

HAVE YOU EVER





City University of Hong Kong
Final Year Project 2020-2021

MOBILE - BASED LOGISTICS SYSTEM WITH SMART ROUTING AND TRACKING SERVICES

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Project Background



ONLINE SHOPPING



E - COMMERCE



SERVICE QUALITY



RELIABLE



MANAGEABLE

Comparison

SF EXPRESS

<

Ship

Please enter sender's information

Add. Book

Please enter recipient's information

Add. Book

Shipping method

To-door Drop off

Expected collection time

within 1h >

Commodity Description

Required >

Payment

Pay by sender >

SPP

recommended if >1000 >

Estimated value HKD -- Detail +

Please view

Terms & Conditions of Carriage

Place order

<


Waybill details

Waybill details

Signature

Waybill

2020-09-12 08:47:44



SF1030917122115 ,SF1030891230412 ,
SF1040986933963 ,SF1094190040445 ,
SF1040974718095 ,SF104096727977 ,
SF1029800662147 ,SF1040989169800 ,
SF1041011503505 ,SF1030979193513 ,
300270081514 ,SF1030949790382 ,SF1
029776452431 ,SF1092145938341 ,SF1
040996691284

<

Shipment Status

Waybill No. SF102977

Waybill details >

Delivered

Delivered

9月12日 08:47

Service Rating

5.0

★

2020-09-12 08:47:47

Delivered

Signed by 3rd party
Thank you for using SF Express.
Looking forward to serving you
again(Total quantity of package :1
piece(s))

2020-09-12 07:32:16

Delivering

The shipment is handed over to and
being delivered by (contact
number: 13688809115. Please answer
the call at ease as your privacy is
properly protected by "safety call")
(Total quantity of package :1 piece(s))

2020-09-12 07:26:16

In transit

Shipment arrive at [Shenzhen Dafu
service point]

2020-09-12 05:57:46

In transit

Departed

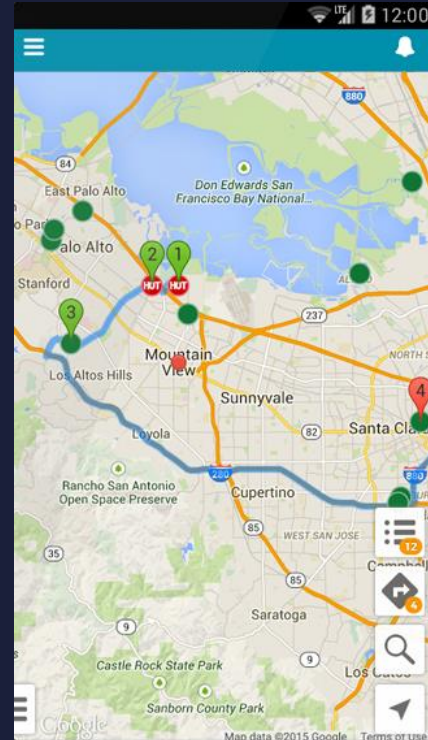
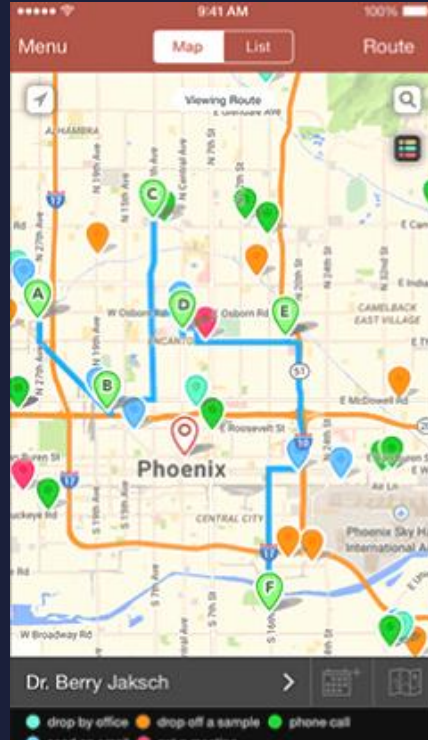
2020-09-12 05:32:33

In transit

Shipment loaded at
, prepare to send to [Shenzhen
Dafu service point]

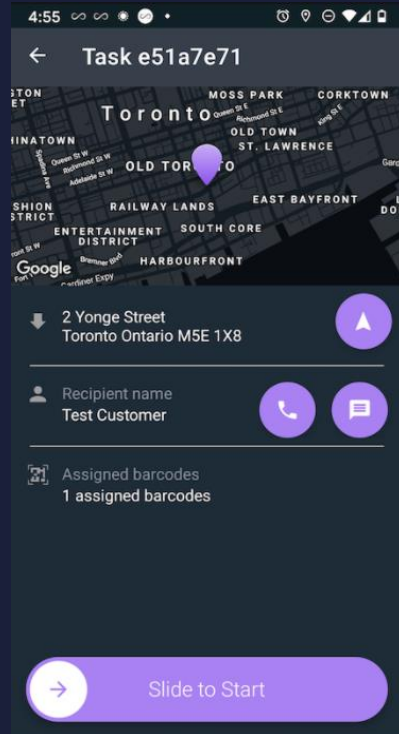
Comparison

GEOPOINTE



Comparison

ONFLEET



Comparison

Features	Market Existing Products			Prosposd Product
	SF Express	Geopointe	Onfleet	Moblie-based Logistics System
App Interface	✓	✓	✓	✓
Items Check-in	✓			✓
Bill Tracking	✓		✓	✓
Live Location		✓	✓	✓
Proof of Delivery	✓		✓	✓
Route Planning		✓	✓	✓
Stocks Management				✓
Profit Calculation				✓
Bill History	✓			✓
Items QR Code				✓
Driver Identity Proof				✓
Smart Driver Dispatch			✓	✓
Users and Drivers Management				✓
Estimated Arrival Time				✓



