

Pre-notification Parcel Tracking System

Loke Chin Soon¹, Shamsul Mohamad^{1*}

¹Faculty of Electrical and Electronic Engineering,
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Johor, MALAYSIA

*Corresponding Author Designation

DOI: <https://doi.org/10.30880/eeee.2021.02.02.086>

Received 01 July 2021; Accepted 05 August 2021; Available online 30 October 2021

Abstract: Nowadays, the goods tracking system is becoming more and more important due to the rise of online shopping. It is very convenient to buy online as users only need to relax and press some buttons to buy the goods they want. The trend of online shopping increases drastically, especially during these few months due to the rise of coronavirus. In order to provide a better service to the customer, most online shopping platforms cooperate with courier services to provide a better preferential to customers. Hence, a pre-notification parcel tracking system is created so that customers can obtain the latest host location using this system. This paper aims to accomplish the objectives where the customer can obtain the latest host location by using the GPS service on Android devices. The user and host application were created using Android Studio, and the Firebase Realtime Database is used as the database for this system. As a result, the GPS obtained for both applications is highly accurate. The host location is updated to the database when there are chances for the host location while the user application obtained the latest host location from the database. The tracking application also able to record and update the parcel information for future reference.

Keywords: Pre-Notification, Parcel Tracking, Android Studio, Firebase Realtime Database

1. Introduction

In this modern century, the goods tracking system is becoming more and more critical due to the rise of online shopping. It is very convenient to buy online as users only need to relax and press some buttons to buy the goods they want. The trend of online shopping increases drastically, especially during these few months due to the rise of coronavirus. Most online websites (e.g., Lazada, Shopee, etc) provide a seller and buyer platform to complete their transactions.

In 2019, Lazada took only 13 hours to surpass the previous year's 11.11 sales record, while Shopee recorded three times more orders in the first hour of 11.11 in 2019 compared to the same period in 2018 [1]. From the report, we can see that online shopping is a better choice for Malaysian shopping than shopping in the mall because the convenience and price of online shopping are better than shopping in

the mall. Hence, online shopping is becoming another way of shopping for the customer shopping, and the courier service responsible for sending their parcel is more important nowadays [2].

Poslaju Express, J&T Express, DHL, etc., provide courier service in Malaysia [3]. The express service provided by these companies is provided as a commodity, so in terms of space, it can be said that the price of express service is reasonable. Hence, some online shopping platform companies cooperate with a courier service company to provide a better courier service for the seller and the customers. Next, all the courier companies also can deliver all the parcel which compliance with government treaties.

So, to better control the parcel, all the parties, including the seller and customer, can track the parcel by using the tracking number provided by the courier service company. By using the tracking number, the arrival time can be controlled, and the parcel's security will be perfect.

1.1 Problem Statement

Although the courier service's existing tracking system can track the parcel through the tracking number, it is not a perfect system. The current tracking system does not show the latest rider location to update the statement by courier service is limited [4]. Next, some customers accept the wrong parcel when the parcel has arrived due to the carelessness of the rider and customer who does not check the details of the parcel. In addition, there are cases where the customer did not receive their parcel or the parcel received had been damaged. When the rider arrived, there is no one in the house, and no one can receive the parcel. Therefore, this causes the rider to throw the parcel into the house without notifying the owner or just leaving.

Hence, the pre-notification parcel tracking system is designed to solve these problems. By using this system, the customer can obtain the latest host's location. Next, this system will notify the customer when the rider is near the targeted location. Hence the customer has time to prepare to receive the parcel. Then, the rider and customer can update the parcel status to confirm that the received parcel is correct.

