



## MOBILE APPLICATION FOR REAL TIME BUS TRACKING AND SEAT BOOKING

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### INTRODUCTION

The transport sector in a country plays a vital role in boosting its economy (McKinnon, 2006). There is a significant improvement in the road sector in Sri Lanka with the development of the construction industry after 30 years of civil war. Hence, the focus of the national road master plan is on building expressways, improving expressways and rehabilitating roads in particular rural areas (Oliver 2019). Similarly, the expressway is a new experience which would bring great benefits to the lives of Sri Lankans. The Southern Expressway from Kottawa to Galle was introduced to Sri Lanka in 2011. Since then, the Southern Expressway was extended up to Hambantota and the Outer Circular Expressway as well as the Katunayake Expressway were opened keeping in line with the country's demand for an efficient transport system. Moreover, the Central Expressway is in the proposed country development plans. The advantages of the expressways such as increased safety, comfort and convenience for drivers and passengers and the low vehicle operating costs encourage people to use them more frequently (Expressway Road, 1998).

The government has introduced a bus service to improve the passenger use of the expressway as it is limited to four-wheeled vehicles (Sri Lanka Transport Board, 2020). However, the bus service is only limited to few major destination points of the expressways (ex: Kottawa to Galle, Kottawa to Matara etc.). The use of the expressway sometimes reduces the distance and time of the journey in comparison to the normal routes. For example, using the expressway is better than using the railway system or the Kandy Road to go to Petah taking the Maharagama bus (the distance is approximately 16.8km and the travel time to Maharagama is around 50 minutes). The private bus sector has seized this opportunity by introducing more routes in response to the increasing demand of the passengers. In fact, it is a cost-effective and timesaving solution for travelers, especially the office crowd to reach their destinations.

More importantly, the private and government expressway bus system operates following a schedule according to which the passengers must adapt. Due to the high demand, passengers cannot get the express way buses, especially during the office hours, unless they are at the starting point. This has created a group of unsatisfied customers who attempt to find alternatives. Moreover, drivers and conductors receive phone calls to reserve passenger seats and to know the current location of the bus which causes great inconvenience. Moreover, due to the dynamic bus schedule, customers need to record a large number of telephone numbers and make several calls until they receive the bus number that matches their schedules. Moreover, the drivers have to look for different bus schedules at the request of certain passengers. Therefore, the drivers are discouraged from answering the passenger calls made to reserve seats. Also, it is very difficult for drivers to locate the passenger who has made a reservation and there is a problem with passenger identification at bus stops due to the high demand for limited seats. The complexity of this process has led the passengers to abandon this valuable service causing financial loss for bus owners.

Thus, there is a great demand for an automated solution to track the buses and to reserve the seats, both from bus owners and passengers. Since this service requested when the passengers are on the roads, the best solution is to go for a mobile application rather than a web application. Further, Mobile application is considered as the most suitable solution as the usage of mobile devices in Sri Lanka is very high (Datareportal, 2020). In the year 2020 January, there were 31.80 million mobile connections in Sri Lanka; out of them the use of the smartphones also has a high percentage (Datareportal, 2020). The complete system enables the passenger to track the bus using GPS (Global Positioning System) technology and reserve the seat as well making it easier for drivers and conductors too. Due to the large use of Android devices in Sri Lanka, the proposed system is built for Android users.



## METHODOLOGY

The main functionalities of the proposed system are depicted clearly in Figure 1. In this system, the passenger can locate the bus with the help of the phone's GPS signal and the bus can also locate the passenger. GPS signals track the location data using the longitude and the latitude. With the advancing mobile phone technologies, GPS receivers have been incorporated into the mobile devices. GPS signals are received by each device from at least four different satellites positioned around the Earth (McClelland, 2017). The GPS technology developed in the mobile phones of the buses is used to track the location of the bus, and the real-time data (longitude and latitude) of the bus location is updated to the database regularly. Google Places, Roads and Map SDK for Android APIs (Application Programming Interfaces) were applied to increase the accuracy of the real-time location by collecting data of nearby places and roads. Accordingly, the location of the buses is indicated to the passengers on Google Maps installed in their mobile phones (Figure 2). Buses as well as passengers

need to register with the system to obtain this service. Buses must be attached to specific routes at the time of registration and the specified route can be changed if the route of the bus changes. The driver is given the option to indicate the start and the end of the bus journey in his User Interface (UI). Therefore, the passengers can observe the buses on the route. In addition, the driver is capable of adding the number of seats on the bus at the starting point. Please refer to Figure 3 for more information. Depending on the availability, they can reserve the preferred seats on the bus and the reservations will be updated in the database while notifying the concerned bus (Figure 4). Google Firebase was used to keep the data. There are two types of databases in Google Firebase as “Cloud Firestore” and “Real-time Database”. To handle the real-time data more efficiently, “Realtime Database” was used on the Google cloud console, and it is directly supported by Google APIs. The summary of the system architecture is shown in Figure 5. Android Studio, the official tool introduced by Google with JetBrains was the tool used to develop the system. Java classes and XML (Extensible Markup Language) files were the major files used to develop the methods and the User Interfaces in Android Studio.

