022		
Tester: Lim Kai Shen				
Transactions: PackageResult.js				
Purpose of Test Case: To test filtering of table information based on prepaid package suggestion				
Step No.	Input Value	Expected Results	Actual Results	Pass/Fail
1.	User selects on courier company in dropdown	Table returns only information of selected company	Table returns only information of selected company	Pass
2.	User selects on courier company in dropdown not in result table	No filtering is performed	No filtering is performed	Pass

Table 5.2.5 Filter Prepaid Package Suggestion Result List Test Case Table

Sort Prepaid Package Suggestion Result List				
Test Case Filename: PackageResult			Date Created: 13/08/2022	
Tester: Lim Kai Shen				
Transactions: PackageResult.js				
Purpose of Test Case: To test sorting of table information based on prepaid package suggestion				
Step No.	Input Value	Expected Results	Actual Results	Pass/Fail
1.	User selects sort on courier company field	Table returns information sorted by company	Table returns information sorted by company	Pass
2.	User selects sort on courier company field in empty table	No sorting is performed	No sorting is performed	Pass
3.	User selects sort on weight limit field	Table returns information sorted by weight limit	Table returns information sorted by weight limit	Pass
4.	User selects sort on weight limit field in empty table	No sorting is performed	No sorting is performed	Pass
5.	User selects sort on package type field	Table returns information sorted by package type	Table returns information sorted by package type	Pass
6.	User selects sort on package type field in empty table	No sorting is performed	No sorting is performed	Pass
7.	User selects sort on package dimension field	Table returns information sorted by package dimension	Table returns information sorted by package dimension	Pass

8.	User selects sort on package dimension field in empty table	No sorting is performed	No sorting is performed	Pass
9.	User selects sort on current rate field	Table returns information sorted by current rate	Table returns information sorted by current rate	Pass
10.	User selects sort on current rate pe field in empty table	No sorting is performed	No sorting is performed	Pass

Table 5.2.6 Sort Prepaid Package Suggestion Result List Test Case Table

Interactive Dropoff Map				
Test Case Filename: GoogleMaps		Date Created: 13/08/2022		
Tester: Lim Kai Shen				
Transactions: GoogleMaps.js				
Purpose of Test Case: To test displaying map and requesting permission to access device location upon courier page load				
Step No.	Input Value	Expected Results	Actual Results	Pass/Fail
1.	Courier result page loads	Map loads with 1 feature button	Map loads with 1 feature button	Pass
2.	User allows access to device location	Pan to location and display drop off centers	Pan to location and display drop off centers	Pass
3.	User denies access to device location	Map defaults to pre-defined location	Map defaults to pre-defined location	Pass

Table 5.2.7 Interactive Dropoff Map Test Case Table

Interactive Dropoff Map – Pan to current location				
Test Case Filename: GoogleMaps		Date Created: 13/08/2022		
Tester: Lim Kai Shen				
Transactions: GoogleMaps.js				
Purpose of Test Case: To test pan to user current location function				
Step No.	Input Value	Expected Results	Actual Results	Pass/Fail
1.	User select pan to current location button	Map is panned over to the users device location	Map is panned over to the users device location	Pass
2.	User select pan to current location button with blocked permission to access location	Map location defaults to users previous location on map	Map location defaults to users previous location on map	Pass

Table 5.2.8 Interactive Dropoff Map – Pan to current location Test Case Table

Interactive Dropoff Map – Search Area				
Test Case Filename: GoogleMaps		Date Created: 13/08/2022		
Tester: Lim Kai Shen				
Transactions: GoogleMaps.js				
Purpose of Test Case: To test seach drop off centers around pinned location on map				
Step No.	Input Value	Expected Results	Actual Results	Pass/Fail
1.	User double clicks a point on map	A marker is displayed on the map, centered and zoomed in	A marker is displayed on the map, centered and zoomed in	Pass

2.	Selected area searched returned drop off centers results	Map is populated with markers of dropoff centers in the form of icons of the respective company	Map is populated with markers of dropoff centers in the form of icons of the respective company	Pass
3.	Selected area searched does not return drop off centers results	Map is not populated with markers	Map is not populated with markers	Pass

