RT-Train: A Real-Time Tracking System for Public Train in Malaysia

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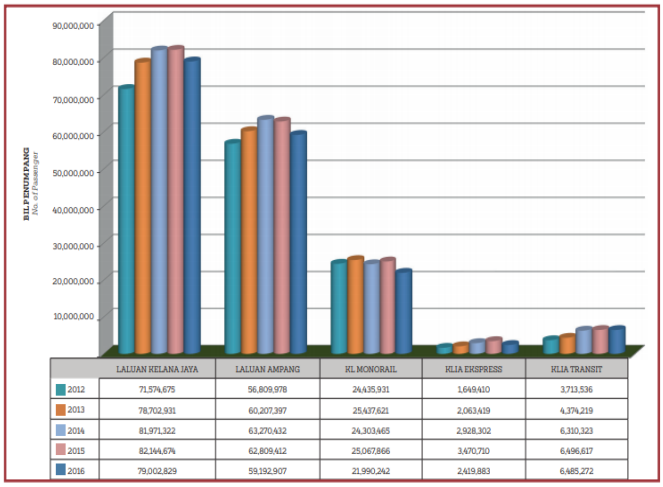
***Abstract*— Real-time Public Train Tracking System is a system for the train user to check the train schedule, track the upcoming train's location in real-time, and receiving announcement via push notification. In this paper, a new prototype of the Real-Time Public Train Tracking System called "RT-Train" was introduced. This proposed system can reduce the congestion of train users and allows train users to know the accurate train schedule and the real-time location of the train. Besides, it allows the train users to receive the push notification if the train is delayed. In this paper, we had also included an Abstract Architecture in explaining the system flow of the proposed system by using use case diagram. In the testing stage, four (4) major sub stages includes Unit Testing, Integration Testing, System Testing and User Acceptance Testing (UAT) have been done. From the results, all the actual results are same as the expected results. As a conclusion, the proposed system has achieved all the objectives that aimed by us.**

***Index Terms*— Real-time Tracking, Public Train, Delay, GPS, Location Detection**

1. Introduction

Nowadays, in this fast life where everyone is in a hurry to reach their destination, railway in Malaysia has been playing a major role in the economic and social advancement of the nation. There are many types of rail transports in Malaysia, such as heavy rail (which is including the commuter rail), light rail transit (LRT), mass rapid transit (MRT), monorail, airport rail link (ERL) and a funicular railway line in Penang (Masirin *et al.*, 2017). Commonly, the heavy rail is used for the intercity passenger services or the freight transport services; while the LRTs, MRTs and monorail are used for the intra-city urban public transport.

The intercity rail network in the Peninsular Malaysia comprises of KTM West Coast Line and KTM East Coast Line. KTM West Coast Line is used in the between of Singapore and Padang Besar, Perlis, and on the Malaysian-Thai border. For the KTM East Coast Line, it is used in the between Gemas in Negeri Sembilan and Tumpat in Kelantan. From the Figure 1, it shows that started from the year of 2012 for the year of 2015, the number of the railway passengers was increasing. However, when reached for the year of 2016, the statistics were shown that the number of passengers has been reduced compared to the year of 2015. The main reason of the decreasing is because the train fares were increasing in Malaysia during the year end of 2015. (Chan, 2015). Besides, public perception and attitude towards the public transport also one of the important issues that affecting the usage of the public transport.



	LALUAN KELANA JAYA	LALUAN AMPANG	KL MONORAIL	KLIA EKSPRESS	KLIA TRANSIT
2012	71,574,675	56,809,978	24,435,931	1,649,410	3,713,536
2013	78,702,931	60,207,397	25,437,621	2,063,419	4,374,219
2014	81,971,322	63,270,432	24,303,465	2,928,302	6,310,323
2015	82,144,674	62,809,412	25,067,866	3,470,710	6,496,617
2016	79,002,829	59,192,907	21,990,242	2,419,883	6,485,272

Figure 1: Statistic of users that use public transport(Ministry of Transport Malaysia, 2017)

Thus, to develop a suitable transport network for the community, it is important to study on the current perceptions and attitudes of the users (Rojas López and Wong, 2017). In this project, before introducing a new prototype of Real-Time Tracking System for Public Train in Malaysia, we had also done a survey that focusing on the public perception and attitude towards the public train in Malaysia. All the survey results are included in the result and discussion section.