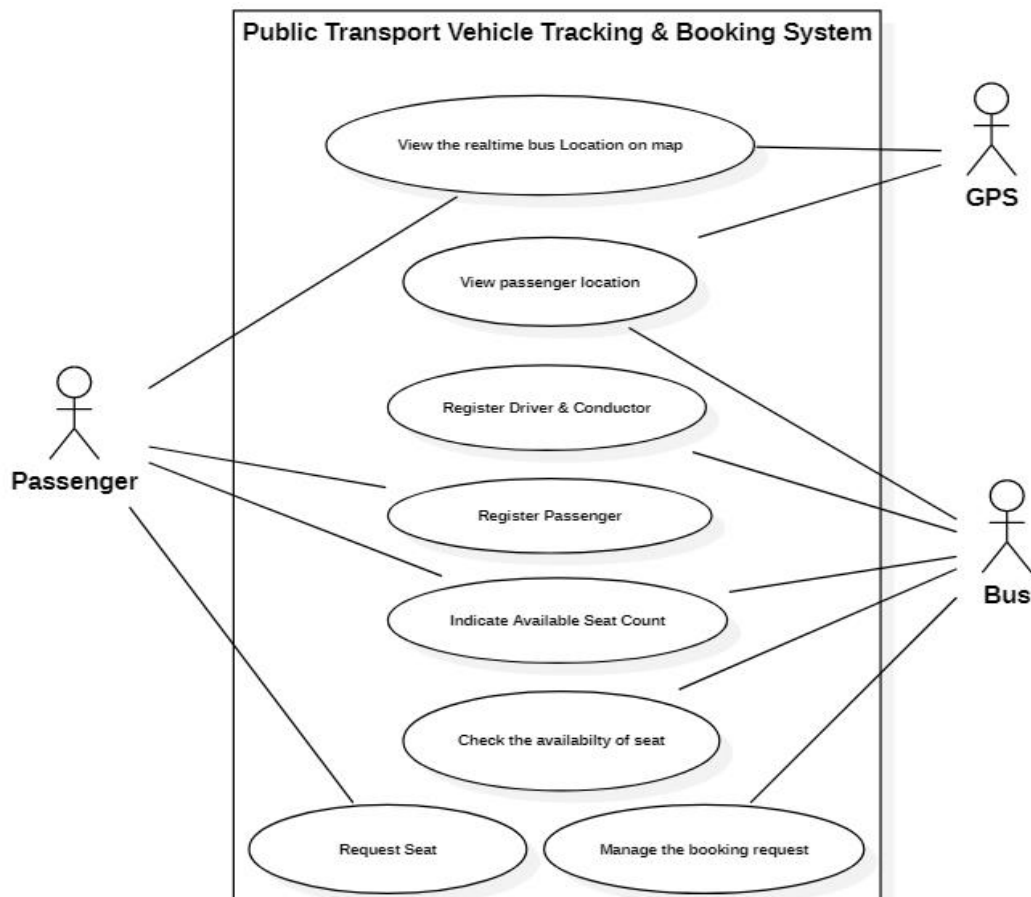


Figure 1: Use case diagram of the proposed system indicating the bus

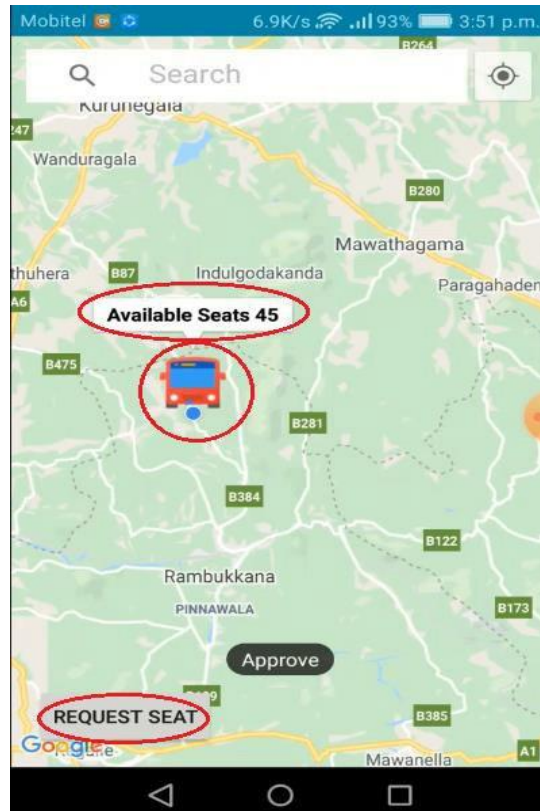


Figure 2: User Interface of the Registered Passenger indicating the bus

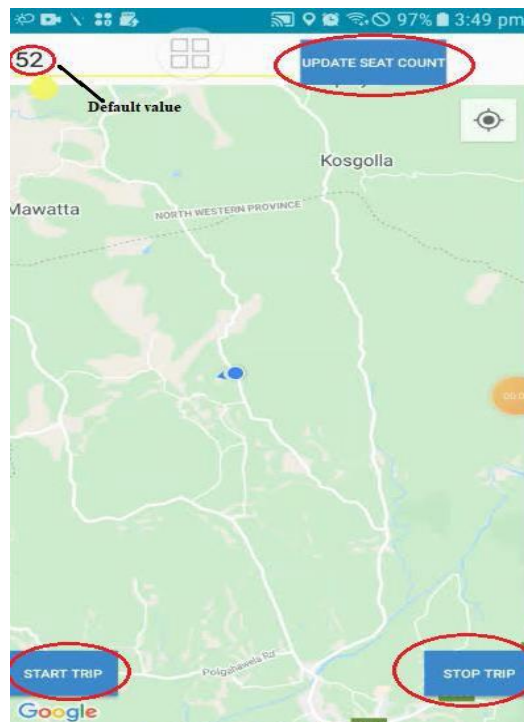


