Implementation of an Android App for real-time bus tracking and information system

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Introduction

The public transportation system in Sri Lanka mainly consists of busses (public and private) and trains. There are several categories of busses based on comfort and fare namely, super luxury, luxury, semi-luxury, and standard. Due to the inconvenience with the excess number of passengers per bus and inconsistency of the arrival times people who can afford prefer private vehicles over busses. This increase of private vehicles on roads causes high traffic congestion, waste of public time, accidents, causing a considerable financial loss to the country. When the user is unfamiliar with traveling information such as bus time, bus location, bus route, etc., it is difficult to use public transport networks (buses). In this work, our effort is to enhance the user satisfaction and usage of the public transportation system.

For finding bus locations and predicting arrival time many unique designs have been proposed and implemented. A mobile application-based bus tracking system of Sarnobat *et al.* guides the daily commuters with bus routes, bus stops, bus schedules from source to destination as well as display maps and track real-time bus locations and display the estimated remaining time required to reach the destination [1]. The intelligent transportation system (ITS) of Bhonge *et al.* provides dynamic traffic information such as bus arrival information, route information, bus service information, allocation information, route arrival information, station arrival information, transit time, to users [2]. In the GPS/GSM-based bus tracking system in [3], location name and GPS coordinate values are stored as a LUT (Look Up Table) in a microcontroller. An android application was proposed, which will track the location of both user and the Bus and then will calculate the approximate time required by the Bus to reach the stop including the traffic analysis [4]. A bus arrival time prediction was proposed by Khetarpaul *et al*. using a modified amalgamation of *fuzzy* clustering and neural network on spatio-temporal data in [5].

Methodology

The proposed system has three parts namely, Android Traveler App, a tracking device, and a ticketing machine. The Traveler App is for the users to track busses. The tracking device is an alternative in case the traveler app and ticketing machine are not available. Traveler App is the main scope of this work which gives the user to search for the correct bus to reach their desired destination. Features of the Traveler App are shown in Table 1 and a comparison with related work is given in Table 2. In the tracking device, SIM 808 GSM module, a GPS antenna, and Arduino Uno is used to send current bus information into the database. Real-time tracking displays the bus location on a map of the Traveler App. The Android based ticketing machine consists of the basic principle of a custom GSM ticket machine and is capable of giving the current passenger count according to the issued tickets. Traveler App uses a colour code to

display the busload based on the passenger count p: yellow ($p < 40$), green ($40 \leq p < 70$), or red ($70 \leq p$).

Results and Discussion

Implemented Traveler App contains real-time bus tracking, details about passenger count, details about bus routes, bus schedule, bus fares, bus booking, user support section, and comment section (Figure 1). Users first have to register for the Traveler App using username, email, and password. After login, the current location of the user was displayed on the map and can search for a destination. Then, all the buses in the route from the user location to the destination were displayed on the map according to the destination. Also, arriving bus details were displayed with arrival time. In the route search option, the App displays all the bus stops around the user location (5 km range). In the bus details option, a user searches for start and destination. Then the App displays all the buses on the map according to the start and destination with arrival time and distance. In the bus schedule option, users can select any bus stand and get all the bus schedules with bus type (CTB / PVT). In the bus prices option, based on the user's start and destination, luxury, semi-luxury, and standard bus fares are displayed. Three additional features of the Traveler App are bus booking, user support, and user comments. The booking option allows users to book an available seat by adding a mobile number to the particular seat number. Seat numbers are displayed as same as seats are arranged on the bus in this bus booking option. The owner/driver can get booking details using the driver option. Further, the owner / driver can update the current situation of the bus and fares.

Table 1. Features of the Traveler App.

No.	Features	Description
1	Real-time tracking	Obtain user location from mobile GPS or by network state in a frequency of 8s and display the bus location on the Traveler App map. Can search bus details on a path and search buses on another location through the search bar.
2	Route schedule	Display timetables of routes including bus type (CTB/ Private) and condition. Provides a timetable for each stop to its destination.
3	Load status	Display passenger load of buses with defined color codes (yellow ($p < 40$), green ($40 \leq p < 70$), or red ($70 \leq p$)).
4	Prices lists	Display updated government price-lists for destinations.
5	Customer reviews	Users can add / view public reviews on the quality of service of a bus Bus operators / conductors can add details about unavoidable incidents.
6	Bus schedules	Display timetables of buses including destination, bus number, bus type, and condition.
7	Arrival time prediction	Arrival time prediction of buses to each stop. There are several methods to get predictions for the arrival time of buses. At first, we have to search the start and the destination location and then we can take the average time to travel to these destinations, and in the meantime, we can take arrival times for each bus stop. And each user can be tracked and can save his location to the database and it helps to analyze predictions using the control panel application.

