Automated Railway Ticketing System: Replacing the paper based ticket with the Electronic National Identity Card

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ABSTRACT

Trains are a popular mode of public transport used by daily commuters in Sri Lanka. However, the process of ticketing in the trains causes a number of inconveniences. At present, some countries use a debit card designed exclusively for train travel as a means of reducing the hassle. However, the paper based ticket is still commonly used for train travel in many countries, including Sri Lanka. The aims of this research are to develop an automated ticketing system that would replace the existing train ticketing system while providing an online seat reservation system. This would be beneficial to the commuters as well as the staff of the Department of Railways. From the beginning of 2016, the Electronic National Identity Card (henceforth referred to as e-NIC) was proposed to be used in Sri Lanka. The research presents an alternative system of ticketing where the e-NIC is mainly used to replace the traditional train ticket, thereby increasing the efficiency of the purchase and the use of train tickets. The e-NIC is combined with the bank account of the commuter. The system supports four types of passes, the e-NIC, prepaid pass, booked ticket and kids pass. Once the commuter enters a station, the pass is initially validated by the platform scanner (PS), upon entering a certain train, the train number and station he/she enters is recorded by the train scanner (TS). Once he/she gets down from the destination, the TS and the PS validate the train details and trip cost is deducted from the account. This new method has a number of advantages over the traditional train ticketing system. These include the reduction of time spent on ticket purchase, eliminating the need to use cash in the process and strengthening the security of the issue and purchase of the train tickets. This would also help prevent ticket fraud. The program was white box tested. This is proposed to be used in Sri Lanka, however the method can be implemented globally. The system was developed using Java and backed up by MySQL databases.

Keywords: Automated Railway Ticketing System, Electronic National Identity Card, Java, MySQL database

1.0 INTRODUCTION

Trains are a popular mode of public transport used by daily commuters in Sri Lanka. In the year 2014, there was a total of 129 million trips by commuters [1, p. 126]. Out of the total number of the passenger trips, 67 million [1, p. 126] travelled with the ordinary ticket which was purchased at the station. Since the introduction of trains to the country in 1864 [2], a manual paper based system existed for ticketing. At present, this method is considered inefficient and inconvenient. Especially when issued to millions of commuters, it poses a number of inconveniences.

Currently, each station maintains ledgers to keep records of the monthly train ticket sales, these numbers are collected by the Department of Railways periodically in order to generate reports for the entire country. The method discussed in this paper uses the electronically stored ticket details to generate monthly reports for all the stations in the country.

At present, there are five ticketing methods used by the Department of Railways,

a) Daily Commuters - The paper ticket used at present is issued from the station of arrival and collected from the station of exit. Each ticket used is 0.74 mm thick on average (equivalent to eight 80gsm papers

[3]), and is not reusable. The production cost per ticket is Rs. 10 (personal communication).

b) Season Ticket – This is a ticket issued monthly for commuters who travel on a daily basis.

c) Railway Warrants – Government Employees are entitled to Railway Warrants.

d) Mobitel mTicketing – This system launched by Mobitel in 2009 allows the Mobitel customers to book railway tickets (reserve a seat) over the phone[4] and by visiting the train station. However, later on, this service expanded to other telecommunication service providers. Even though the booking occurs over the phone, a paper ticket is issued at the railway station.

e) Mobitel mWarrants – Tickets could be reserved for warrants through the Mobitel mWarrents service which was an extension of the mTicketing system. [5].

All the above mentioned methods are paper based. The zero usage of paper in the proposed system for ticket production makes it a low cost and efficient ticketing system in compliance with green technology.

In developed countries, the paper based ticketing system has been replaced by an electronic automated ticketing system [6]. India too is gradually making the shift to electronic train ticketing [7]. However, the systems in the above countries need a separate prepaid card [8] or the commuters have to book the tickets online beforehand [7]. Thus, in a strict sense, these methods are not paper-free either.

In Sri Lanka, a fully automated ticketing system for trains is yet to be introduced. However, such a system exists for commuters travelling by buses. The Touch Travel Pass [9], [10], introduced by Dialog Axiata in 2013, is a contactless prepaid payment solution. However, due to its limitations in recharging, it failed to grab the attention of the general public.