2. Backgrounds and Related Works

In this section, we briefly discussed on the latest research topics that related to the public transport, and also the existing public train mobile application that available in Malaysia and other countries.

2.1. Location Tracking and Time Prediction

Location tracking and time prediction is one of the important researches have been done in the public transport area. Sinha *et al.* (2017) is one of the researchers that doing the research on the bus location tracking. They developed a real-time bus tracking application by using the GPS API. This system able to display the real-time location and timetable of the bus by using GPS. Besides, in the system, it's able to upload the current

location of the bus to the server; while the server able to broadcast the bus location to the students automatically by using the SMS. For the bus drivers, they only need to log in to the system and use their mobile phone to act as a GPS receiver for locating the current location. They can update the server in every moment in the form of *longitude and latitude* (Sinha *et al.*, 2017).

On the other hand, Bhardwaj, Daphal and Nerkar (2016), also presented a new bus arrival time prediction system on the GPS based sensing. Figure 2 shows the system architecture of their proposed system. The technologies that used in their project are using GPS, Global System for Mobile Communication) GSM technology. The real-time coordinates of moving vehicle will be obtained from the GPS device and report the position of the vehicle on request for passengers (Bhardwaj, Daphal and Nerkar, 2016).

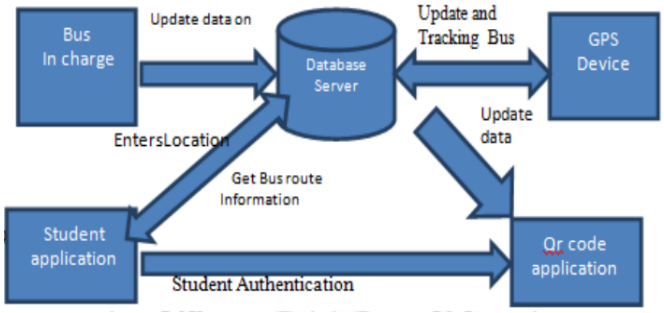


Figure 2: Architecture of bus arrival time prediction system from Bhardwaj, Daphal and Nerkar (2016)

In the paper of Salunkhe *et al.* (2018), they presented a bus arrival time prediction system for the users too. However, their proposed system is based on the user participatory sensing with the smart application. In their system, users who are waiting at the bus stop can request for a bus. When the number of requests exceeds more than a certain limit in a control room, a bus will be sent to the location of the request. Besides, they installed the Raspberry pi with a GPRS module in each bus, so that the users can track the location of the bus and the accurate timetable by using the GPRS tracking. Figure 3 shows the proposed architecture from the paper of Salunkhe *et al.* (2018).

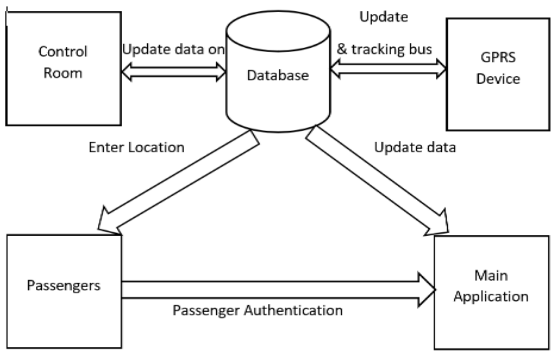


Figure 3: Architecture of bus arrival time prediction system from Salunkhe *et al.* (2018)

Besides, other researchers such as Farkas *et al.* (2015), also focusing their research on the area of crowd-sensing based public transport information service. They proposed a system called "Traffic Info" in their paper. This system can visualize the real-time public transport information of the given city on the Google Maps and also can do a live update on the transport schedule based on the automatic stop event detection of the public transport vehicles.

