

RFID-based Ticketing for Public Transport System: Perspective Megacity Dhaka

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Abstract-The paper based public transport ticketing system, prevailing in the megacity Dhaka (Bangladesh), introduces severe malfunction in the system, malicious argument among public, corruption and most of all traffic jam. This paper actually suggests a much more public friendly, automated system of ticketing as well as the credit transaction with the use of RFID based tickets. The total system mainly acts to bring out the consistency among various bus agencies that will conclude in uniform access of passengers in daily rides through an automated server being updated every single time the passengers travel by carrying the RFID based tickets.

Keywords: *RFID ticketing; Public transport system;*

I. INTRODUCTION:

As for the RFID application, it's been a widespread tool for both tracking the transit transports and for the public ticketing system. It's already been an outstanding achievement throughout the globe including big cities like London, Helsinki, Shanghai, Istanbul, Moscow, Porto and many more. The system can be implemented for subways, railways and public bus services for the sake of systematic operations in corresponding cases.

In the megacity Dhaka, the conventional system of public transport is based on paper based bus or railway tickets that ultimately lead to chaos among public, system loss, corruption and most of all traffic jam that is responsible for a huge wastage of time. No prior notification of the arrival and departure of the transports are available creating a lot of confusion among the passengers resulting in a rough argument

between them and the bus supervisors or the operators. Again having no government authority to take control or keep an eye over the whole scenario, the private sectors are creating a monopoly, taking control over the public transport and autocratic raise in bus fair.

The tracking and ticketing systems using RFID can be merged to solve the prevailing problems. Even though the GPS based system can be designed, we propose the RFID based tickets for its low cost, easy operation, portability, durability, reliability and being much more user friendly. Also the high speed RFID tags and detectors make the tracking system of a running bus merely a child's play.

Public carrying RFID based electronic tickets will have access to any bus service of the city only entering his current location and his destination on the keypad attached to every bus. The data will directly be transferred to the server main database and the equivalent credit will be stored in the corresponding bus account. Also the screen at every bus stop will notify the passengers, the departure time of the last bus of any route. This automated system will save time, have a higher authoritative inspection and reduce chaos and confusion on the road.

II. SYSTEM DESCRIPTION

Radio Frequency Identification (RFID) is a generic term for technologies that use radio waves to automatically identify and track product, animal, or person by means of using RFID tags that are applied or incorporated on them. An RFID system consists of

a tag, basically a microchip with an antenna and an interrogator or reader with an antenna. Most RFID tags contain at least two parts that is shown in figure1. One is an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency (RF) signal, and other specialized functions. The second is an antenna for receiving and transmitting the signal. The reader

sends out electromagnetic waves. The tag antenna is tuned to receive these waves. A passive RFID tag draws power from field created by the reader and uses it to power the microchip's circuits. The chip then modulates the waves that the tag sends back to the reader and the reader converts the new waves into digital data.

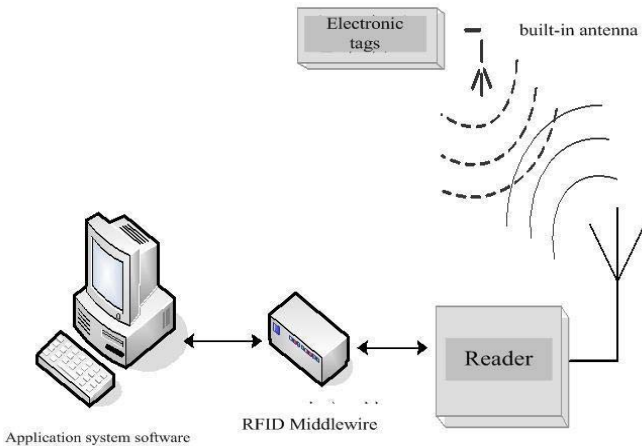


Figure 1. Typical RFID system components

For the purpose of Bus Identification, the tags are embedded into the bus. Each bus will have two tags: one is at front and other is at rear. The front tag will inform the reader about its arrival to the bus stop whereas the rear one informs its departure. Each bus will also have a reader that is connected to the main server for charging of ticket fare from the passengers through a keypad attached with the reader on which the passengers give the information of their departure & destination locations. The reader sends the electromagnetic waves to the tag. The tags draw the power from this wave and return back the bus information, which are stored in its memory to reader. The readers again demodulate this wave and convert it as a digital data.