Figure 3: User Interface of the Driver to indicate the start and end of the journey and number of available seats

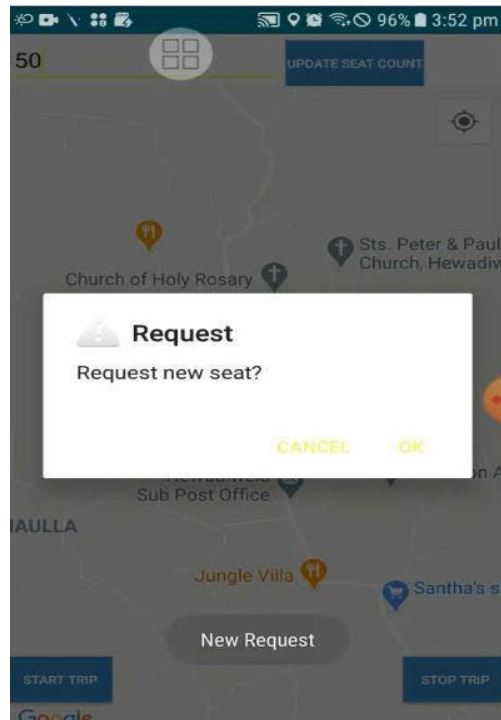


Figure 4: Driver/conductor interface to confirm the seat reservation request made by customer