1.2 Real-Time Tracking System

Geethanjali.K and Pushparani. M. proposes a real-time vehicle monitoring and tracking system with a low-cost board, and the system can detect the vehicle's path. However, this system requires a very accurate real-time road detail to ensure that the vehicle is in the right way [5]. Shubham Ingle, Ankita Sanjay Chavan, and Avinash Palave propose a mobile application to detect vehicle accidents and tracking systems using GPS/GMS. This system will cause a wrong report when the sensors read the wrong reading, and a false report might be made [6]. Next, Akshay Sonawane, Ankeet Bhanushali, Kushal Gogri, and Milind Khairnar proposed a real-time bus tracking system to obtain the estimated time taken to reach the destination and the exact bus location. However, this system is only for Android [7]. Then, Medhat H. A. Awadalla proposes a real-time shipment tracking system using RFID. This system requires high cost and a longer time for the scanning process [8]. Lastly, Dina A. Bahr, Osama A. Awad proposed LTE based vehicle tracking system using Raspberry Pi Microcontroller where the system requires a Raspberry Pi Microcontroller to trace the vehicle [9].

2. Methodology

The waterfall model is used as the SDLC approach for this project. The advantages of using the waterfall model in this project are simple and easy to understand and use, ease to manage, control and schedule, and phases can be processed and completed [10].

2.1 Software Component

There are several software components is used to complete this project, including:

i. Android Studio

Android Studio is an official IDE for building Android applications. It is designed and released specifically for the development of Android applications. The programming languages that mainly used for development in Java and Kotlin programming language. However, Android Studio can also support other programming languages such as C and C++ coding using the Android Native Development Kit (NDK). Hence, the developer can use Android Studio to complete some cross-platform projects. Next, the development for the Android application is easy to optimize for all Android devices and can be implemented on almost all devices that support Android. Java had been chosen as the programming language for the development of this project.

ii. Firebase Realtime Database

Firebase Realtime Database is a NoSQL database that provides an efficient and low-latency solution for the applications which require the synced states across clients in real-time. The data such as the user and host's location and the parcel data are stored using Firebase Realtime Database. Using Firebase Realtime Database, users can get the latest data, such as the host's location, in time to obtain the latest updates.

iii. Firebase Authentication

Firebase Authentication is back-end services that support authentication using passwords, phone numbers, and popular federated identity providers such as Google, Facebook, and more. The purpose of using Firebase Authentication is to make it easy to build a secure authentication system while improving the sign-in and onboarding experience for end-users.

2.2 System Design

The system architecture of the tracking system consists of 6 components: users, Android smartphone, Internet, GPS location, application for the tracking system, and server database. Users use their Android smartphone to get their location via a designed android application with GPS functions on their Android smartphone and an available Internet connection. Then, the data from users were transmitted between the Android application and the cloud server database. Users obtained the host user location from the android application, and the host user location will be shown on the map of the designed application. Hence, the system design for this project is divided into two-part, which are the user and host application. Both applications are designed to obtain each user's location and display it on the user application to achieve the tracking system.

2.3 Tracking system flowchart for the host application

Figure 1 shows the tracking system flowchart for the host application. The existing users were required to log in to their account using the registered email and password. Meanwhile, the new users were required to register their accounts before logging in. The user was allowed to proceed to the main page when the login is successful. After the user logged in successfully, the user can choose their activity, which is tracking system activity, checking the tracking ID list activity, or logging out. For the tracking activity, the user must turn on the tracking system and request the user to turn on their GPS on the Android smartphone. After that, the application will start to obtain the user's location data and display it on the page. Then, the application will upload the location data to the database, and user can check their location on the map activity. For the tracking ID list activity, the system will display the user's parcel data. Users can check the parcel status displayed on the list and update the tracking details by selecting the tracking detail. The user can also add new parcel data to the database, and the new parcel data will show in the list after the user insert successfully.