Table 2. Comparison of our method with existing systems.

Ref.	Real Time Tracking	Route Schedule	Load Status	Price Lists	Customers Reviews	Bus Schedules	Arrival Time Prediction	Security Alert
[1]	✓	✓	-	-	-	✓	✓	-
[2]	✓	✓	✓	✓	-	-	-	✓
[3]	✓	-	-	-	-	-	✓	-
[4]	✓	✓	-	-	-	✓	✓	-
[5]	✓	-	-	-	-	-	✓	-
Our System	✓	✓	✓	✓	✓	✓	✓	-

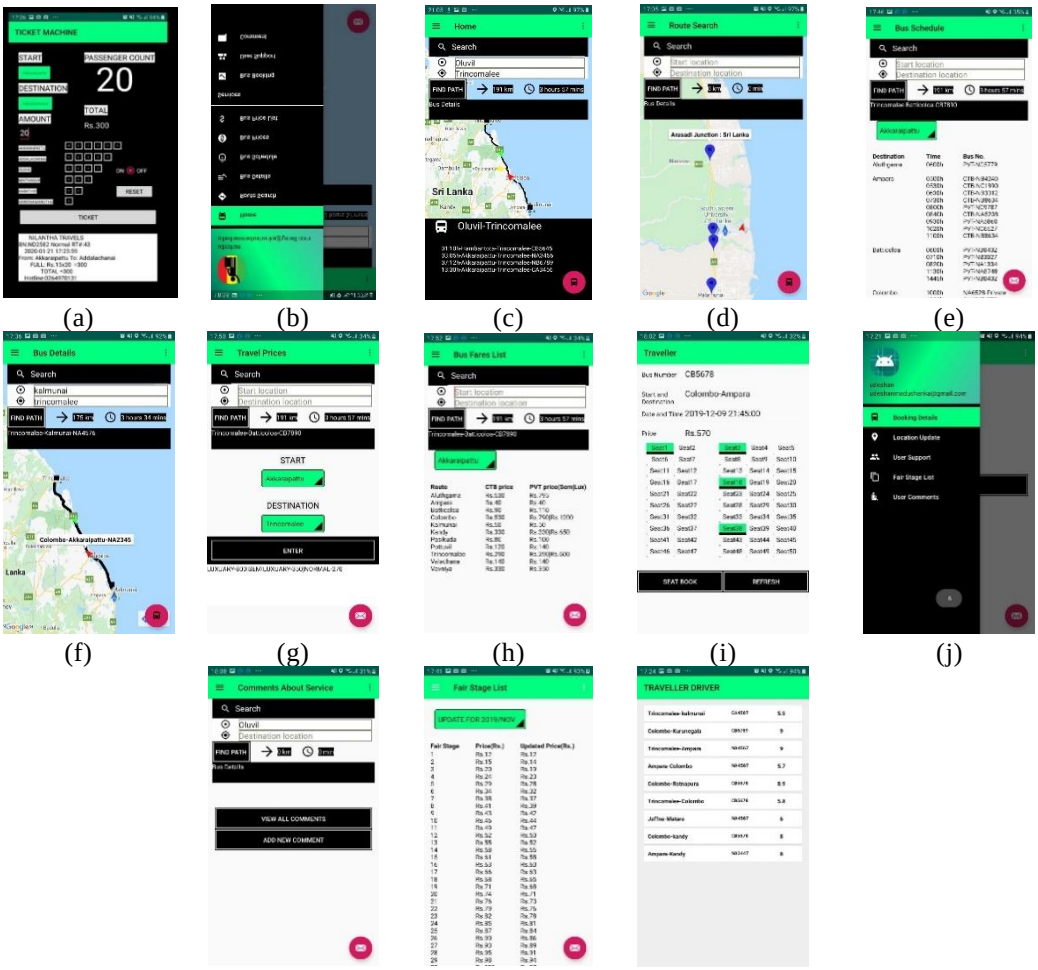

Figure 1: The interfaces of the Traveler App, (a) ticket machine, (b) main menu, (c) current and destination locations, (d) bus stop locations, (e) bus schedule, (f) bus search, (g) bus price list, (h) bus fare list, (i) bus booking, (j) driver App, (k) comment section, (l) fare stage list of driver app, (m) comment section of the driver app.

Conclusion

The proposed Traveler App reduces the waiting time of passengers. This system shows bus location on a map and provides route schedule, bus schedule, booking, fares, current load, arrival time, and real-time tracking. The users can schedule their journey according to the availability of busses. The system has high practical value, is cost-efficient, and can be further extended for multiple applications such as managing other public transport mediums (trains) and vehicle management software for a transport company. Further, testing in real-world applications and improving prediction algorithms with machine learning are planned for future works.

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