A Low-cost Public Transport Tracking and Information System for Commuters in Sri Lanka

Pasindu Ranasinghe*, Thilanta Dammalage**, Guenther Retscher***

* SMI Engineering Company (Pvt) Ltd., 154 Vijaya Kumaranathunga Mawatha, Colombo, Sri Lanka
** Department of Remote Sensing and GIS, Faculty of Geomatics, Sabaragamuwa University of Sri Lanka
*** Department of Geodesy and Geoinformation, Engineering Geodesy, TU Wien – Vienna University of Technology

Abstract. Public transportation in developing countries, such as in Sri Lanka, can be generally quite chaotic; these ranges from poor management of the vehicles, traffic congestion, reckless driving and unreliable service provision. The main objective of this study is to develop a customized location-based service catering for the needs of public transport users. For that purpose a free prototype solution for management of public transport is developed providing GPS and GPRS technologies for real-time transmission of locations from the tracking devices (i.e., ticketing machines and/or Android phones) to the central database server and finally rendering to an Android application. The development process of the system involves the analysis of existing systems used in Sri Lanka, system design and development, evaluation and implementation. Thus, a cheaper solution can be provided for passenger information saving users waiting times for public buses and effective transport management by preventing vehicle misuse. The chosen solution comprises an Android application providing real-time graphical visualization on Google maps for prediction of the arrival time of the vehicles.

Keywords. Low-cost vehicle tracking, GPS, GPRS, Android application, Public Transport

1. Introduction

In Sri Lanka most people use trains and busses as mean of public transportation. According to the 2018 statics 6,152 busses are in operation

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under the Sri Lanka Transport Board. By managing travel disruptions caused by heavy traffic it is possible to improve traffic flow and living quality. Especially with the Android devices, development of web GIS technologies and mobile GIS, a good solution for management of public transport can be realized. The project uses an application for Android mobile devices to present a solution to improve the management of public transport. The nature of the internet in the country through the cell phone network and mobile GIS provides a great platform for management. Recent developments in geospatial technology have led to the emergence of GPS-enabled cell phones and mobile devices which have promoted the growth of location-based services (Damani et al., 2015).

2. Development of a Public Transport Tracking System

In a first stage of the development the current existing bus tracking systems were studied while visiting several companies (Dialog Axiata PLC, Sri Lanka Transport Board-Sahasara project). From this investigation fundamental requirements for the project were clearly identified and common problems of the existing systems verified. The main expectation of the system user is to graphically represent the location of the bus on the map on their portable device. Users want to know the location of the bus, estimated arrival time and occupancy of the bus to see how many seats are still available in real-time on a map. By interviewing commuters who are waiting for the bus it was seen that they may get impatient waiting for the bus and they are not trusting the official time tables. *Figure 1* shows the result of the survey of the commuters. The Figure on the left depicts how the public transport users currently get information about bus arrival times. It is either from time tables, asking someone, by experience, through internet or other means. Most remarkable thereby is that the arrival times are guessed nearly by half of the commuters by experience, i.e., 42 %. Then the end user acceptance of a new public transport tracking and bus arrival time system was queried in the survey. It could be seen that 62 % of the users would agree to share their location information to the system. Only 26 % said no and 12 % maybe. Furthermore, it was seen that 97 % of the commuters have already Android smartphones. Thus, the implemented system is currently based on the Android platform.

The overall system architecture is depicted in *Figure 2*. Using the Android device either from a commuter or the bus driver the location of the bus is determined with GPS. In the following, this information is sent to the online database through the GSM network. Finally, this information can be distributed through the internet. The data transmission part as shown in

Figure 3 has five stages, i.e., (1) reading and displaying the current location of the device, (2) creation of the database for saving the location information, (3) implementation of the application to transfer the location to the database, (4) implementation of periodically performing this procedure and (5) combining and integrating everything together. *Figure 4* shows the location data receiving system at the users' side. In this system part, the locations are displayed on Google map in the Activity window. A code was written in a JSON (JavaScript Object Notation) format to provide the location data on the map from the database. Because of the users' intent he can switch between the main to the map activity. Finally, the arrival time of the public transport vehicle is estimated following the procedure illustrated in *Figure 5*. In this arrival time analyzing system, the users' location coordinates and vehicle location are sent to the API (Application Programming Interface). Then the API provides a JSON output with which the arrival time of the vehicle can be estimated.