LOGISTICS SYSTEM



Predictable - Estimated Arrival Time



User - friendly - Reactive and Clean Interface



Trustworthy - Manageable and Functional



Cost Efficient - For small - scale logistics businesses



BILL TRACKING

Live Location

Items Online Check-In

DISPATCHING

Smart Jobs Assignment

Optimal Routing

MANAGEMENT

Delivery Items

Drivers and
Users

PROOF OF DELIVERY

E - signature

QR Code

User Check-in Item



**Driver Register
Jobs**



Item Tracking



Admin Assign Jobs



Optimal Routing



Process Items

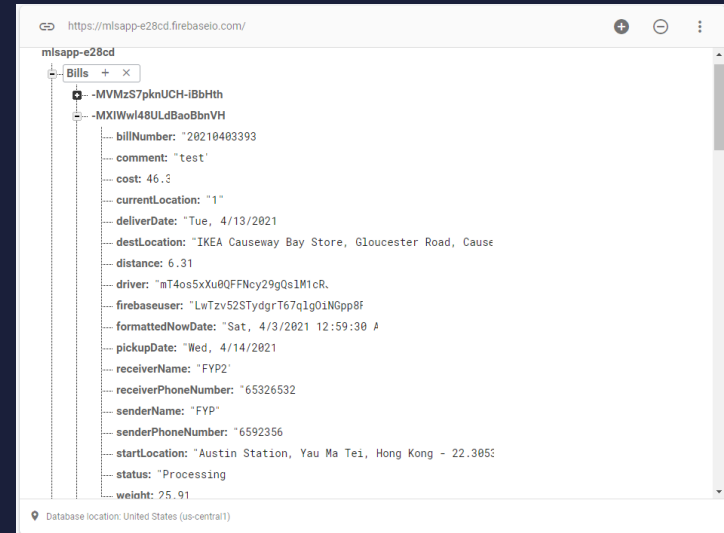


Methodology

Database and Application Structure



- Flutter, Android - 3 Interfaces
- Firebase Realtime Database
- Authentication



Real-time bill tracking

- Periodically Retrieve Driver's Location
- Real-time update
- Estimated Arrival Time



Smart Jobs Assignment



- Bin Packing Problem
- Modified First Fit Algorithms
- Check the status of the Bills

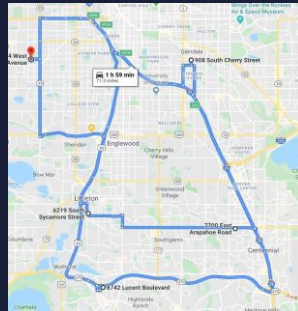
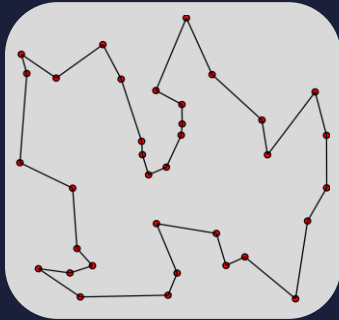


Driver ID	Driver03 (Capacity 5.5 tons = 5500kg)
Total Jobs	B1. 482.4kg (Status: Pending) B2. 9999.9kg (Status: Pending) B3. 28.6kg (Status: Assigned) B4. 76.9kg (Status: Pending)
Calculation	1. Sorting the Bill: B3, B4, B1, B2 2. Check the status: B3 has assigned - FAIL 3. Bill List available: B4, B1, B2 4. Assign B4 (Capacity = $5500 - 76.9 = 5423.1$ kg) - SUCCESS 5. Assign B1 (Capacity = $5423.1 - 482.4 = 4940.7$ kg) - SUCCESS 6. Assign B2 (Capacity = $4940.7 - 9999.9 = -5059.2$ kg) - FAIL
Jobs Assigned	B4, B1
Jobs Fail to Assign	B3, B2

Optimal Routing



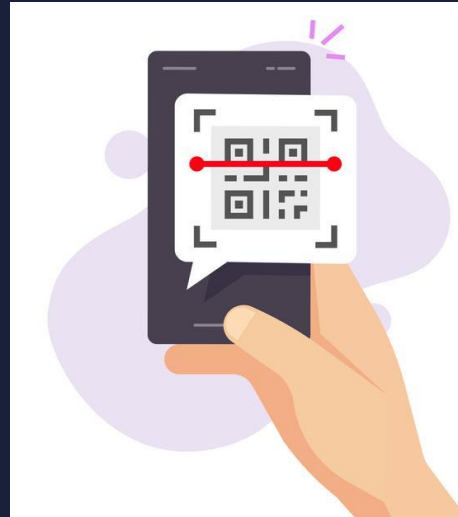
- Travel Salesman Problem
- Retrieve the Driver Location
- Keep finding the nearest destinations