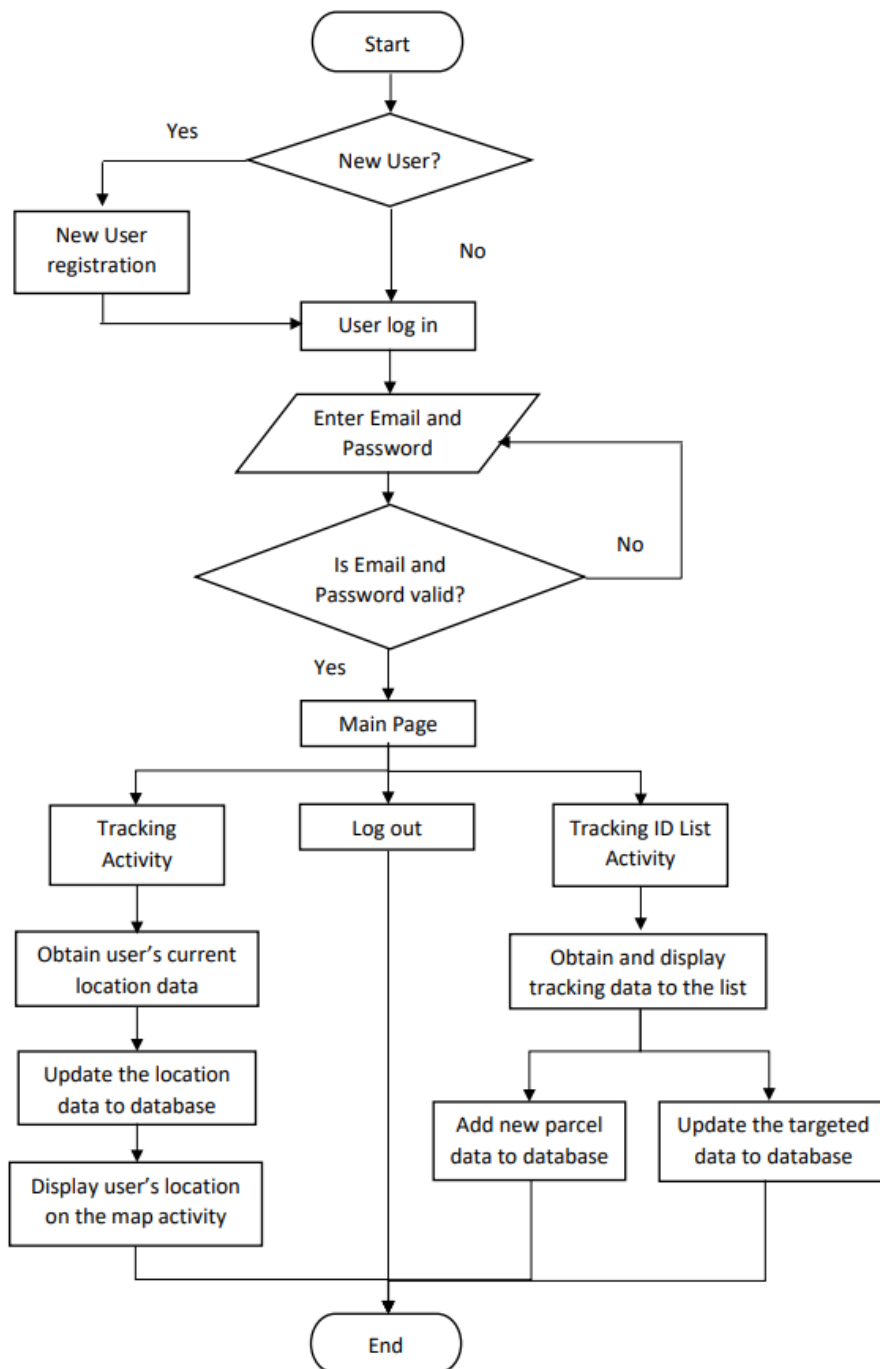


Figure 1: The tracking system flowchart for the host application

2.4 Tracking system flowchart for user application

Figure 2 shows the flowchart for the user application. For the user application, users also require an account before they can log in to the application. After the user enters the main application page, the user can choose the activity, whether tracking activity or logging out of the application. For the tracking activity, users are requested to turn on their GPS on the Android smartphone and accept permission for the application to obtain the GPS data. Next, the system will obtain the user's location data and display it on the page. The system also starts to update the user's location data to the database. Then, the user requests to insert the valid tracking number before entry to the map activity. The user is then directed to the map activity, where the host and user location and the parcel information are shown on this page. Users can update the parcel status when they receive their parcel.