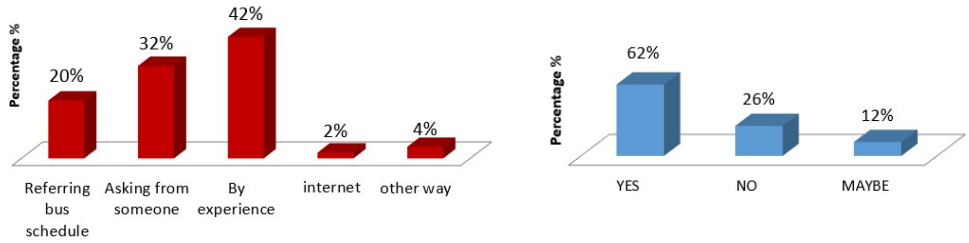

Figure 1. Results of a survey of commuters concerning the information collection (left) and end user acceptance of a new public transport tracking and bus arrival time system (right)

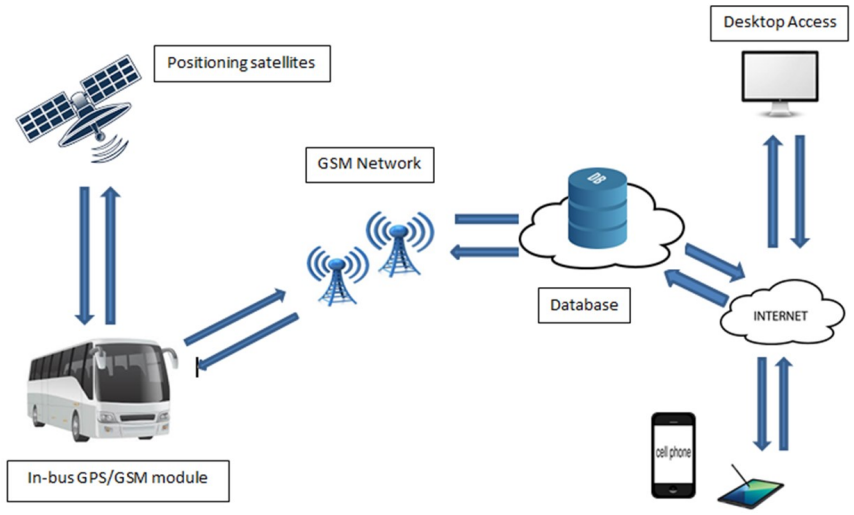

Figure 2. Overview of the public transport tracking system

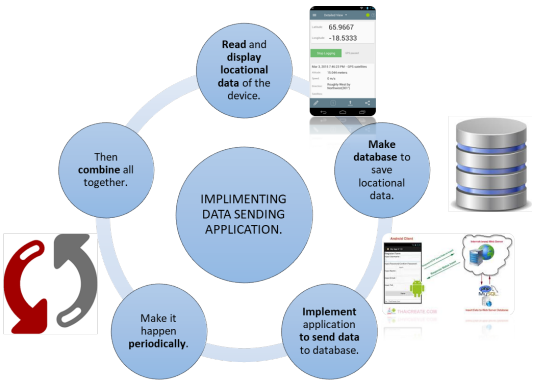

Figure 3. Location data transmission system

Figure 4. Location data receiving system

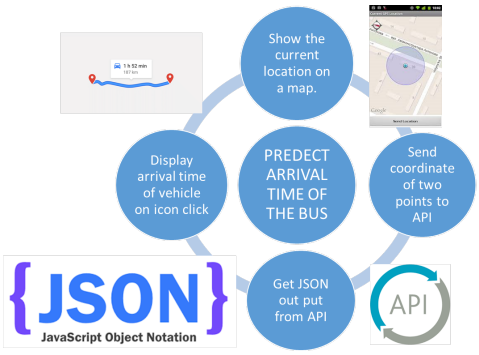

Figure 5. Arrival time analyzing system

3. Exemplary Results and Discussion

An application to track and send location data on the relevant bus to the server was implemented and tested on several Android phones. It is demonstrated that the developed real-time graphical representation method for national transport in Sri Lanka is very reliable and inexpensive. *Figure 6* shows the resulting App interface and three examples for providing information to the system users. As can be seen the trajectory of the bus is estimated and visualized and the estimated arrival times are presented to the App users. The gap in the trajectory shown in *Figure 6* (left) is due to lacking of GPRS coverage and connectivity to the server. Therefore it was not possible to transfer the bus location in this road section. *Figure 6* middle and right show two examples of responses to the user providing information about the current bus location and estimated arrival time. Thereby the blue pin depicts the current location of the commuter. The text box at the bottom in the App interface contains the