Driver ID [Ⓔ]	Driver03 [Ⓔ]																				
Destinations [Ⓔ]	D1. Tiu Keng Leng Station, Tiu Keng Wan, Hong Kong - 22.3039051/114.2522843 [Ⓔ] D2. IKEA Causeway Bay Store, Gloucester Road, Causeway Bay, Hong Kong - 22.2811761/114.1864329 [Ⓔ] D3. One Island East, Westlands Road, Quarry Bay, Hong Kong - 22.2862479/114.2135458 [Ⓔ] D4. Pacific Place, Queensway, Admiralty, Hong Kong - 22.277152/114.1648871 [Ⓔ]																				
Driver Coordinates [Ⓔ]	22.3314414/ 114.2025193 [Ⓔ]																				
Calculation [Ⓔ]	<div>Step 1 :[Ⓔ]</div> <table> <tr> <td>Current location to D1[Ⓔ]</td><td>12.2km[Ⓔ]</td></tr> <tr> <td>Current location to D2[Ⓔ]</td><td>10.9km[Ⓔ]</td></tr> <tr> <td>Current location to D3[Ⓔ]</td><td>14.0km[Ⓔ]</td></tr> <tr> <td>Current location to D4[Ⓔ]</td><td>9.7km[Ⓔ]</td></tr> </table> <div>Step 2 :[Ⓔ]</div> <table> <tr> <td>D4 to D1[Ⓔ]</td><td>15.8km[Ⓔ]</td></tr> <tr> <td>D4 to D2[Ⓔ]</td><td>3.1km[Ⓔ]</td></tr> <tr> <td>D4 to D3[Ⓔ]</td><td>7.6km[Ⓔ]</td></tr> </table> <div>Step 3 :[Ⓔ]</div> <table> <tr> <td>D2 to D1[Ⓔ]</td><td>13.6km[Ⓔ]</td></tr> <tr> <td>D2 to D3[Ⓔ]</td><td>5.4km[Ⓔ]</td></tr> </table> <div>Step 4 :[Ⓔ]</div> <table> <tr> <td>D3 to D1[Ⓔ]</td><td>11.9km[Ⓔ]</td></tr> </table>	Current location to D1 [Ⓔ]	12.2km [Ⓔ]	Current location to D2 [Ⓔ]	10.9km [Ⓔ]	Current location to D3 [Ⓔ]	14.0km [Ⓔ]	Current location to D4 [Ⓔ]	9.7km[Ⓔ]	D4 to D1 [Ⓔ]	15.8km [Ⓔ]	D4 to D2 [Ⓔ]	3.1km[Ⓔ]	D4 to D3 [Ⓔ]	7.6km [Ⓔ]	D2 to D1 [Ⓔ]	13.6km [Ⓔ]	D2 to D3 [Ⓔ]	5.4km[Ⓔ]	D3 to D1 [Ⓔ]	11.9km[Ⓔ]
Current location to D1 [Ⓔ]	12.2km [Ⓔ]																				
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Current location to D3 [Ⓔ]	14.0km [Ⓔ]																				
Current location to D4 [Ⓔ]	9.7km[Ⓔ]																				
D4 to D1 [Ⓔ]	15.8km [Ⓔ]																				
D4 to D2 [Ⓔ]	3.1km[Ⓔ]																				
D4 to D3 [Ⓔ]	7.6km [Ⓔ]																				
D2 to D1 [Ⓔ]	13.6km [Ⓔ]																				
D2 to D3 [Ⓔ]	5.4km[Ⓔ]																				
D3 to D1 [Ⓔ]	11.9km[Ⓔ]																				
Optimal Path [Ⓔ]	Current Location -> D4 -> D2 -> D3 -> D1 [Ⓔ]																				