Table 5.2.9 Interactive Dropoff Map – Search Area Test Case Table

5.7 Modules

Landing Page

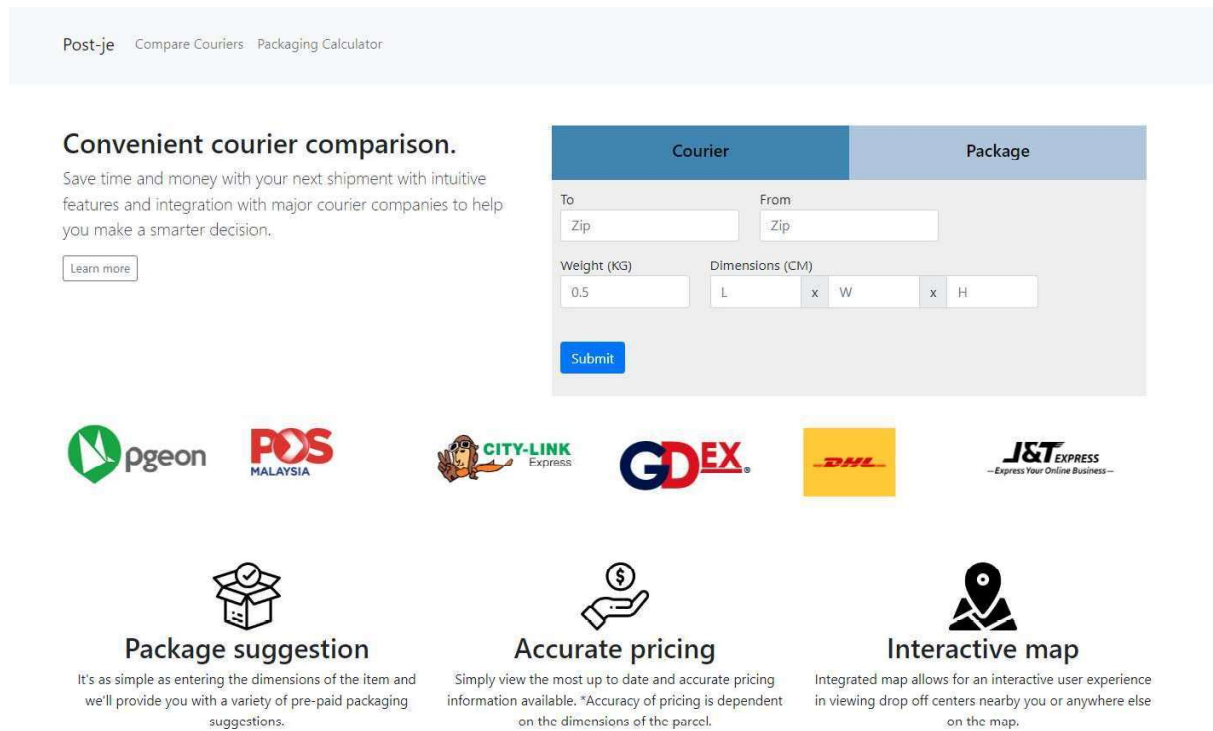


Figure 5.3 Landing Page - Desktop

Fig 5.3 Shows the landing page for the courier service comparison web application that has two forms which are the compare courier and pre paid packaging suggestion, when the form is submitted, the user will be redirected to the respective page to view the results.