respective information for the user, i.e., the distance to the current location of the user and the estimated waiting time until the bus is arriving.

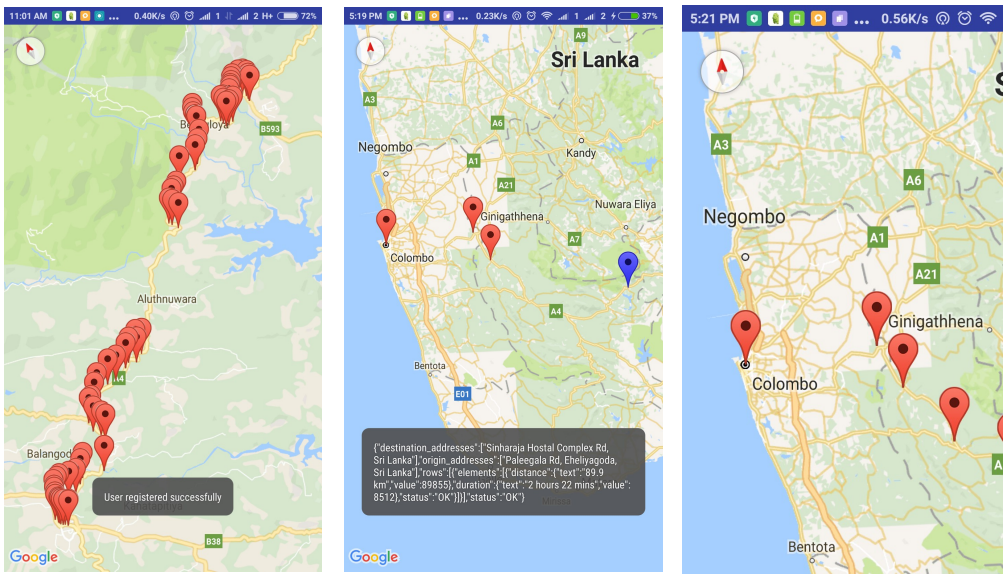

Figure 6. Example of an estimated bus trajectory (left) and two responses to the user providing information about the current bus location and estimated arrival time (middle and right)

4. Conclusion

Because of long waiting times for public vehicles people may feel impatient and anxious if they do not know when a vehicle arrives. Although timetables are provided, most probably bus drivers are unable to drive according to them. If passengers can see the location of the bus in real-time it will be beneficial for both sides. Thus, such kind of platform was developed in this study applied for the public transport network in Sri Lanka. In order to increase the performance of the public transport service, a real-time bus tracking system is needed. This system provides the ability to the passenger to know the exact location of the desired vehicle on the fingertips on his Android device. Further enhancement is on the way do to make it more efficient and user friendly. This will further increase the user acceptance.

Reference

Damani A, Shah H, Shah K, Vala M (2015) Global Positioning System for Object Tracking. Int. J. Comput. Appl, 109, 40-45