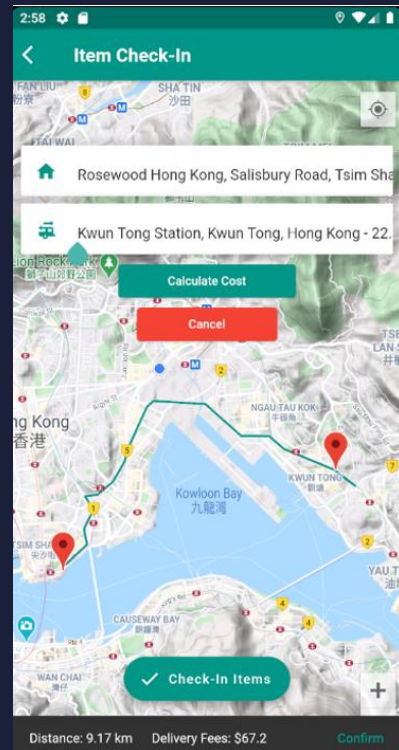
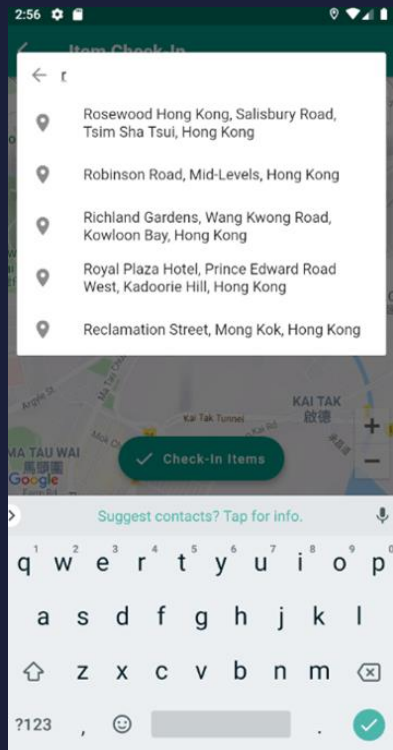
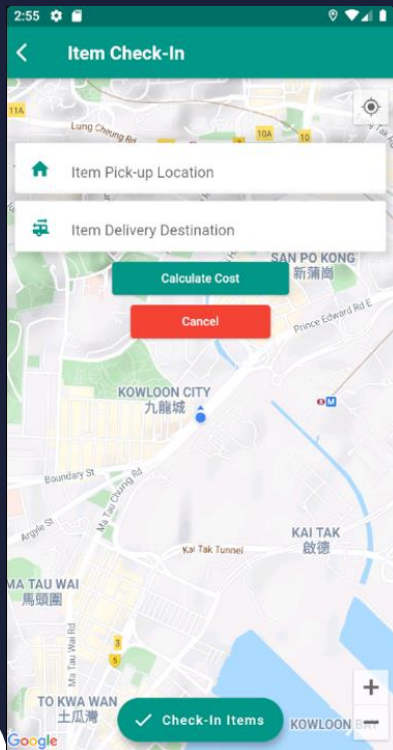
QR Code and Signature

- Make use of Flutter packages
- Secure the item process
- Upload to Firebase Storage



Results and Novel parts

Items Check-in Function



Items Check-in Function



3:01

Create Bill

Rosewood Hong Kong, Salisbury Road, Tsim Sha Tsui, Hong Kong - 22.2949764/114.1758105

Delivery Destination

Kwun Tong Station, Kwun Tong, Hong Kong - 22.3121714/114.226465

Distance: 9.17 km \$ 67.2

Sender Name

Alice Wong

Sender Phone Number

67586779

Item Weight (In KG)

2.8

Pick-up Date : 2021-1-27

Select Pick-up Date

Receiver Name

Billy Chan

Receiver Phone Number

67586779

Deliver Date : 2021-1-31

Select Deliver Date

Additional Information (If any)

3:00

Create Bill

Kwun Tong Station, Kwun Tong, Hong Kong - 22.3121714/114.226465

Distance: 9.17 km \$ 67.2

Sender Name

Alice Wong

Sender Phone Number

67586779

Item Weight (In KG)

2.8

Pick-up Date : 2021-1-27

Select Pick-up Date

Receiver Name

Billy Chan

Receiver Phone Number

67586779

Deliver Date : 2021-1-31

Select Deliver Date

Additional Information (If any)

testing

Submit

3:02

Create Bill

Kwun Tong Station, Kwun Tong, Hong Kong - 22.3121714/114.226465

Distance: 9.17 km \$ 67.2

Sender Name

Alice Wong

Sender Phone Number

67586779

Item Weight (In KG)

2.8

Pick-up Date : 2021-1-27

Select Pick-up Date

Receiver Name

Billy Chan

Receiver Phone Number

67586779

Deliver Date : 2021-1-31

Select Deliver Date

Additional Information (If any)

testing

Submit

SELECT DATE

Sun, Jan 31

January 2021

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

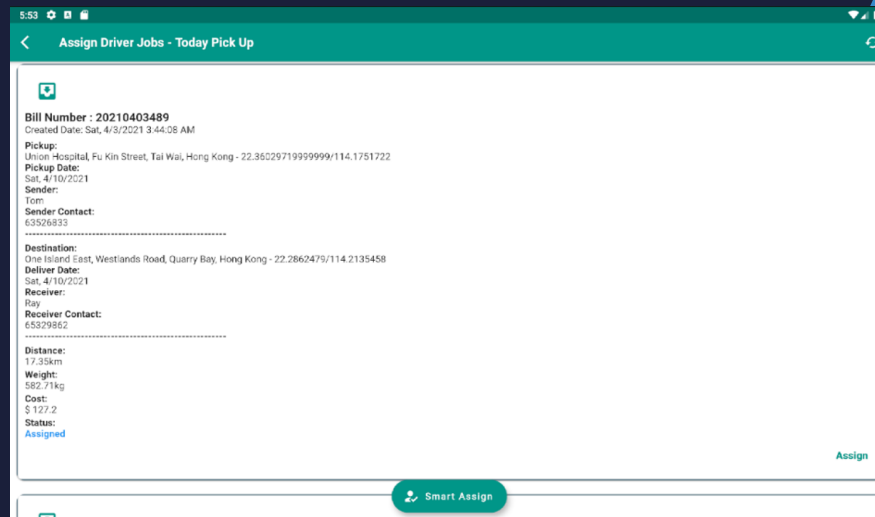
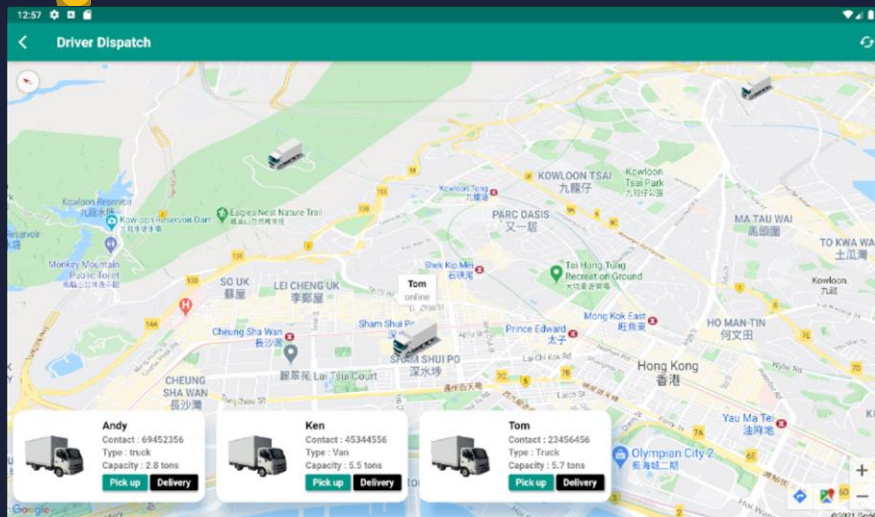
CANCEL OK