For the purpose of Ticketing, the operational feature of the cards is almost the same but here the tags are attached to special cards carried by the passengers and the reader collects the detail from them. By using RFID technology in ticketing system, allowing passengers to "tag on" and "tag off" and be charged automatically, according to how many zones they have travelled.

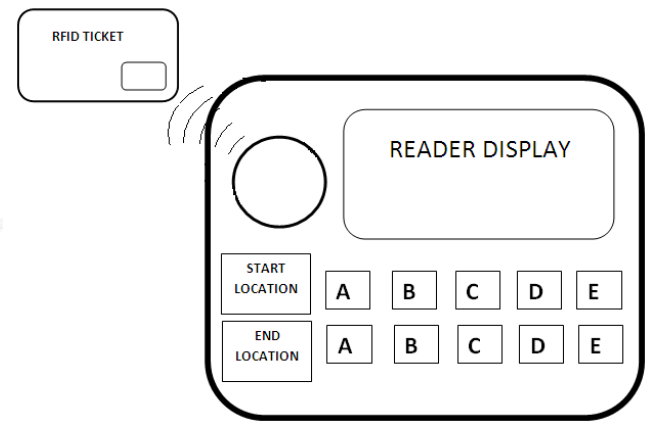


Figure 2. Reader with keypad for selecting location attached to each bus

III. COMPARISON & BENEFITS OVER CONVENTIONAL SYSTEM

In conventional paper based ticketing, each & everyday lots of tickets are being printed and sealed showing that date manually by the person sitting in the bus stoppage counter. After finish travelling, the passengers usually through away the used paper made tickets here & there which ultimately pollutes the environment. Again large number of trees is being destroyed since the current system uses paper based ticketing and the used tickets are just wasted. But in our proposed system the RFID tagged card carried out by the passengers does everything automatically and eventually reduces these mentioned complexities. Some benefits of RFID based ticketing system over conventional system (both paper based tickets & magnetic tickets) are mentioned below:

Using automatic ticket systems enables operators such as transportation authorities to save time and personnel costs; fare collection can be organized much more efficiently. These systems' low maintenance costs and reduced fraud-induced losses represent further advantages [11].

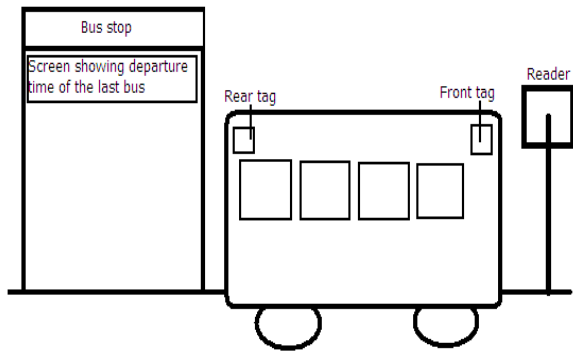


Figure 3. Bus arrival identification in the bus stop by the reader

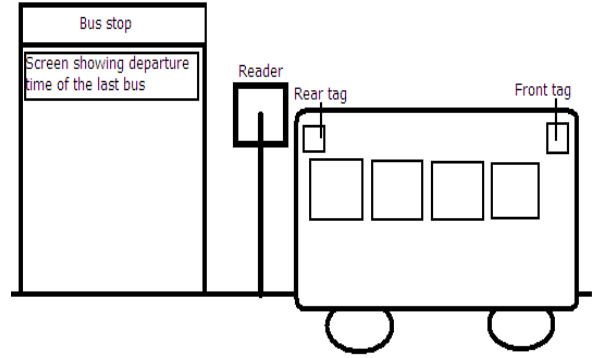


Figure 4. Bus departure identification in the bus stop by the reader

Automation is the key, but it comes alongside crime reduction, reducing excess stocks and work in progress and reducing the time taken from raw materials to finished item on the retailer’s shelf (“time to market”) and other benefits that directly impact costs [8].

Actually, the RFID uses the low-end of the electromagnetic spectrum. Thus waves coming from readers are not dangerous and are similar to those waves coming from our car radio. Just as our radio tunes into different frequency to hear different channels, RFID tags and readers are tuned to the same frequency to communicate [8].

Radio waves travel through most non-metallic materials, so they can be embedded in packaging or encased in protective plastic for weatherproofing and greater durability.

Like smart tickets, RFID tickets are more difficult to duplicate than magnetic tickets, reducing the possibility of fraud.[2]

RFID tickets achieve almost 100% read rate, which virtually eliminates free ridership.