In the paper of Gholami and Sotskov (2014), they had done a research on the total train tardiness issue. In their research, there are three stages of strategy to reduce the delay in train scheduling. And, from the computational results, it shows that their proposed idea was very useful to reduce the total tardiness, total completion time and make span in the train scheduling. Below are the strategy stages that presented by Gholami and Sotskov (2014):

1. Pre-scheduling algorithm executed to achieve some data about trains.
2. The departure time of the trains is modified to decrease train delays.
3. A controllable processing time module tries to reduce train delays as much as possible via increasing speeds of some trains.

Moreover, Walde *et al.* (2014) and Rahman, Wirasinghe and Kattan (2018) also done a research on the location and time prediction area. To give numerous services to the user based on their location, Walde *et al.* (2014) had implemented location based services through Walk Score Transit and Google Web Services APIs on Android Phones. The application can request for periodic update of the device location information and register an intent receiver for proximity alerts like when the device is entering and existing from an area of giving longitude, latitude and radius (Walde *et al.*, 2014). For Rahman, Wirasinghe and Kattan (2018), they had analyzed the changes of bus travel time characteristics as pseudo horizon varies and how such characteristics can be applied to real-time bus arrival estimation in their paper.

2.2. Existing Public Trains' Mobile Application

Recently, to improve the service quality of a public transport, there are some mobile application have been developed for the users. Below are the current public train mobile application that used in Malaysia and other countries.

2.2.1. Moovit

Moovit is an application that gives a peace of mind for the public transportation users. It allows users to discover their best routes to anywhere in the city. Whenever users need a direction to the destination, *Moovit* has built-in a feature that allows to get detailed itineraries and provide GPS for the transit with step-by-step guidance from destination A to destination B. Besides, it has an automatic notification to remind the users whenever the users have set a targeted station, so that they will never miss a stop. Moreover, it allows users to make their

favorite locations. Therefore, users can just get 1-tap and it will direct them to the most travelled places. In addition, whenever users need the information on nearby transit, it has provided a real-time status to let them know when do they need to be at the station and allows them to know where is the nearby stations by viewing all lines running at the station around their location. Other than that, users can get the crucial information of train stations. For example, schedules of the train from each platform as well as the last ride of the night. Moreover, *Moovit* will send a service alert if there is any announcement made by train management.

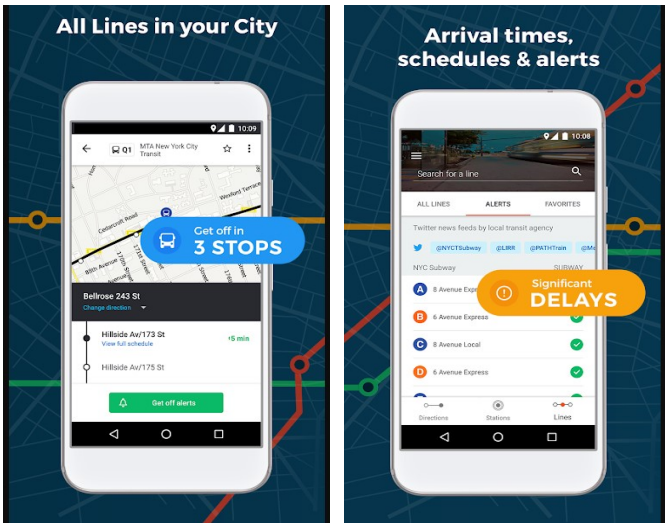


Figure 4: Moovit Application (Moovit, 2018)

Last but not least, it has provided a route and system maps for users to download it when there is an internet connection with the application and use it even if there is no internet connection to the application. So far, there are more than 150 million of the users in over 2200 cities throughout the world used this application (Moovit, 2018). Figure 4 above shows some of the screenshots in the *Moovit* application.