Success

Created Bill.
Bill status is "Pending".

Confirm

Smart Jobs Assignment



Smart Jobs Assignment



12:58 Assign Driver Jobs - Today Delivery

Bill Number : 20210403622
Created Date: Sat, 4/3/2021 5:02:52 AM

Pickup:
K11, Hanoi Road, Tsim Sha Tsui, Hong Kong - 22.297525/114.1736855
Pickup Date:
Fri, 4/2/2021
Sender:
or
Sender Contact:
1

Destination:
Pacific Place, Queensway, Admiralty, Hong Kong - 22.277152/114.1648571
Deliver Date:
Sat, 4/10/2021
Receiver:
or
Receiver Contact:
5

Distance:
7.63km
Weight:
4.9 kg
Cost:
\$ 55.9
Status:
Assigned

20210403622 Assign Fail
The Bill is already Assigned

Confirm

Assign

Smart Assign

12:58 Assign Driver Jobs - Today Delivery

Bill Number : 20210403622
Created Date: Sat, 4/3/2021 5:02:52 AM

Pickup:
K11, Hanoi Road, Tsim Sha Tsui, Hong Kong - 22.297525/114.1736855
Pickup Date:
Fri, 4/2/2021
Sender:
or
Sender Contact:
1

Destination:
Pacific Place, Queensway, Admiralty, Hong Kong - 22.277152/114.1648571
Deliver Date:
Sat, 4/10/2021
Receiver:
or
Receiver Contact:
5

Distance:
7.63km
Weight:
4.9 kg
Cost:
\$ 55.9
Status:
Assigned

20210403681 Exceed Capacity
The weight exceeds vehicle capacity.
-9.67 tons.
(~8769.71kg.)

Confirm

Assign

Smart Assign

Optimal Routing



< Assigned Jobs

✓

Bill Number : 20210309429
Created Date: Tue, 3/9/2021 5:15:57 PM

Pickup:
ICC, Austin Road West, West Kowloon, Hong Kong
- 22.3034032/114.1601907

Pickup Date:
Mon, 3/29/2021

Sender:
Kelvin Wu
Sender Contact:
65325632

Destination:
Tiu Keng Leng Station, Tiu Keng Wan, Hong Kong -
22.3039051/114.2522843