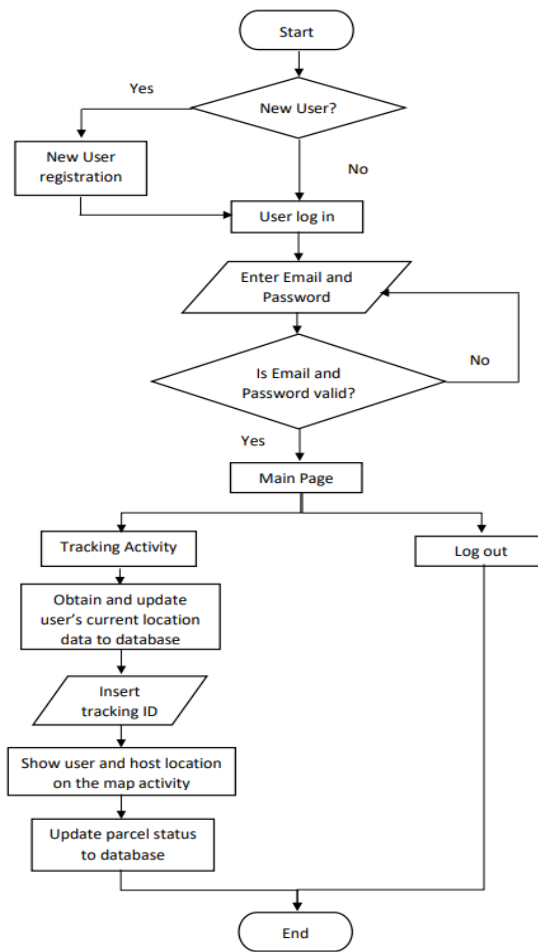


Figure 2: The tracking system flowchart for user application

2.5 Entity Relationship Diagram of Database

Figure 3 shows the entity-relationship (ER) diagram for the data in the Firebase Realtime Database. The ER diagram consists of two main modules, which are the host module and the customer module.

For the host module, the rider must register an account to log in and access the database. For the account registration, users must fill in the main details: the user's name, email, password, and phone number. After users log in to the main page, users can choose to manage the parcel data or start tracking. If users choose to start tracking, the application will start to request the user's location, and the data will be stored in the database. When the user takes the parcel, the customer can obtain the user's location from the database by inserting the parcel's tracking ID. Hence, customers can obtain the location and parcel's latest data. If users choose to manage the parcel data, users can obtain all the parcel data they manage. Hence, the user can add, update or delete the parcel record on this page. In addition, after the user completes the delivery process for a particular parcel, the user can update the parcel status to the database. The delivery can be completed when both user and host status for that parcel is complete.

Customers are required to register an account for the customer module before users can log into the user application's main page. For the account registration, users must fill in the main details: the user's name, email, password, and phone number. After the customer logs in to the application, the customer can track their parcel where the parcel's status is recorded in the database. By entering the tracking ID, users can start to trace their parcel in real-time. When users start the tracking process, the application will request the user's location, and the data will be stored in the database. After that, users can enter the tracking ID and start to obtain the host's location. When users press the start tracking button, the application will start to monitor all the data on the database and search the data tracking ID. If the

tracking ID exists, the database will display the host's location, take that parcel, and display it to the user. When the user received the parcel, the user can update the parcel status to complete the process.