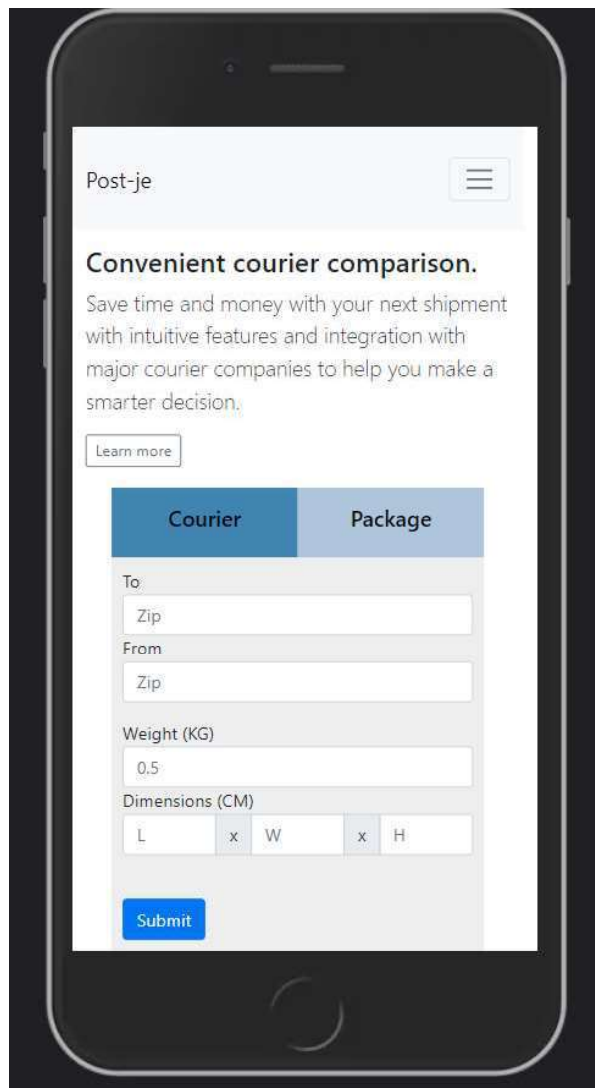








Figure 5.4 Landing Page - Mobile

Post-je Compare Couriers Packaging Calculator

Compare courier services

To: 11900 From: 50088 Weight (KG): 1 Dimensions (CM): 15 x 15 x 12



Courier Company	Service Type	Pre-paid packaging suggestion	Current rate	
 CITY LINK	pickup	=	5.71	<input type="button" value="Order"/>
 J&K	pickup	=	6.88	<input type="button" value="Order"/>
 GDEX	pickup	=	8.46	<input type="button" value="Order"/>
 J&T EXPRESS Express Your Online Business	pickup	=	8.66	<input type="button" value="Order"/>
 ninjavan	pickup	Prepaid Box M	7.97	<input type="button" value="Order"/>

5 Showing 1 to 5 of 8 Results

Figure 5.5 Compare Couriers – Desktop

Fig 5.5 Shows the compare courier services module which allows users to enter the shipment to and from information as well as the weight to obtain the list of courier services and their respective rates. Additionally, if the user were to enter the dimension of the item to be shipped, the application will also suggest a suitable pre-paid packaging option if applicable. Lastly would the presence of an interactive map in which users can view the drop off centres of different courier companies around them as well as explore different areas by double clicking on the map and courier drop off centres available in the selected area will be displayed.