Deliver Date:
Sat, 4/10/2021

Receiver:
Cindy
Receiver Contact:
62547852

Distance:
17.79km
Weight:
702.1kg
Cost:
\$ 130.4

Optimal Routing

< Optimal Routing - Delivery

Track My Location

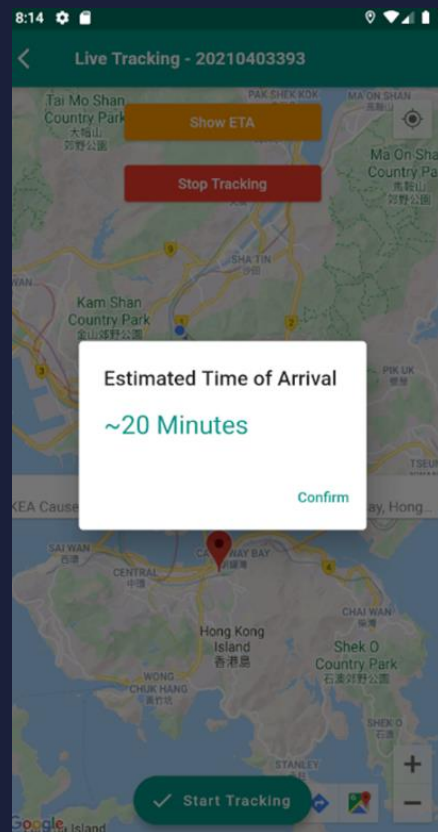
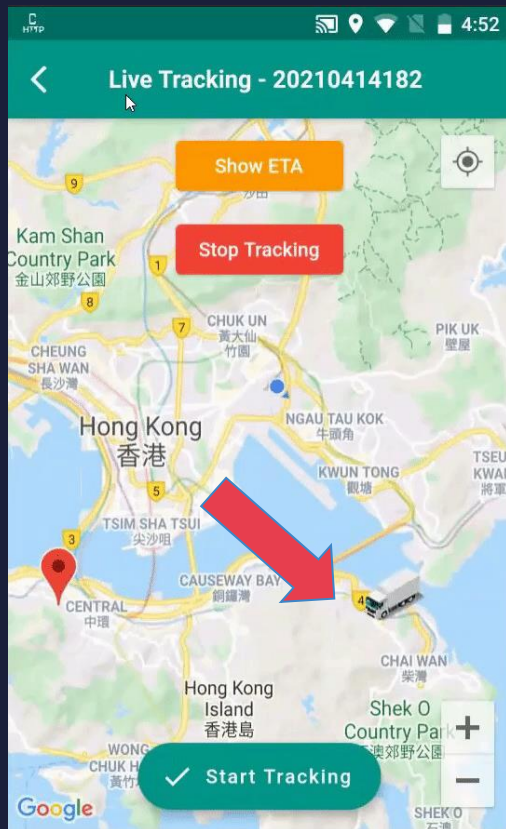
Stop Tracking

Hong Kong

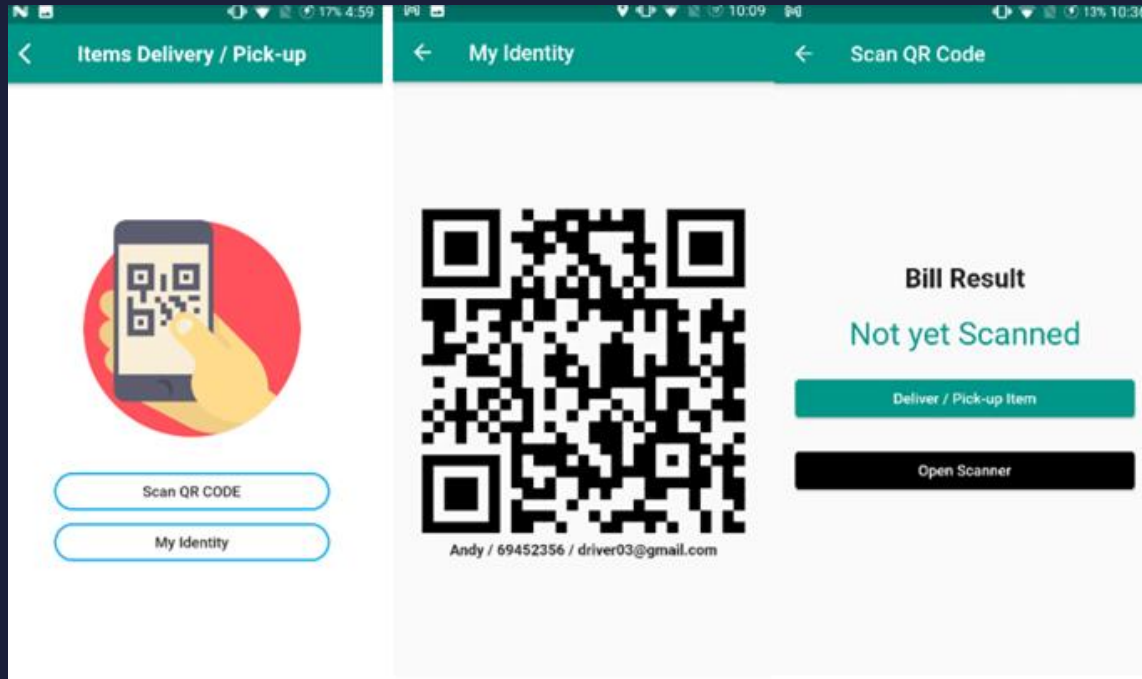
Admiralty, Hong Kong - 2...