2.2.2. Malaysia Rail Map – Kuala Lumpur

Malaysia Rail Map is developed by TOKYO STUDIO INC. This system has covered all the railway in Malaysia which includes Light Rail Transit (LRT), Keretapi Tanah Melayu (KTM), KL Monorail, KLIA Express, and some of the other railway information. The system does not require registration and perform login. The system allows user to search the station. However, this system does not provide any train schedule to train user which is the most important information for train users. Moreover, the system allows the user to locate their current location and see what the public transportation is nearby. Furthermore, there is train information for every station that is provided by the system. Besides, it can also check the tweets around the station that has connected and linked with Twitter. There is some weather information from the station that allows users to know. The system allows user to know when they need to change their train if there is a need to interchange train in between. Lastly, there are multiple language support for the system. Figure 5 below shows some of the screenshots in the *Malaysia Rail Map – Kuala Lumpur* application.

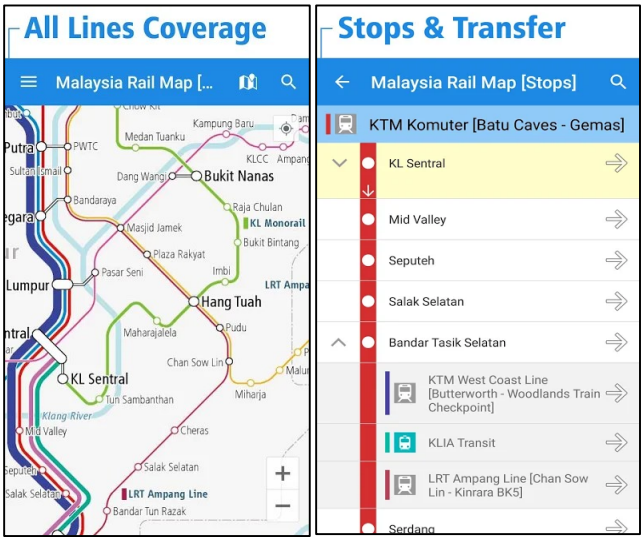


Figure 5: Malaysia Rail Map – Kuala Lumpur Application (STUDIO, 2018)

2.2.3. KL Transit

KL Transit application, which shows in Figure 6 below was developed by SearchGuru Sdn Bhd. The system has just included the train schedule for Keretapi Tanah Melayu (KTM). The system does not require registration and perform login. The user of the system is allowed to check the schedule of the KTM by selecting the departure station and the destination station. After by selecting these two stations, click the "*Check*" button to check the schedule of the train where what is the next few train's schedule from the departure station. However, the train schedule is fixed for a few years, there is no update for the train schedule. The user is able to check the train schedule up to a few hundred years later.

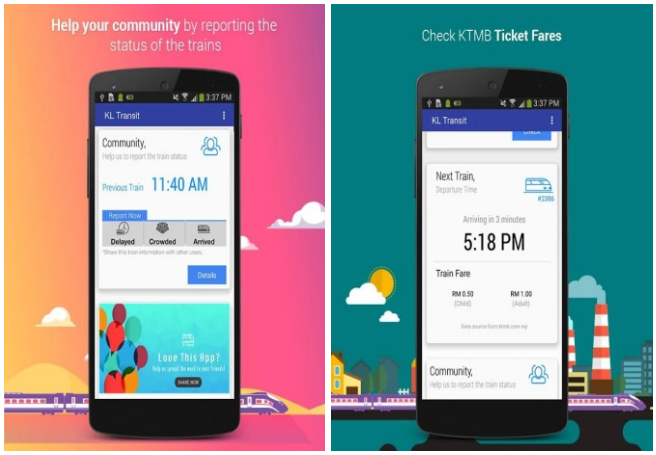


Figure 6: KL Transit Mobile Application (SearchGuru, 2018)

Besides, the ticket fare from the departure station to destination station will be shown at bottom of the system after the user clicked "*Check*". Moreover the system allows the user to set reminders and the system will remind user 15 minutes before the departure time so that they will never miss the train. Lastly, the system allows the user to share the application to their friends or family to download it and use it from Google Play Store or Apple AppStore.