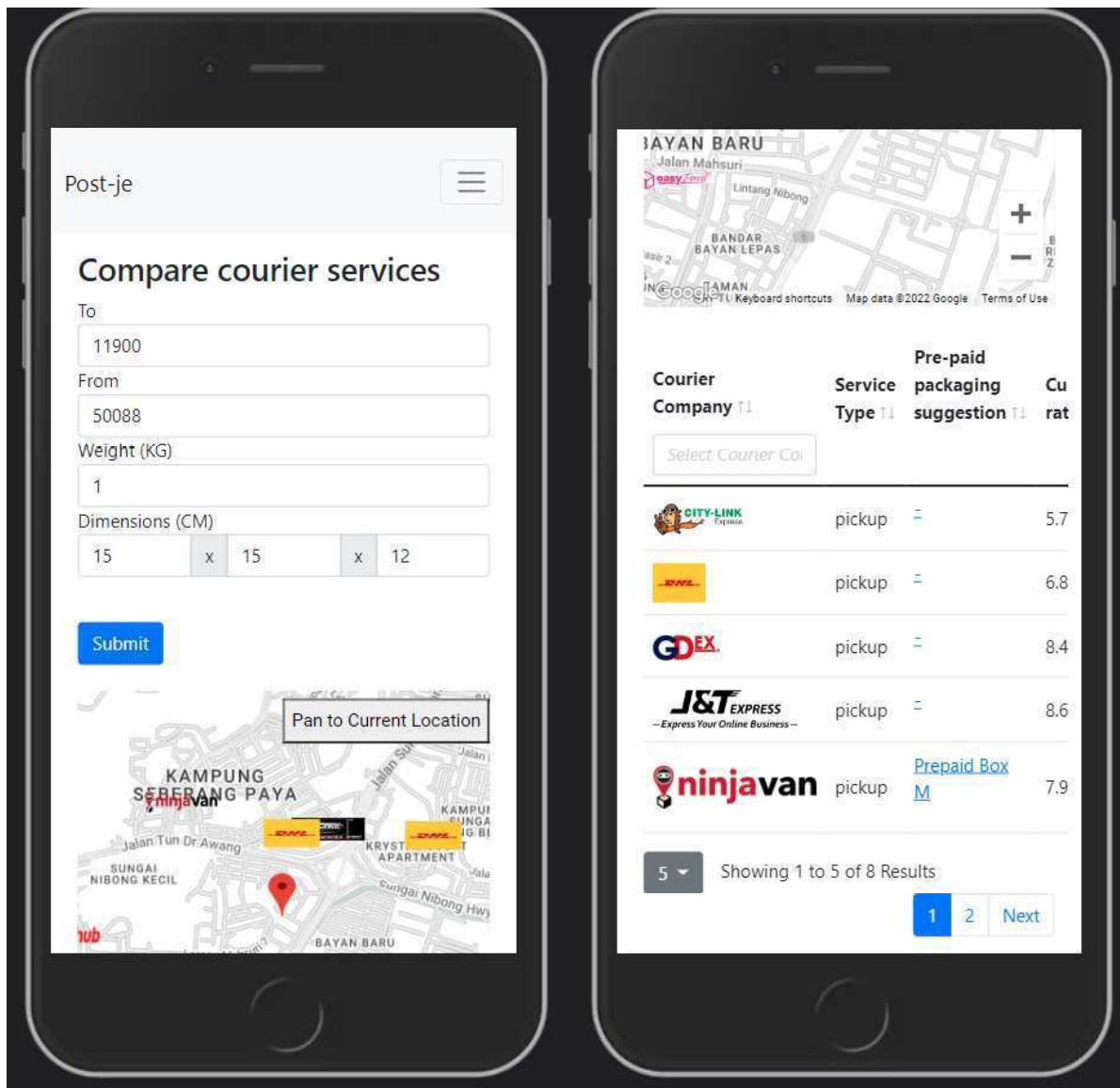










Figure 5.6 Compare Couriers - Mobile

Post-je Compare Couriers Packaging Calculator

Compare courier services

Dimensions (CM) x x Weight (KG)

Courier Company ↑↓	Weight Limit ↑↓	Package Type ↑↓	Package Dimensions ↑↓	Current rate ↑↓	
<input type="text" value="Select Courier Company..."/>					
 ninjavan	10	Prepaid Box M Bundle (20)	320x250x130mm	238	<input type="button" value="Order"/>
 ninjavan	5	Prepaid Box S Bundle (20)	260x200x110mm	198	<input type="button" value="Order"/>
 ninjavan	10	Prepaid Box M Bundle (10)	320x250x130mm	125	<input type="button" value="Order"/>
 ninjavan	5	Prepaid Box S Bundle (10)	260x200x110mm	105	<input type="button" value="Order"/>
 POS MALAYSIA	5	Prepaid Box (M) Blue	340x250x150mm	67.82	<input type="button" value="Order"/>
 POS MALAYSIA	10	Prepaid Box (L) Orange	380x320x200mm	29.99	<input type="button" value="Order"/>
 ninjavan	10	Prepaid Box M	320x250x130mm	12.9	<input type="button" value="Order"/>
 ninjavan	5	Prepaid Box S	260x200x110mm	10.9	<input type="button" value="Order"/>

8 Showing 1 to 8 of 8 Results 1

Figure 5.7 Packaging Calculator – Desktop

Fig 5.7 Shows the packaging calculator module in desktop view where the user is able to enter the dimensions of an item along with its weight to submit and a list of compatible prepaid packaging suggestions will be displayed to the user, along with relevant information such as the weight limit, package dimensions and current rate for users, all of which can be sorted accordingly to allow for better decision making before purchase, which can be done using the order button which links the user to the relevant page of the actual product for purchase.