Start

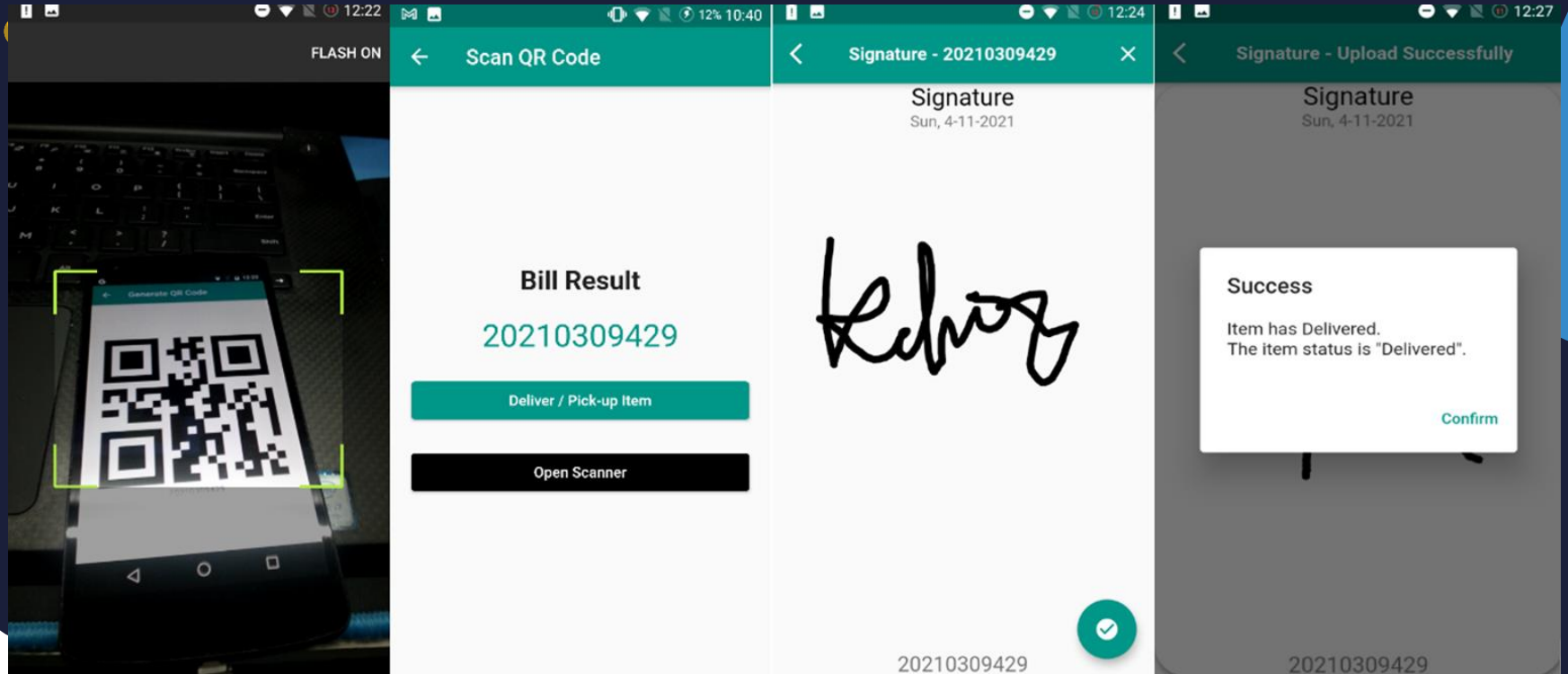
Bill Tracking



Proof of Delivery



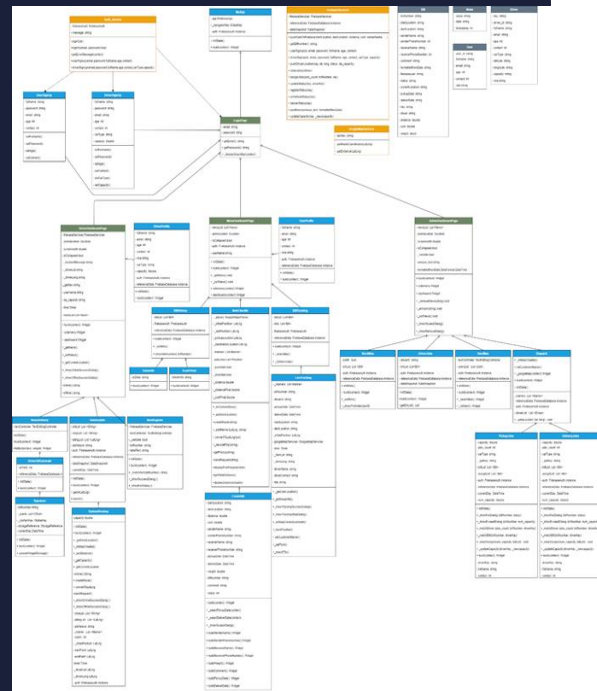
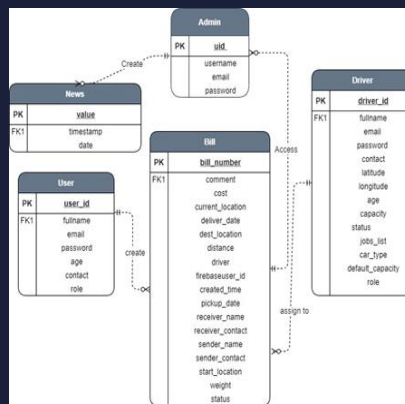
Proof of Delivery



Complexity

Class and Interfaces

- More than 40 Classes
- API calls and Database references
- Handle Application State
- Attributes and Bills Status