2.3. Features Comparison Table

In this section, we briefly discussed on the features of the existing systems and the proposed system (RT-Train). From the Table 1, we can see that the proposed system has all the functions where some of the existing systems does not have.

Table 1: Comparison of features with Moovit, Malaysia Rail Map, KL Transit, and Proposed System

Features	Moovit	Malaysia Rail Map	KL Transit	Proposed System
Plan Journey	✓	×	×	✓
Real-Time tracking on the train	×	×	×	✓
Train departure notification	×	×	×	✓
Live Directions with Get Off Notifications	✓	×	×	✓
Train information from every station	✓	×	✓	✓
Favourites Screen	✓	×	×	✓
Service Alerts	✓	×	✓	✓
Route & System Maps	✓	✓	×	✓
Stops & transfer information of all lines	✓	✓	×	✓
Free automatically updates to the latest versions of maps	✓	✓	×	✓
Switch to Street Map View at every station	✓	✓	×	✓
Multiple languages	×	✓	✓	×

3. System Architecture and Overview

In this project, the Programming Language that chooses for the application development is Java. Java is the most common programming language for developing Android mobile application. Therefore, Java is the best language for developing the proposed system. For the Interactive Development Environment (IDE), the developer has chosen the Android Studio. There are some Libraries and Tools also have been integrated in this project, such as Firebase System and Google Map API. Figure 7 shows the user roles that involved in our proposed system.

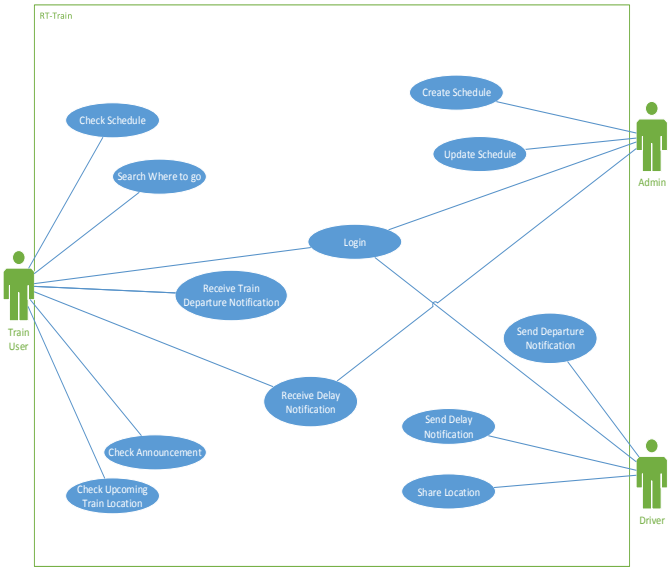


Figure 7: Use Case Diagram for the RT-Train system.

Train user can log in to the system. The system allows train user to check the schedule of the train arrival time; Allows train user to search where they want to go and the system will prompt them to the location of what they have searched; Allows train users to get train departure notification where they can know how long will the train depart from the station; Allows train user to receive notification if the train is delayed or glitches; Allows train user to check the announcement from the train management; Allows train user to know the location of upcoming trains.

For the admin side, the system allows admin to create the train schedule and save into the database; Allows admin to update the existing train schedule and save into the database; Allows admin to receive notification if the train is delayed or glitches. Besides train users and admin, the train drivers also can log in to the system. The system allows driver to use the GPS of their mobile phone for showing up the location of the train in the system; Allows driver to send notification to train user and admin if the train is delayed; Allows driver to send notification where how long will the train depart from the train station.