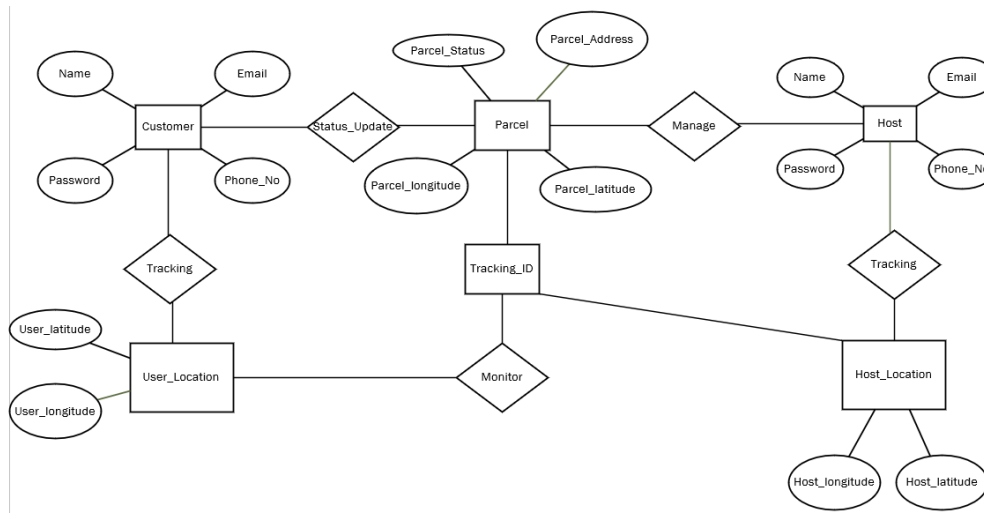


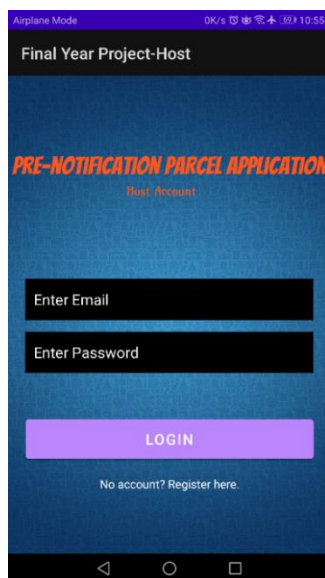
Figure 3: The Entity Relationship Diagram of Database

3. Results and Discussion

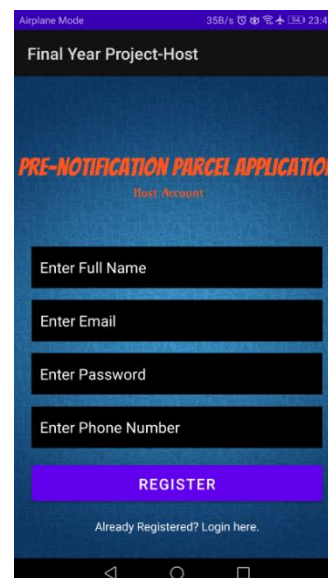
This section will describe the results and analysis for the implementation of the pre-notification parcel tracking system.

3.1 Login and register module for both applications

Figure 4 shows the login and register module for both applications. The Firebase Authentication is used for the login and register module. Users must insert the information into the respective field before the user can complete the login or register process. An error message is shown when the program detects that there are empty fields. For the login module, users are required to insert the registered email to log in to the application. Users can press the line "No account? Register here." To direct to the registration page (register module). For the register module, users must insert a non-registered email to register a new account. Users can also press the line "Already Registered? Login here." to direct to the login page (login module).



(a)



(b)

Figure 4: Login and register module for application (a) Login module; (b) Register module

3.2 Host application

Figure 5 shows the tracking system, while Figure 6 shows the parcel information page for the host application. For Figure 5, the tracking activity, the user's latest location is displayed on this page, and users can press the "SHOW MAP" button to show their latest location on the map. For Figure 6, the tracking ID list activity, the user's parcel information is displayed on the Tracking ID List. Users can scroll down to obtain more parcel information. On this page, the user can add new parcel information by pressing the "ADD NEW TRACKING ID" button or update the parcel details by select the target parcel information in the list.