Along with the railway ticketing system, another system in the country which hasn't undergone any change in the last few decades is the design and issue of the National Identity Card (NIC). The first paper based NIC was issued in 1972 [11], and is still in use. The NIC lacks proper verification methods. Thus, fraud related to the NIC is not uncommon in the country. In spite of its technological limitations, the NIC is used as the main document of identification of a person in many instances ranging from obtaining a new mobile connection, obtaining the driving license or the passport and even when opening a bank account. It is also the main source of authentication of a user for the "Free Wi-Fi" service provided by the government [12]. In 2012, a proposal was made to replace the paper based NIC with an Electronic National Identity Card (e-NIC) [13], and the project is yet to be initiated. In Manitoba, a project to re-define the use of the identity Card (ID) would commence in 2017, and they would issue an all-in-one ID consisting of the owner's driver's license, photo ID, health card and travel ID. [14]

In Sri Lanka, the e-NIC was proposed in order to prevent tampering, and to create a digital database of citizens which will include biometric information.

The next stage of public transport proposed in Sri Lanka, is the "Light Rail" system, which is an electronic railway system [15]. This project is to be implemented in order to reduce traffic within Colombo city limits. At the time of writing, it is awaiting government approval.

As many projects for the future development of the Railway System are underway, this paper discusses a novel approach to utilize the e-NIC as a replacement for the paper based train ticket. The payment method for this approach would be the bank account of a commuter. This would also address the absence of an online booking system for tickets.

2.0 PROBLEMS IN THE CURRENT SYSTEM

The current manually operated paper based ticketing system has the following issues,

a) Time consuming – The commuter needs to stay in a queue to obtain the ticket, which is time-consuming. As the payment occurs through cash, this further adds to delays.

b) Static – The destination of the commuter cannot be changed in the middle of the journey.

c) Inconvenient – If the commuter loses the ticket, he/she could be suspected of travelling without a ticket.

d) Lack of proper verification – The only way to verify a ticket is by checking the back of the ticket for the date stamp, which could be tampered with, and at times, not very clear.

e) Ecological Footprint – Due to the incapability to reuse the ticket and its thickness, it is not eco-friendly. A large amount of paper is wasted in printing train tickets.

f) High production cost – The paper based ticket cost close to Rs. 10. Approximately, for the year 2014, the production cost for the train tickets was Rs. 670 million.

g) Inefficient and time consuming book keeping – As all the ledgers for stations are maintained manually, the Department of Railway's final ledgers take time to be updated.

h) Inability to adjust ticket prices – The current system has to reprint the tickets in order to reflect a price change.

i) Absence of an Online System for booking tickets – Currently the only way to book seats is the Mobitel mTicketing System which happens over the phone.

The method discussed in this paper was developed to address the above mentioned issues.

3.0 PROPOSED METHODOLOGY

For demonstration purposes the approach discussed in paper was developed using Java and a MySQL database. The methodology used addresses the problems discussed in Section 2. The Driving License (DL) and the proposed e-NIC employ a similar technology. Hence, apart from the e-NIC, the DL could also be used for the proposed system. Each ticket is assigned a unique ticket ID. The record for each ticket contains the date, e-NIC/Pass number, entering station number, exiting station number, train number and the cost.

The following terminology is used in the method discussed,

1) Train ID – Each train is assigned with a unique identification number for each route. (E.g. Train numbers in the route from Colombo Fort to Kandy are different from those which return from Kandy to Colombo Fort [16])

2) Station ID – Unique identification number assigned to a station.

3) Ticket ID – Automatically generated Identification number per Trip

The proposed system is mainly implemented using the e-NIC.

An overview of the process of the system is shown in Figure 1.

The four types of passes supported by the system are,

a) e-NIC/DL - e-NIC/DL of the daily commuters linked with the bank account.

b) Prepaid Pass – Obtained from the Train Station. Suitable for foreigners and in case of loss of the e-NIC/DL.

c) Booked Ticket – The mTicketing system with an online seat reservation.

d) Kids Pass – Issued to children from 3 years to 16 years. The pass is linked to the e-NIC of a parent from which the costs are deducted. Presently, according to the regulations by the Department of Railways, children up to 3 years are not charged while children between 3-16 years travel half the ticket cost [17]. The Kids Pass would have a special pricing scheme.

3.1 Ticketing System: Procedure for the Commuter

Step 1 – Registration of personal details and obtaining a railway pass

The registration of user details will be handled by the Department of Registration of Persons. When the record for the e-NIC is created, all the bank details and other entities registered under the NIC number would be accessible through it. Thus, the user can select a primary bank account which should be used for the train ticketing. For this paper, it was assumed that this step has already been completed.