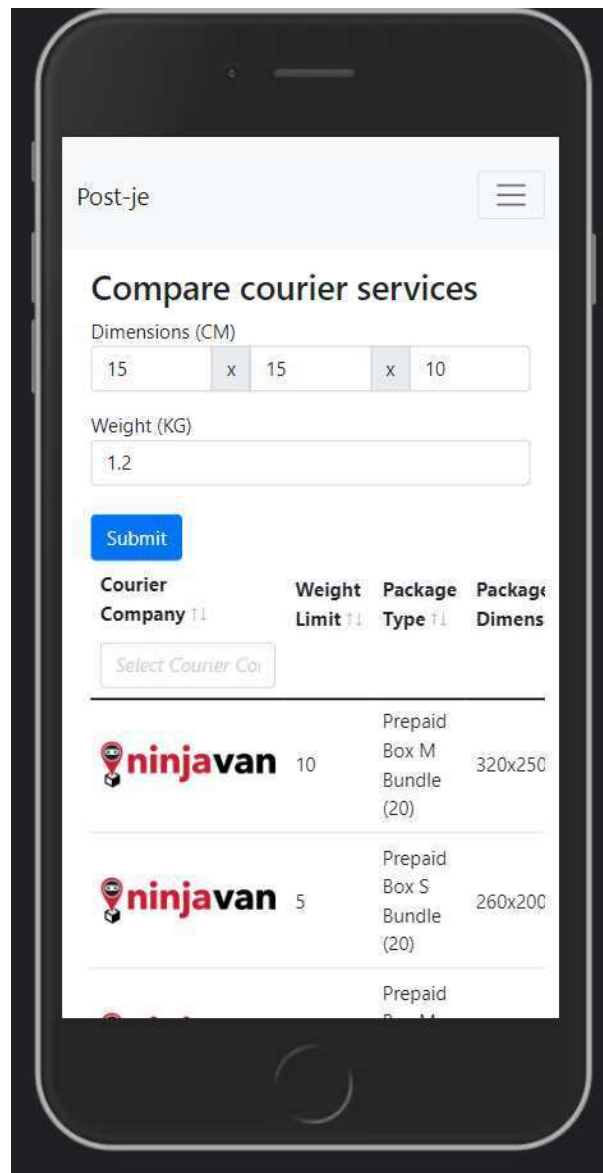


Figure 5.8 Packaging Calculator - Mobile

CHAPTER 6 : SYSTEM EVALUATION AND DISCUSSION

6.1 PERN Tech Stack

This project employs the PostgreSQL, Express, React, and Node.js technology stack, also known as PERN. By combining these technologies, a full-stack web application with CRUD operations can be created. This section will describe the benefits and rationale for selecting each component.

1. PostgreSQL (Object-Relational Database)

PostgreSQL is a robust, open source object-relational database management system (ORDBMS) with a focus on extensibility and standards compliance that uses and extends the SQL programming language along with numerous features that safely store and scale the most complex data workloads. PostgreSQL is ACID-compliant, transactional database management system that stores data in a tabular format and uses constraints, triggers, roles, stored procedures, and views as its core components to ensure data integrity and create fault-tolerant environments.

2. Express (Back-End Framework)

It is a minimal and adaptable Node.js web application framework. As a free and open source software, it is primarily used for building web applications. It enabled the development of robust and efficient APIs for this project, with different endpoints serving different functionalities. Express provides a thin layer of fundamental web application capabilities without obscuring Node.js capabilities.

3. React (Front-End Library)

React is a JavaScript library for constructing user interfaces. By allowing components to be reused, it is a simple, efficient, and painless method for developing Interactive Uis. Virtual DOM in ReactJS enhances the user experience, expedites developer work, ensures code stability, and is SEO-friendly. Facebook and a community of individual developers and businesses maintain it. Design simple views for each state in your application, and React will

efficiently update and render the appropriate components when your data changes; for this reason, it is used exclusively for developing single-page applications and mobile applications.

4. Node.js (JavaScript runtime environment)

Node.js is a JavaScript runtime built on Chrome's V8 JavaScript engine for developing server-side and networking applications with event-driven and asynchronous features, making it lightweight, efficient, and quick. As an asynchronous event-driven JavaScript runtime, it is used to develop scalable and speedy network applications. Node.js is a free, open-source server environment that is highly scalable, extensible, and compatible with multiple platforms.