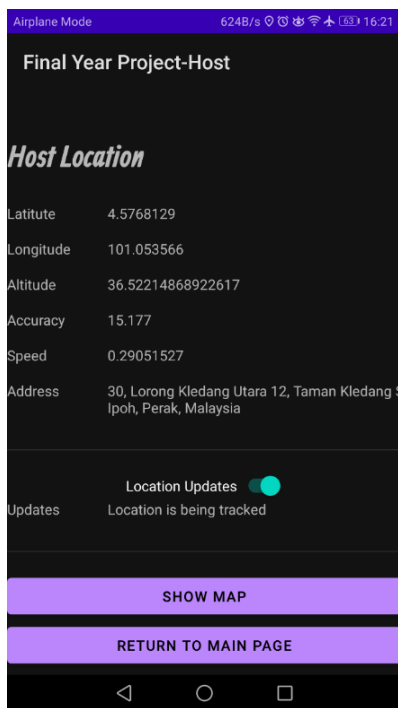


Figure 5: The tracking system for the host application

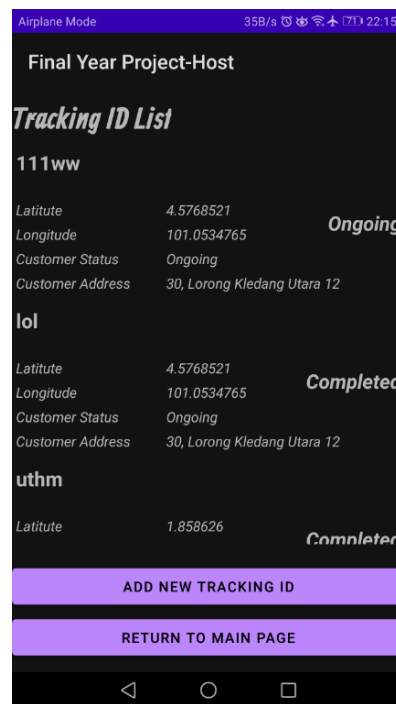


Figure 6: The parcel information page for the host application

3.3 User application

Figure 7 shows the tracking activity for the user application. The user's latest location is displayed on this page, and users must insert the valid tracking number. After the user inserts the valid tracking number, the user can direct to the map activity by pressing the "SHOW MAP" button. Figure 8 shows the map activity after the user inserts the valid tracking number. On this page, the user can observe the user and host the latest location on the map. Users can also obtain the parcel details on this page. When the distance between host and user is less than 2km, the notification is sent to the user application, as shown in Figure 9. After the user receives the parcel, the user can update the parcel status in the parcel information update page to complete the delivery process, as shown in Figure 10.

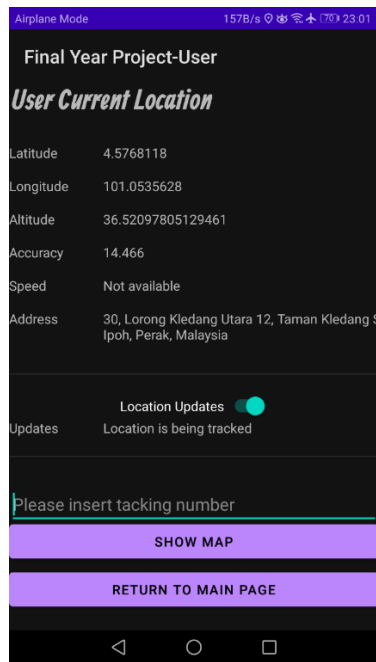


Figure 7: The tracking system for user application

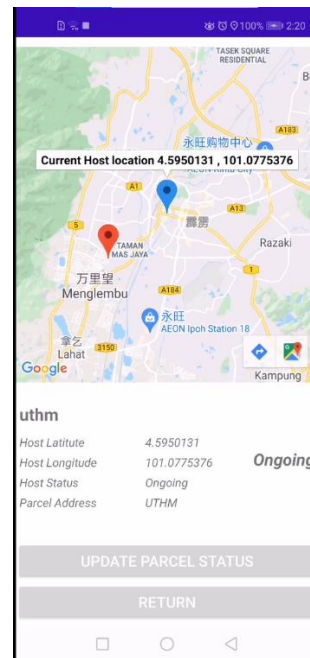


Figure 8: The map activity for the user application.