This proposed RT-Train system has been implemented and tested in a real environment, where our developer team went into a real-life train and tested the system and get the most accurate result during the testing for a better development process. During the unit testing stage, to make sure that the component itself is working perfectly, each of the system unit has been tested at least 10 times. For the User Acceptance

Testing (UAT) stage, the proposed system also have been tested with 5 end-users include students and staffs. The screenshots of our proposed system were shown in the Figure 8 below.

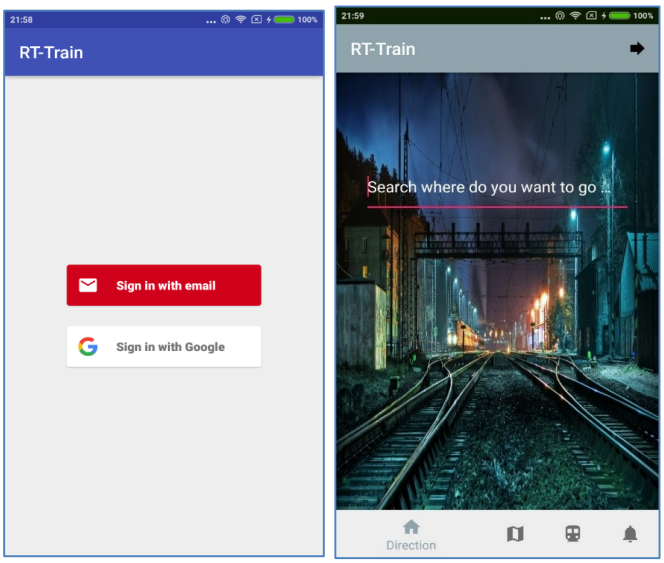


Figure 8: RT-Train's login page

4. Results and Discussion

From the survey, there are 48.7% of the Malaysia respondents are taking train more than 10 times per month, and 33.3% of the respondents had spent more than 15 minutes of waiting an arriving train. Besides, there are also 94.9% of the respondents would like to know the location of the upcoming train and most of them had also suggested the below features for the system, such as:

i. Check the arrival time for the train,
ii. Shows an accurate schedule,
iii. Check announcement and receiving Push Notification from train management.

Therefore, based on the user requirements, all the suggested features had been included in our proposed system. Therefore, based on the user requirements, all the suggested features had been included in our proposed system. Figure 9 to Figure 11 show the important results that retrieved from our questionnaire survey.

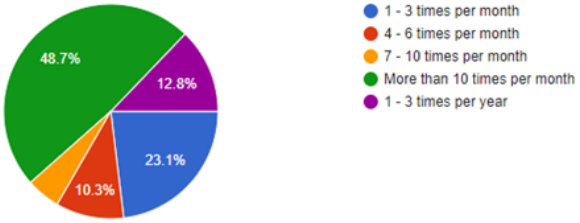


Figure 9: Survey on how often a Malaysian used the train service.

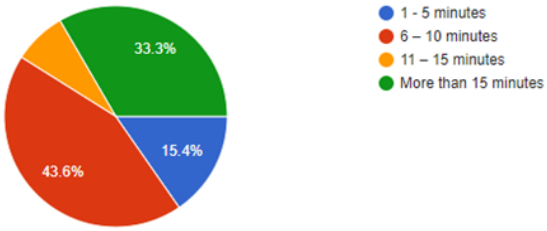


Figure 10: Survey on how much time a user spent to wait an arriving train in Malaysia.

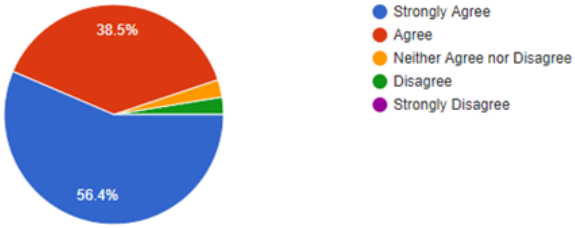


Figure 11: Survey on how many users wish to see the location of the upcoming trains.