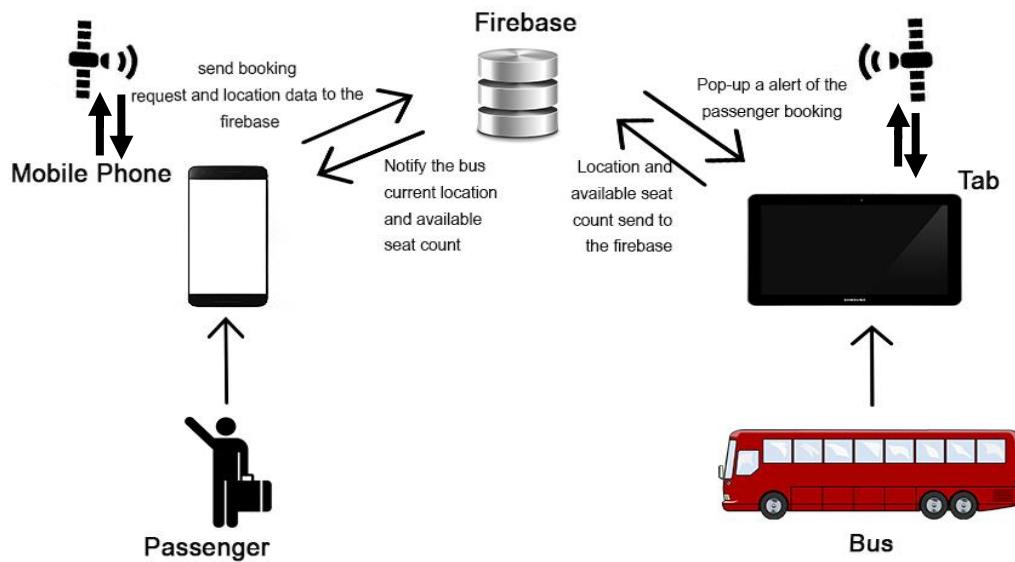


Figure 5: Architecture of the proposed system



## RESULTS AND DISCUSSION

In the proposed system, buses and passengers must register with the system to receive services. Once they are provided with the necessary information to register, a unique ID will be created for each user (both the bus and the passenger). Buses should login to the system using the username and password they are given at the registration. Once the bus is successfully loaded, the route is automatically inserted into the system at the start of the journey. The number of seats on the bus must be updated to make it visible to passengers who wish to book seats on a particular bus. Passengers are enabled to view the real time bus location (only the buses traveling in the requested direction can be seen; that is, from A to B or from B to A.) with the seat availability through GPS technology and the Google Map. If the seats are available, they can make the seat reservation effortlessly. It is not necessary to call the bus to make a seat reservation. The request is visible to the particular bus for their confirmation. Reservation status (allowing or refusing to reserve seats) can be seen by the passenger enabling them to make their next decisions. With regard to the accepted reservations, a token will be generated and sent to the passenger. In order to take this invaluable service, the passenger is also required to login to the system. This system is not complicated as it does not require the payments to be made for the reservation. Even if the passenger is far away from the selected route of the bus, the passenger can request for a seat without paying for the reservation. If the passenger is not in the location when the bus reaches it, the driver can give priority to another passenger. The ticket can be issued when the passenger is on board.

Since the passenger can view the location of the buses in real time with the number of available seats, they do not have to maintain a separate set of telephone numbers of the drivers/conductors to know where the bus is and to make the seat reservation as they currently do. Moreover, the information provided about the seat availability and the status of the seat reservations (if there are no seats or if the bus refuses to reserve seats) allows the passenger to make a reservation for the next bus or to go for another decision without wasting time. This will eliminate the passenger dissatisfaction with the bus service which has led the passenger to skip this valuable service causing a financial loss to the bus owners. Since the driver and conductors do not receive unnecessary calls requesting to make seat reservations and asking for the telephone numbers of the other buses; they can provide their valuable service to the passengers without any disturbances. Buses can arrive at the right location without any problem to take the passengers who have booked seats. By displaying the token received after the reservation of seats, passengers can enter the bus without causing any problem at certain bus stops where there is a high demand. Hence, this automated mobile application provides a valuable service to the passenger as well as to the buses.

## CONCLUSIONS/ RECOMMENDATIONS

This study provides an automated solution to the major problems associated with the present system faced by passengers using the highway bus system. The proposed solution supported by GPS technology and Google Maps provides the passengers and buses with the necessary data that are not easily accessible through the current system. This is a convenient solution for passengers to find out where the bus is located and the seat availability. Moreover, they can reserve the seats of a preferred bus depending on their availability. This solution will eliminate unnecessary hassle for the passengers who regularly use the highway bus service. Moreover, calling the bus drivers/conductors can be minimized through this solution and it provides a quality and hassle-free seat booking service to the passengers. The bus can pick the right passenger from the right place without causing any injustice to the other passengers who demand the service.

Since, seat reservation proposed by this study is limited to the buses traveling at the time of the reservation, the service (seat reservation) can be enhanced to facilitate in advanced reservation on any bus. The passenger can then be notified of the departure of the particular bus and its arrival at the passenger location. This will minimize the unnecessary waiting time spent by the passenger at bus stops.

Ordinary passengers who receive the service on time can upgrade this service by giving feedbacks. Moreover, this system can be introduced to the relevant authorities for the purpose of monitoring



the bus timetable which is currently done manually by the timekeepers. Therefore, the bus service can be improved by the relevant authorities by providing warnings if the buses wait unnecessarily in certain locations. Moreover, the system can be enhanced with an automated ticketing system. A Bluetooth printer can be connected to the system to generate a ticket for the passenger after getting on the bus. This will also help updating the seat counts automatically. Moreover, this will eliminate the job role of the conductor reducing the cost of the bus owner.

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