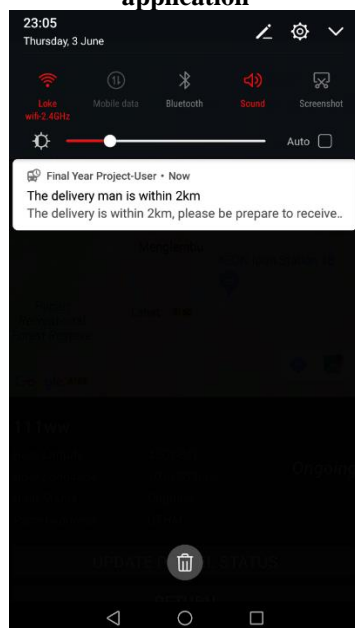


Figure 9: The notification is shown when the distance is less than 2km

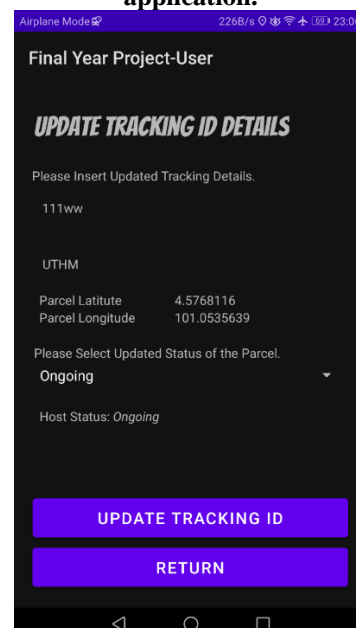


Figure 10: The parcel information update page for user application

3.4 Firebase Realtime Database

When a new user is created, all the registered data will store in the Firebase Realtime Database. The Firebase Realtime Database is a NoSQL database, and it is like a cloud-hosted JSON tree. The base root for this database is "galvanic-portal-312007-default-rtddb", and all the new data will be created and store under this root. When new data is added to the JSON tree, it will become a node in the existing JSON structure and extend like a tree branch. All the data updates will be store here under respective nodes, and both applications will read the data according to the data required by the user. The interface of the Firebase Realtime Database is shown in Figure 11.

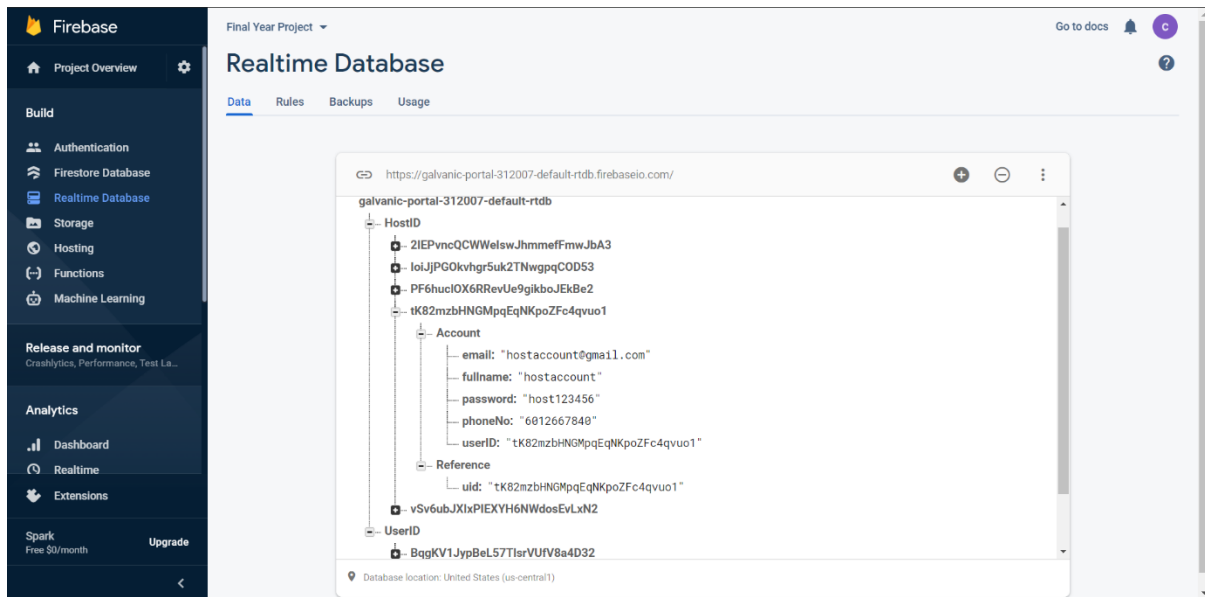


Figure 11: The interface of the Firebase Realtime Database

3.5 Discussion

The GPS accuracy for both applications is tested by calculating the percentage error, PE. The latitude and longitude obtained from both application are used to calculate the percentage error by comparing the latitude and longitude of a reference point of 4.57710, 101.05332 using Eq. 1 and Eq. 2 as below:

$$PE = \left(\frac{|Reference\ Latitude - Received\ Latitude|}{Reference\ Latitude} \right) * 100\% \quad Eq. 1$$

$$PE = \left(\frac{|Reference\ Longitude - Received\ Longitude|}{Reference\ Longitude} \right) * 100\% \quad Eq. 2$$