To ensure the proposed system able to work well in the real environment, there are four (4) main testing stages were done, such as Unit Testing, Integration Testing, System Testing and User Acceptance Testing (UAT). As a summary, all the test cases under these four (4) testing stages were passed in the experiment. From the Figure 12 to Figure 14, they show a few of the testing results from our system. Therefore, the proposed RT-Train system is ready to go live in a real production environment.

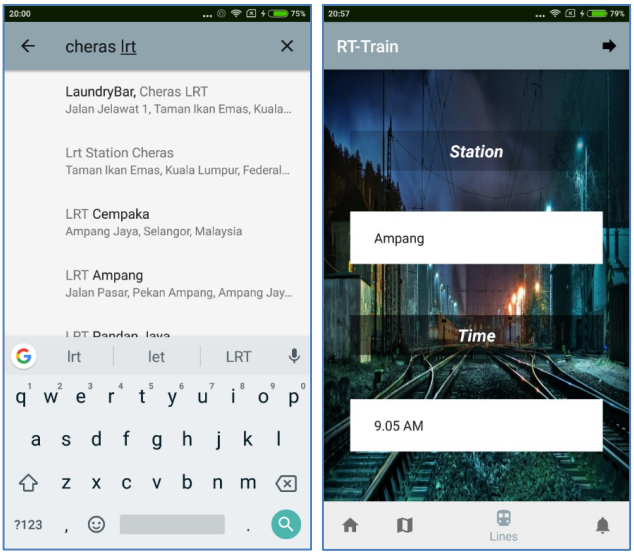


Figure 12: Screenshots for how a user search for a train station.

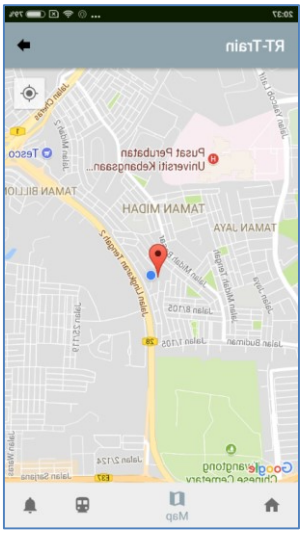


Figure 13: Screenshots for how a user detects the real-time location of a moving train using their application.

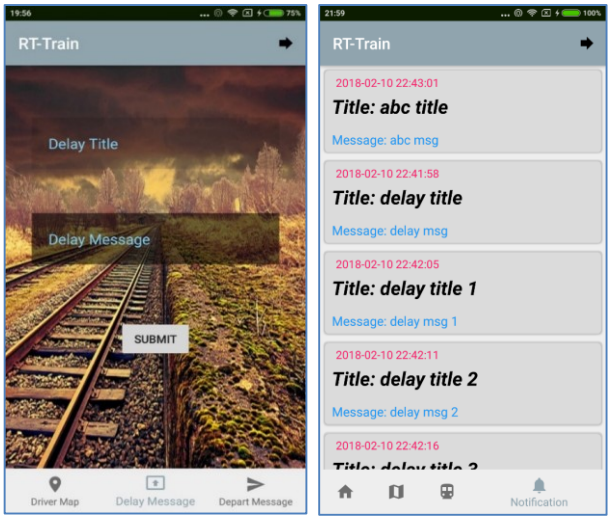


Figure 14: Screenshots of how the train driver to broadcast the delay messages and users received the delay messages.

5. Conclusions

RT-Train is a mobile application, which allows train users to get track the schedules and the location of the train without having any difficulty. The user interfaces in our proposed system are simple and user-friendly. Besides, this system can also increase the punctuality rate of train users like workers and students. From the experiments' results, they show that all the proposed objectives of the system had been achieved, where the system able to provide a real time train arrival and departure features for the public train station, able to provide a train schedule for train users, allows train users to receive push notification about the departure time of the train from the station platform and etc.. Thus, as a conclusion, *RT-Train* is a good and potential system, which is ready to publish to the public.

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