The children who are within the age limit of the Kids pass would be issued the pass upon the parent registering for the e-NIC.

The prepaid pass can be obtained and topped up at a train station.

The Booking for tickets can occur through the online system available for e-NIC/DL holders. Upon reservation of a seat, the ticket is recorded in the database with the trip details. The ticket cost is automatically deducted from the bank account.

Step 2 – The entrance of a person to a railway station and to a Train

There would be two checkpoints installed, one at the entrance/exit of the railway station (called the PS – Platform Scanner) and the other at the door of the train (called the TS – Scanner at the Train). If a parent is travelling with children aged 3 – 16 years, he/she needs to scan the Kids Pass as well.

Checkpoint 1 – Entrance to the Railway Station (PS)

When a person enters the Station, the pass is scanned at the entry point and validated for the following criteria,

a) Validity of the pass – Verification occurs by cross checking the e-NIC (or DL) or Railway Pass with the database.

b) Check on previous settlements – If the commuter has a credit balance from a previous trip that has not been settled, the commuter does not get access to the terminal.

c) Illegal Trip – As a security measure, the system checks if the previous ticket purchased by the person has an exit station.

A commuter's e-NIC/pass needs to pass through all the verification checks mentioned above in order to enter the train platform.

Upon successful entry into the station, a ticket with the pending status is created in the database with the entrance station.

Checkpoint 2 – Entrance to the Train (TS)

When a person enters a train, the e-NIC/Pass is processed for the following criteria upon entry,

a) Bookings – If the e-NIC/Pass has a booking with the relevant train, it is confirmed.

b) Travelling class – The class the commuter wishes to travel in is recorded as there would be scanners for each compartment.

c) Train Number –The train number is recorded for the Pending Ticket created at Checkpoint 1.

Step 3 – Ending a trip

Once the commuter reaches the destination, the e-NIC/Pass is scanned at the point of exit of the train by the TS and the train number is validated. Following are the steps for ending a trip,

a) The exiting station ID is recorded when passing the PS of the exit station, and the fare is automatically deducted from the account.

b) Return Trip - In any case where the commuter has the same entrance station and the exit station but with different train IDs, it is recorded as a return trip, and the due costs are charged.

c) Platform Ticket - If the entrance station and the exiting station scanned by the PS,

and the train ID are the same, it is considered as a platform ticket.

d) Wrong Train – If a commuter gets in to a wrong train and gets off, he/she will not be charged the ticket since the entering and exiting train number and the locations are the same. The commuter can get into the correct train later on.

In any case the e-NIC or the parent of the Kids Pass does not have sufficient balance for the ticket in the bank account, it is recorded as an overdraft.

3.2 Ticketing System: Benefits to the Department of Railways staff.

3.2.1 Monthly Reports

The system is able to generate monthly reports which can be sorted according to the station. These reports can be used for analysis.

3.2.2 Updating Ticket Prices

Ticket prices can be updated by updating the database directly, eliminating the need to reprint the paper based ticket to reflect new pricing structures.

3.2.3 Ticket Booking and Seat Reservation

The Department staff has the ability to allocate seats and manage ticket booking through the administrative panel of the online system.

3.2.4 Issuing Prepaid Pass

The staff also has the ability to issue a prepaid pass in any case where the automated system for issuing and topping up the pass fails.

4.0 DISCUSSION

The issues of the present manual paper based ticketing method discussed in section 2.0 were addressed through the proposed automated e-NIC based ticketing system. The solutions are as follows,

a) Less time Consuming – The proposed method takes only a few seconds to verify the e-NIC (or DL) at the entrance and exit of a station. The method does not involve cash exchange, making the process faster and hassle free.

b) Not Static – The destination of the trip is determined when exiting the railway station. Hence, the commuter can switch trains and change the route at mid points in the journey.

c) Convenient – The e-NIC (or DL) acts as a railway ticket, even if the e-NIC is lost, the trip can be traced using the e-NIC number.

d) Easy Verification – The e-NIC/DL is verified at the point of entrance as discussed in section 3.1., Step 2.

e) Ecological Footprint – This is a zero-paper method, and reduces the footprint.

f) Decrease in production cost – Due to the absence of the paper based ticket and printing, there is less production cost. However, there would be an implementation cost in order to set up the e-NIC/DL scanners and upgrade train terminals.

g) Efficient book keeping – This is done by the monthly reports introduced in section 3.2.1.

h) Zero-cost involved for adjustment of ticket prices – The ticket prices can be updated, without incurring any cost, by updating the database as mentioned in section 3.2.2.

i) Online System for Seat Reservation – The proposed method would introduce an online seat reservation system for long distance trains.