Complexity

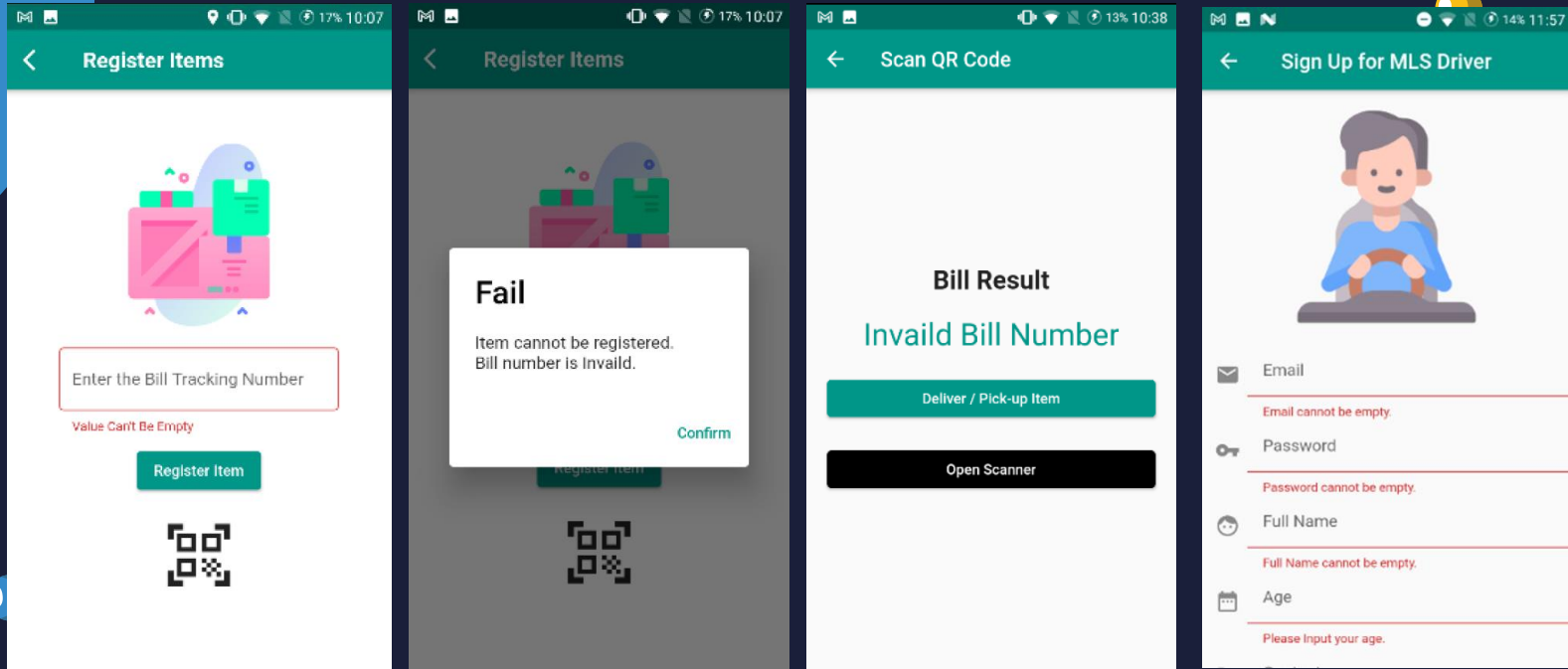
Exceptions Handling

The image displays four screenshots of the MLS App, illustrating different exception handling scenarios:

- Welcome to MLS App:** The first screenshot shows the login screen with a green header. It features a truck icon and a sign-in button. Below the sign-in button, there are two links: "Sign Up - User" and "Sign Up - Driver". A red error message "Email cannot be empty." is displayed below the email field, and another red error message "Password cannot be empty." is displayed below the password field.
- Welcome to MLS App:** The second screenshot shows the login screen with a green header. It features a truck icon and a sign-in button. Below the sign-in button, there are two links: "Sign Up - User" and "Sign Up - Driver". A red error message "Incorrect Email / Password" is displayed at the bottom of the screen.
- Sign Up for MLS User:** The third screenshot shows the sign-up screen with a green header. It features a clipboard icon and a sign-up button. Below the sign-up button, there are four links: "Sign Up - User" and "Sign Up - Driver". A red error message "Email cannot be empty." is displayed below the email field, and another red error message "Password cannot be empty." is displayed below the password field.
- Create Bill:** The fourth screenshot shows the "Create Bill" screen with a green header. It features a clipboard icon and a sign-up button. Below the sign-up button, there are four links: "Sign Up - User" and "Sign Up - Driver". A red error message "Email cannot be empty." is displayed below the email field, and another red error message "Password cannot be empty." is displayed below the password field.

Complexity

Exceptions Handling



Complexity

Algorithms, Functions and Application Design

- Jobs Assignment
- Optimal Routing
- Real-time Checking
- Reactive and Responsive
- Time Management



Conclusion

- Mobile-based Logistics Management System
- Online Check-in and Bill Tracking
- Optimal Routing
- Smart Jobs Assignment
- Easy Proof of Delivery
- Transportation, Security, IoT



References

1. <https://www.myanmore.com/2020/04/the-yangon-online-shopping-guide/>
2. <https://www.ignant.com/2018/12/12/the-art-of-waiting/>
3. Christofids, Nicos. (1976) "Worst-case analysis of a new heuristic for the travelling salesman problem." No. RR-388. Carnegie Mellon University Pittsburgh Pa Management Sciences Research Group

THANK YOU !

The image features a dark navy blue background. In the upper right corner, there is a large, solid red organic shape. Below it, a series of small circles in red, blue, and yellow are arranged in a diagonal line. In the lower right corner, there is a large, solid yellow organic shape. Above it, another series of small circles in red, blue, and yellow are arranged in a diagonal line. The text "THANK YOU !" is centered in the middle of the image in a bold, white, sans-serif font.