Table 1: The percentage error for each application

Average value for	Received Latitude	Received Longitude	Latitude Percentage Error, %	Longitude Percentage Error, %
Host application	4.5768351	101.0535554	0.0057869	0.0002329
User application	4.5768309	101.0535608	0.0058899	0.0002383

Tables 1 shows the percentage error calculated using the average location data from both application and the reference point. From the result in percentage error, it can be said that the GPS accuracy for these two applications is almost 99%. Hence, it can be concluded that the GPS accuracy for both applications is very high, proving that the applications can trace users' location.

4. Conclusion

In conclusion, this project focuses on implementing the Global Position System (GPS) to track the parcel's current location through the host application and display the current location of the host application to the user application. When the user application detects that the host's location is within 2km from the user's current location, a notification will send to the user to notifies the user to be prepared to receive the parcel. Hence users in the user application can obtain the latest host location

through the user application. Users for the host application can also manage the parcel information through the host application to record the parcel status.

Acknowledgment

The authors would like to thank the Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia.

References

- [1] J. Tan, "Lazada And Shopee Hit Record Sales In Malaysia For 11.11 2019," RinggitPlus, 12-Dec-2019. [Online]. Available: <https://ringgitplus.com/en/blog/personal-finance-news/lazada-and-shopee-hit-record-sales-in-malaysia-for-11-11-2019.html>. [Accessed: 26-Oct-2020].
- [2] F. Siali, A. W. S. Wen, and M. U. A. Hajazi, "Booming of Online Shopping in Malaysia: Do Customers Satisfy with Parcel Delivery Service?," *International Journal of Academic Research in Business and Social Sciences*, vol. 8, no. 12, Dec. 2018.
- [3] "Data Analytics," Data Analytics - Tracking.my. [Online]. Available: <https://www.tracking.my/analytics>. [Accessed: 26-Oct-2020].
- [4] "Introduction to Shopee Free Shipping Program.," Seller Education Hub. [Online]. Available: <https://seller.shopee.com.my/edu/article/388>. [Accessed: 26-Oct-2020].
- [5] Geethanjali.K1 and Pushparani .M .K2, "Real Time Vehicle Monitoring and Tracking System for School Bus via Beagle Bone," *International Journal of Science and Research (IJSR)*, vol. 5, no. 5, pp. 918–921, May 2016.
- [6] A. Shendkar, S. Chavan, A. Palave, and S. Ingle, "Mobile Application for Detecting Vehicle Accident and Tracking System Using GPS/GSM," *Ijarce*, vol. 7, no. 12, pp. 22–25, Dec. 2018.
- [7] A. Sonawane, A. Bhanushali, K. Gogri, and M. Khairnar, "Real Time Bus Tracking System," *International Journal of Engineering Research & Technology (IJERT)*, vol. 9, no. 6, pp. 829–831, Jun. 2020.
- [8] M. H. A Awadalla, "Real Time Shipment Tracking System Using Rfid," *International Journal of Computers and Technology*, vol. 17, no. 1, pp. 7163–7180, Mar. 2018.
- [9] D. A. Bahr and O. A. Awad, "Lte Based Vehicle Tracking and Anti-Theft System Using Raspberry Pi Microcontroller," *Iraqi Journal of Information and Communications Technology(IJICT)*, vol. 2, no. 1, pp. 1–15, Mar. 2019.
- [10] "SDLC - Waterfall Model," Tutorialspoint. [Online]. Available: https://www.tutorialspoint.com/sdlc/sdlc_waterfall_model.htm. [Accessed: 25-Jun-2021].