6.2 Progressive Web Application

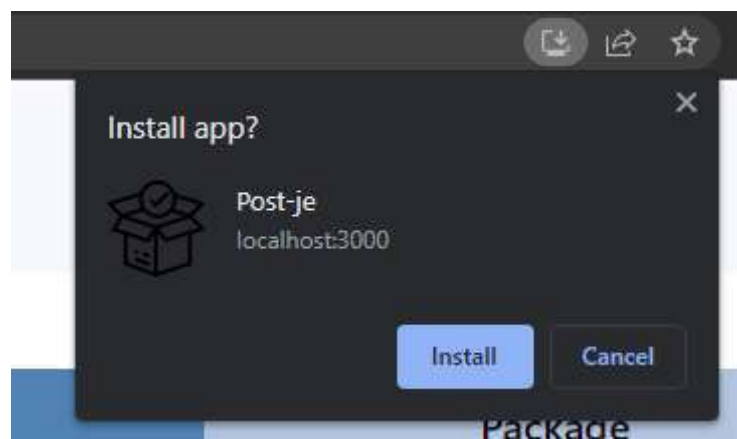


Figure 6.1 Install Application To Local Device From Browser

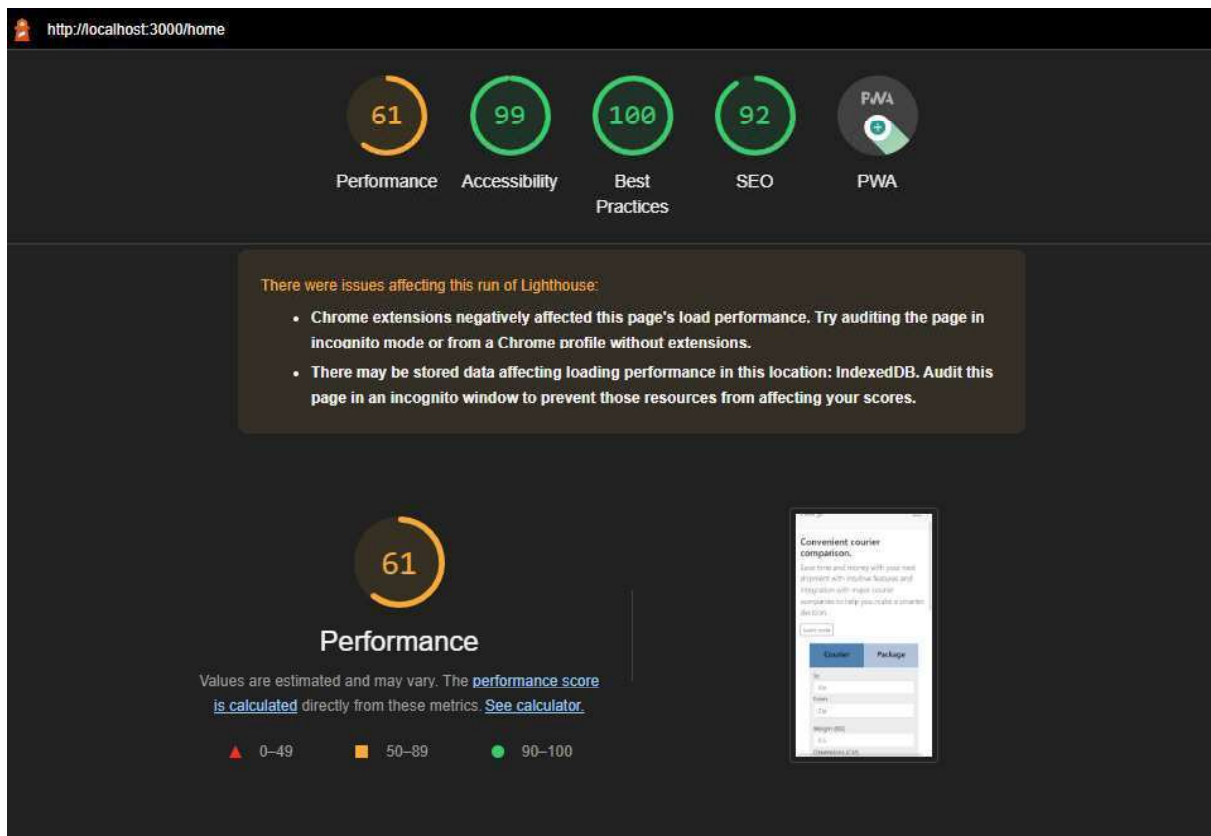


Figure 6.2 Google Chrome Lighthouse Report

The Google Chrome Lighthouse Report is an open-source, automated tool developed by Google that analyses web apps and web pages. It does this by collecting modern performance metrics and insights on developer best practises, which ultimately leads to an improvement in the overall quality of web pages. Figure 6.2 illustrates this. It is possible to run it against any website, regardless of whether the website requires authentication or not. It includes audits for performance, accessibility, progressive web apps, and a number of other things; of which we can see that this web application is PWA enabled allowing it to be installed to a local device like desktop or an android mobile phone (Fig 6.1)

CHAPTER 7: CONCLUSION AND RECOMMENDATION

7.1 Project Review and Discussion

The advent of online shopping has benefitted the courier sector by increasing its efficiency in delivering numerous digital solutions such as order tracking and online payment. When clients are seeking for the best deal, they must use the same strategy of entering similar information into the websites of each courier firm, including the origin and destination postcodes, the weight and dimensions of the cargo. When it comes to selecting a courier service, the absence of equivalent features for a particular weight complicates the procedure. Additionally, the physical qualities of different courier services vary according to their varying needs.