The proposed method uses the e-NIC and the DL, which would be available to majority of the people. This resolves the issue of unavailability that was faced by the Touch Travel Pass.

5.0 TESTING

The proposed method was white box tested. Few of the test cases and their expected results along with actual outcomes are mentioned in Table 1.

Test Case	Expected Result	Actual Result	Comments
E-NIC or DL number verification(incorrect length)	Error Message	No error message	Rectified by adding a verification check
Insufficient Account Balance	Error message, insufficient balance	Deducted the bank account with a credit value.	-
No exit station	Error message, "No exit station"	Same as expected result	-

Table 1

6.0 LIMITATIONS AND FUTURE WORK

At present, the system has the following limitations,

a) Season Tickets and Railway Warrants are not supported.

b) Initial establishment costs for infrastructure are high.

The future work related to this project are as follows,

a) Improving the implementation for commuters who are travelling with children.

b) Including the commuters travelling with the Season Pass into the system.

c) Expansion of the same methodology to other forms of commuter transport, such as buses.

7.0 CONCLUSION

The present manual paper based railway ticketing system is considered inefficient in terms of accuracy, efficiency, record keeping and cost adjustments. The proposed method would address these issues. One of the strongest advantages of replacing the paper based method with an automated method is reducing the ecological footprint.

Sri Lanka is in need of a method to replace the current paper based railway ticketing system, and with the e-NIC rollout around the corner, it in only timely to utilize the e-NIC, which is common and readily available to every citizen of the country, as a replacement.

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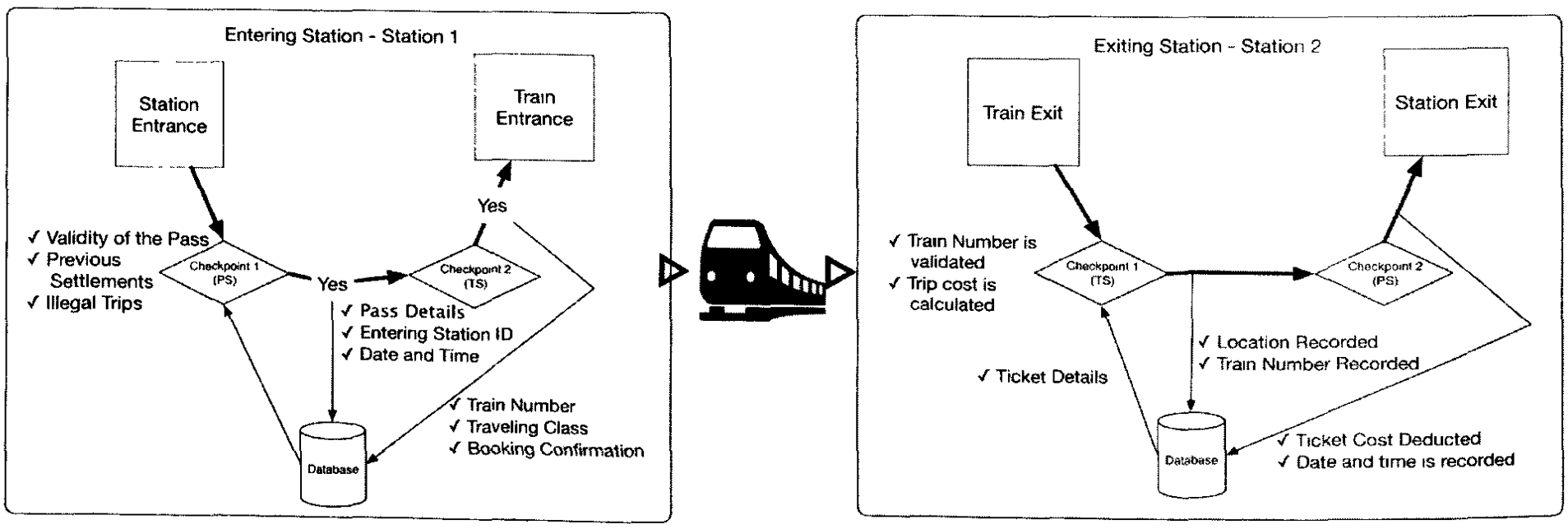

Fig. 1 : Overview of the Ticketing Progress