Smart Bus Transit System with RFID

Habimana Desire, Dr Niyigena Papias

Department of Information Technology, University of Lay Adventists of Kigali, Rwanda

Abstract : E-ticketing system plays a larger role in public transport services and mobile commerce with cashless because it reduces the production and distribution costs compared with paper-based ticketing system, and increase customer convenience that providing new and simple ways to buy bus tickets. This paper proposes a new system based on RFID technology, in which each passenger owns a smartcard fitted with an RFID tag. The card is scanned by the RFID reader after filling the departure, destination and selecting main route and then the system deduct the fare from the passenger account according to filled data. The system enables also agents and cards managements. In addition, the passengers can track the location of their desired bus in real time through an Android app, and get an occupancy estimate of the bus. The proposed system aims to increase convenience for passengers and eventually eliminate the use of paper tickets in transit systems.

Index Terms: USSD, RFID, Android, GTFS, Raspberry Pi and Ticket issuing

1 INTRODUCTION

In public transport system operations, the movement of buses is uncertain because of different conditions such as traffic congestion, unexpected delays, dispatching times of irregular vehicle, and other incidents. Such uncertainty results to passengers having to wait or came late for bus to arrive at the bus stop. Much has been done on ground of transit. Many ticketing system have been seen but none of them have a clear vision. The proposed system has all the requirements, in a single package.

The proposed system integrates all of these sub-systems in a single, deployable, tangible solution for public bus systems, in order to simplify and convenience all the parties involved. We will be looking at the literature on these areas and comparing them in the following sections

2 RELATED WORK

[1] Proposed to use GPS on the user's phone to validate the tickets. There is a security problem with this approach. The GPS location on the user's phone can be easily spoofed. The authors use a cloud database for storing the tickets. This is a very good way to achieve some security principles. However, it suffers from the same problems every cloud service suffers, like needing persistent internet connectivity for issuing tickets. It may not be available with all the users. He also proposes using QR codes for tickets. While it works on basically any device with a screen, there are limitations to QR codes which cannot be ignored.

[2] defines security goals for an e-ticketing system like Authenticity where e-tickets should take measures to avoid falsification, an issued ticket cannot be further modified by anyone for integrity, Overspending should be prevented for a one-time-use ticket, ticket could be only valid during an interval of time and The system must work without a persistent internet connection.

[3] Describe an e-ticket system which works in two phases: OTA ticket-provisioning and offline authentication. To enable offline authentication, the design of the e-ticket consists of two parts: A Content part having details such as seat number, date, time etc, and a Security part contains sensitive data such a ticket ID, one-time certificate for the ticket, IC serial number. The Security part of the ticket is encrypted with the public key of the server. The reader is pre-installed with this key and uses it to to decrypt the Security part, hence validating the ticket offline.

[4] Mention a system where every commuter needs to swipe a card over the reader on boarding the bus. After the card is validated by the reader, the commuter needs to manually input his current location and his destination in a keypad near the reader. Hence the system increases the time to issue a ticket. Concept of GPS is not used to detect the commuter's location. This system is highly not feasible in a crowded environment. A screen at every bus stop will notify the passengers, the departure time of the last bus of any route. If an agency has a bus service that the buses come after each amount of minutes, the waiting passenger will surely know when the last bus departed and how long the next bus is going to come.

[5] Propose a system that a passenger passes a card on a reader after boarding and before a lighting the bus. At both the times GPS module inside the bus marks the source and the destination of the passenger and money is deducted from the card as per the fare rate depending on the distance travelled by the bus.

[6] Propose a system that issue tickets via a phone application through internet, where a user is asked to enter his location and destination manually. Ticket issuing involves the database server and the application server which increases the computational part of the system. This system needs persistent internet connection for downloading the ticket on the phone application.

[7]Define a framework for live tracking. The authors suggest having a movement simulator for testing, a server for tracking the data in a centralized manner, and using Google Maps API for displaying the map. The paper fails to utilize the GTFS standard created for storing transit data, and instead uses a different format for storage.

One of the objectives of the proposed system is to be adaptable to any city of Rwanda. With that in mind, a standard format is needed to store the information regarding the specific city, information like the transit stops, routes, etc. Google has developed such a format, called the GTFS, or the General Transit Feed Specification.

3 SYSTEM DESIGN

The buses in the transit system will be fitted with one RFID reader. The buses will also have a GPS device which will report the location of the bus to the server in real time. Each passenger will have a smartcard containing an RFID tag with an ID, which will be associated with his account with the transport service provider. The system also features an Android application for passengers to check the location and occupancy estimate of buses they intend to board.
On boarding a bus, the commuter scans this card at the RFID reader at the entrance. The tag ID is sent to the server and the balance in the passenger's account deducted by the fare from his source stop to the last stop on the route.
Live-Tracking
The GPS devices in the buses periodically report the bus location to the server. The ticketing records are used to generate an estimate of occupancy in a particular bus. The passenger enters the route number or route name of the bus he is interested in into the Android application and is presented with a map view of all the buses with that number currently running. He selects one and is shown the occupancy estimate of the bus.

USSD Ticketing

USSD messages are easy to form and simple to send. In our study, a user will start the USSD message with * followed by 3 digits then * followed by 1 digits, terminating the message with # i.e. the hash key (*801*1#). The message will be sent from the user's phone number i.e. MSISDN (mobile station international directory number) to the GSM network via the air interface to the Base Station Subsystem i.e. the access network. The message will be transmitted from the access network to Core network through intermediary nodes via various interfaces to the database holding the detail records through application server.