This application includes a search page where users can enter critical information such as the origin and destination postcodes, the weight and, ideally, the dimensions of the parcel being sent, a results page with filtering and sorting capabilities, the price, the courier's name, and, if applicable, recommended pre-paid packaging for the respective courier companies. The first source is a sandbox API made publicly accessible by selected courier service providers, while the second source includes simulated pricing and manually compiled drop-off locations for courier service providers whose API is not publicly available.

This application will assist Malaysian courier firms substantially. Additionally, it would empower local small businesses by providing a location for them to display and sell their wares, therefore boosting sales. Furthermore, it will promote transparency on the goods or services provided, hence boosting client confidence in courier service companies. To summarise, customers save time and effort by avoiding the need to visit many websites and do repetitive processes just to compare and purchase.

The primary challenge of this project is to simulate courier service provider information as accurately as possible, as access to information such as pricing and drop-off locations via their APIs is not open to the public, with the exception of one courier company; and to obtain and populate pre-paid packaging information from various courier companies individually, which requires considerable effort in locating and recording the information.

7.2 Novelties and Contributions

With the development of this application, the courier services sector in Malaysia would benefit tremendously. It will also empower local SMEs by putting them on an equal playing field with a platform to demonstrate and market the services that they provide, hence increasing sales. Furthermore, by utilising comparison and filtering tools, it would provide greater transparency in terms of the products or services offered, hence increasing users' confidence in the courier service providers. Finally, the value-adding proposition to consumers saves them time and effort by eliminating the need to visit multiple websites and perform repetitive tasks just to make a simple comparison and order purchase. This is accomplished through the integration of multiple courier service APIs and other unique features that empower the users to make a better purchasing decision.

7.3 Future Work

Although a significant amount of progress has been made toward the development of this project from the stage of ideation to the stage of designing to the stage of coding and eventually to the stage of a fully functional web application, there is always room for improvement. This project has moved from the stage of ideation to the stage of designing to the stage of coding and eventually to the stage of a fully functional web application. In this section, we will discuss potential future steps that can be taken in order to make the solution even more all-encompassing and comprehensive. Pgeon is the only courier company that currently has an open developer sandbox API. Other companies only allow registered companies to apply for access to integrate their APIs, so the API integration with other companies is the first step toward obtaining accurate pricing information. The next step is to establish additional connectivity with third-party courier services, which will enable users to be redirected directly to the websites of the respective couriers in order to place an order for that service. This can be done by utilising the respective courier's application programming interface (API) or by routing to the respective website while providing that website with the pertinent parcel shipping information. In addition, modern web scraping technology can be used to automate this process and make the collection of this information more feasible. This will allow for a greater number of drop off centres to be displayed on the map, allowing users to see drop off centres no matter

CHAPTER 7

where they search for them in Malaysia. This will allow drop off centres to be displayed on the map. Since this project is being executed on a localhost at the moment, the next and final step will be to host this web application on PaaS hosting platforms. This will enable users to access the web application through the internet. This web application and its corresponding database can both be hosted entirely in the cloud if the PaaS used is one such as Heroku or one of the similar offerings provided by Amazon Web Services (AWS)..

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APPENDIX

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jun 2022	Study week no.: 4
Student Name & ID: Lim Kai Shen 1806415	
Supervisor: Mr Tan Chiang Kang	
Project Title: Courier Delivery Services Comparison Web Application	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Implemented PWA manifest, service worker
- Developed front end in React
- Integrated Google Maps API

2. WORK TO BE DONE

- Develop database in postgres
- Develop server side code with database

3. PROBLEMS ENCOUNTERED**4. SELF EVALUATION OF THE PROGRESS**


Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jun 2022	Study week no.: 6
Student Name & ID: Lim Kai Shen 1806415	
Supervisor: Mr Tan Chiang Kang	
Project Title: Courier Delivery Services Comparison Web Application	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Develop database in postgres
- Develop server side code with database

2. WORK TO BE DONE

- Connect front end to backend
- Develop API service for courier and package info

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jun 2022	Study week no.: 8
Student Name & ID: Lim Kai Shen 1806415	
Supervisor: Mr Tan Chiang Kang	
Project Title: Courier Delivery Services Comparison Web Application	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Connect front end to backend
- Develop API service for courier and package info

2. WORK TO BE DONE

- Develop test cases
- Perform use case testing

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jun 2022	Study week no.: 10
Student Name & ID: Lim Kai Shen 1806415	
Supervisor: Mr Tan Chiang Kang	
Project Title: Courier Delivery Services Comparison Web Application	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Develop test cases
- Perform use case testing

2. WORK TO BE DONE

- Feature and design improvements
- Minor bug fixes

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: Jun 2022	Study week no.: 12
Student Name & ID: Lim Kai Shen 1806415	
Supervisor: Mr Tan Chiang Kang	
Project Title: Courier Delivery Services Comparison Web Application	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Feature and design improvements
- Minor bug fixes

2. WORK TO BE DONE

- Document product in report
- Create poster

3. PROBLEMS ENCOUNTERED

4. SELF EVALUATION OF THE PROGRESS



Supervisor's signature



Student's signature

FINAL YEAR PROJECT WEEKLY REPORT*(Project II)*

Trimester, Year: Jun 2022	Study week no.: 14
Student Name & ID: Lim Kai Shen 1806415	
Supervisor: Mr Tan Chiang Kang	
Project Title: Courier Delivery Services Comparison Web Application	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Document product in report
- Create poster

2. WORK TO BE DONE

- Submit FYP2 Report
- Final Presentation

3. PROBLEMS ENCOUNTERED**4. SELF EVALUATION OF THE PROGRESS**

Supervisor's signature



Student's signature

POSTER



COURIER DELIVERY SERVICES COMAPRISON WEB APPLICATION

WORK BY:
Lim Kai Shen

SUPERVISED BY:
Tan Chiang Kang

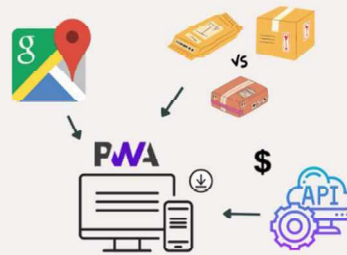
INTRODUCTION

This courier delivery services comparison web application allows users to better make an informed decision on their purchase.

MOTIVATION

The main objective of this project is to develop a full-stack progressive web application with the following features:

- ~To provide users with an interactive map for locating nearby drop-off locations.
- ~To integrate with courier companies to obtain accurate pricing information through API.
- ~To recommend suitable pre-paid packaging options to users.



NOVELTIES & CONTRIBUTIONS

- 1) Prepaid packaging suggestions based on item volumetric weight which saves time and money
- 2) Interactive map with drop off centres in the nearby area which allows for better visibility
- 3) Integration with courier company APIs to get the most accurate and up to date pricing information
- 4) Empower local courier companies by providing visibility to market their product and services

FINAL SYSTEM

Courier Company	Service Type	Pre-paid packaging suggestion	Current rate
	pickup	Prepaid Box XS	8.04
	pickup	Prepaid Box (M) Orange	5.78
	pickup		5.84

Courier Company	Weight Limit	Package Type	Package Dimensions	Current rate
	10	Prepaid Box (L) Orange	380x320x200mm	29.99
	5	Prepaid Box (M) Blue	340x250x150mm	67.82
	5	Prepaid Box (M) Orange	340x150x250mm	19.99
	10	Prepaid Box M	320x250x130mm	12.9
	10	Prepaid Box M Bundle (10)	320x250x130mm	125



PLAGIARISM CHECK RESULT

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FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

Full Name(s) of Candidate(s)	Lim Kai Shen
ID Number(s)	18ACB06415
Programme / Course	CS
Title of Final Year Project	COURIER DELIVERY SERVICES COMPARISON WEB APPLICATION

Similarity	Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)
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Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

Signature of Supervisor

Name: Tan Chiang Kang

Date: 7/9/2022

Signature of Co-Supervisor

Name: _____

Date: _____

Bachelor of Computer Science (Honours)

Faculty of Information and Communication Technology (Kampar Campus), UTAR



UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY (KAMPAR CAMPUS)

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