Procedure is then invoked to confirm eligibility of the MSISDN's access to the call detail records (whitelisting). If not, request is declined and user is availed a network error message.

If yes, some attributes of the call detail records are synchronized to the formatting application server. The formatting application server converts the snippet call detail records into a friendlier readable format rather than GSM unique codes. From the formatting application server, USSD Response is availed to the mobile subscriber via the USSD gateway.

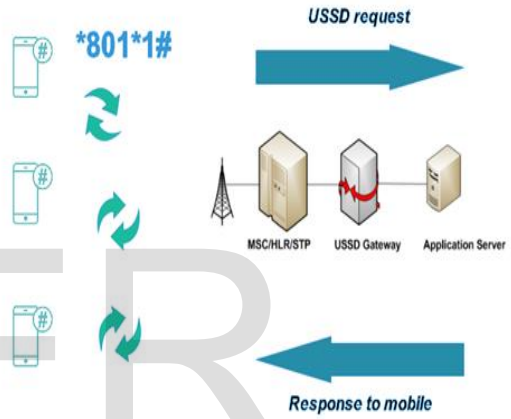

Figure 1: USSD Design

Ticket Checking

The system also has a Ticket Checker to ensure that passengers do not board/disembark the bus without scanning their cards. The Ticket Checker will have a validator with an RFID reader and will randomly check passengers' cards during and/or after transit. The validator will retrieve the passenger's most recent ticket records from the server, which will show whether he has purchased a ticket for the current trip.

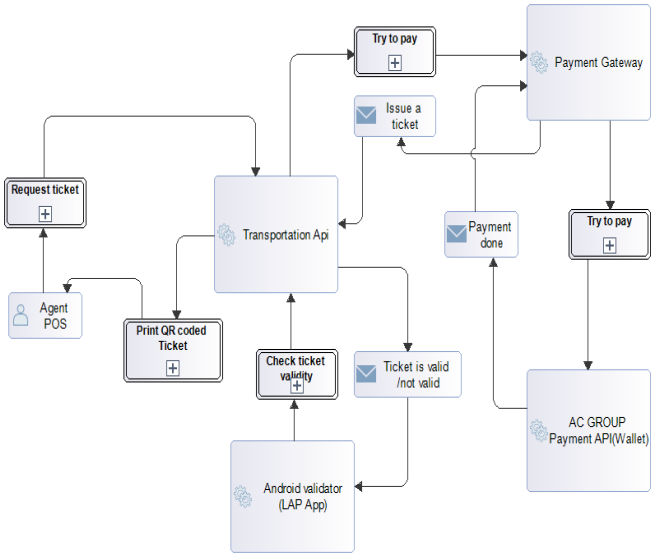

Figure 2: Ticketing system design

4 CONCLUSION

A lot of research in the field of ticketing has been conducted in the recent years, leading to the many new applications based with RFID. Smart Bus Transit System enables passengers to travel hassle-free. The ticketing is seamless. Making public transport more convenient makes it more accessible, that leading to increased usage. Traffic is a growing problem in major cities and effective use of public transport is one of the solutions. A convenient and easy-to-use public transport system helps alleviate this problem.

It also modernizes the public transport infrastructure. Since everything becomes digital, it becomes possible for service providers to collect data, and that make business decisions based on the needs. The system also makes a paper-free system possible, which is the general direction all organizations are going in. Since the system works on standard data format for transits, it is extremely easy for service providers to integrate this system into their existing infrastructure.

REFERENCES

[1] S Karthick and A. Velmurugan , "Android suburban railway ticketing with gps as ticket checker," in In Advanced Communication Control and Computing Technologies (ICACCCT), 2012 IEEE International Conference, 2012.

[2] Arnau Vives-Guasch, Maria-Magdalena Payeras-Capell`a, MUT-PUIGSERVER Macia,JordiCastell`a-Roca, and Josep-Llu´ıs Ferrer-Gomila, "A secure e-ticketing scheme for mobile devices with near field communication (nfc) that includes exculpability and reusability," in IEICE TRANSACTIONS on Information and Systems, 2012.

[3] W. J. W. a. W. H. Lee, "An nfc e-ticket system with offline authentication," in In Information, Communications and Signal Processing (ICICS) 2013 9th International Conference on, 2013.

[4] Md Foisal Mahedi Hasan, Golam Tangim, Md Kafiul Islam, Md Rezwanul Haque Khandokar, and Ariful Alam., "Rfid-based ticketing for public transport system," in Perspective megacity dhaka. In Computer Science and Information Technology (ICCSIT), 2010 3rd IEEE International Conference , 2010.

[5] Saurabh Chatterjee and BalramTimande, "Public transport system ticketing system using rfid and arm processor perspective mumbai bus facility best".

[6] K. T. Patil, Dipti Mehendale,Vidya S., Aldar Leena Govilkar, Dr S.K.Narayankhedkar, "RFID Based Ticketing System For Local Trains," International Journal of Computer Science and Information Technologies (IJCSIT), pp. 2232-2234, 2015.

[7] L´aszl´oBarab´as, R´eka-Andrea K´aroly, and K´aroly Simon, "Live tracking frameworkfor public transportation systems. In Intelligent Systems and Informatics (SISY)," in 2012 IEEE 10th Jubilee International Symposium, 2012.