Unlike magnetic readers, smart ticket terminals do not have moving parts. This reduces wear and tear, makes RFID terminals significantly more reliable, and leads to a reduction of operation/maintenance-time ratios of more than 40%.

RFID offers greater data-collection capabilities than magnetic. Smart tickets could combine a variety of different applications and so enable transit operators to provide additional services and customer-loyalty schemes.

The paper based construction and the reduced memory size greatly reduce the tickets price compared to a Smart Card and makes migration of sectors of ticketing range onto a SMART platform economically feasible. Low-cost RFID tickets allow customers to switch to a single technology system, and consequently reduce maintenance cost [2].

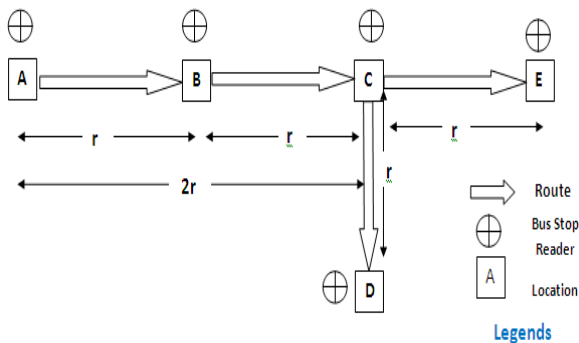


Figure 5. The distances between different bus stops in the route

TABLE I. A SAMPLE DATABASE FOR TICKET FARE CALCULATION CONSIDERING DISTANCE & TYPE OF BUS

Start Location	End Location	Distance	Ticket Fare (credit)	
			Class A Bus	Class B Bus
A	B	r	2	1
A	C	2r	4	2
A	D	3r	6	3
A	E	3r	6	3
B	C	r	2	1
C	E	r	2	1

IV. OPERATIONAL PRINCIPLE OF PROPOSED SYSTEM

Considering from the arrival of a bus at the bus stoppage, the reader will read the RFID tag attached to the front side of the bus that is denoted as the front tag. Thus the reader will have the idea of the bus and also the route of the bus along with the arrival time. Also the reader being connected to the main server, the data will automatically transfer to the server database. The screen in the bus stop will notify waiting passengers about the arrived bus and its route (figure 3).

All the passengers will carry a prepaid system RFID based card that will have a unique ID number. The card is rechargeable from certain electronic booths placed at certain locations of the city. The RFID based ticket will contain some a group of data given in TABLE II. The passenger trying to get on board will have to place the RFID ticket in front of the reader attached to every bus (figure 2). The reader will detect the tag and require certain information from the passenger. According to the route distance between departure & destination (shown in figure 5)

as well as considering bus type, it will calculate the ticket fare and deduct the credit from the RFID tag based ticket electronically. The sample information stored in the database about the route distance & credit unit is shown in the TABLE I. The complete detection algorithm is described in detailed in the later part.

After all the passengers getting on board, the bus will leave the stoppage and the reader will detect the rear tag attached to the bus (figure 4). The reader will send the information to the server and also to the screen showing the departure time of the bus. If an agency has a bus service that the buses come after each 20 minutes, from the screen above the waiting passenger will surely know when the last bus departed and after how long the next bus is coming.

After the whole day, the individual bus reader will know how much credit has been transferred to the corresponding account and also the information can be found in the main database. Cross checking of all those information will allow better monitoring, transparency and thus reducing corruption.

TABLE II POSSIBLE DATA COMPOSITION FOR RFID TICKET

Passenger ID	City ID	Ticket ID	Credit Balance	Check Bit	Others
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V. DETECTION & PROCESSING ALGORITHM

As soon as the tag is placed before the reader attached to the bus, the tag will get energized revealing relevant information to the reader. An authenticated tag carrier will enter the start location and end location information through the keypad. The reader will accept the card if the card has required credit to travel that distance. The data acquired by the reader will be stored in its internal memory as well as transferred to the main server database. After the whole day, the internal memory of the reader will be reset for the next day. The whole process is shown in a flow chart given in figure 6.

VI. CONCLUSION

The system is expected to be fully automated, reliable, transparent and convenient. The whole system can also be used in vehicle on highways, their toll payment and in the railway ticketing system with small or no modification. The cards being reusable, they are much more convenient compared to the paper based ticketing system. The card also can be used to be a universal travel pass card that will allow any transportation on any route. Any unwanted events can be avoided as all the person carrying RFID tickets are monitored every time they travel. Also the possibilities of reducing traffic jams, chaos in the bus stoppage that we usually experienced in Dhaka city are immense.

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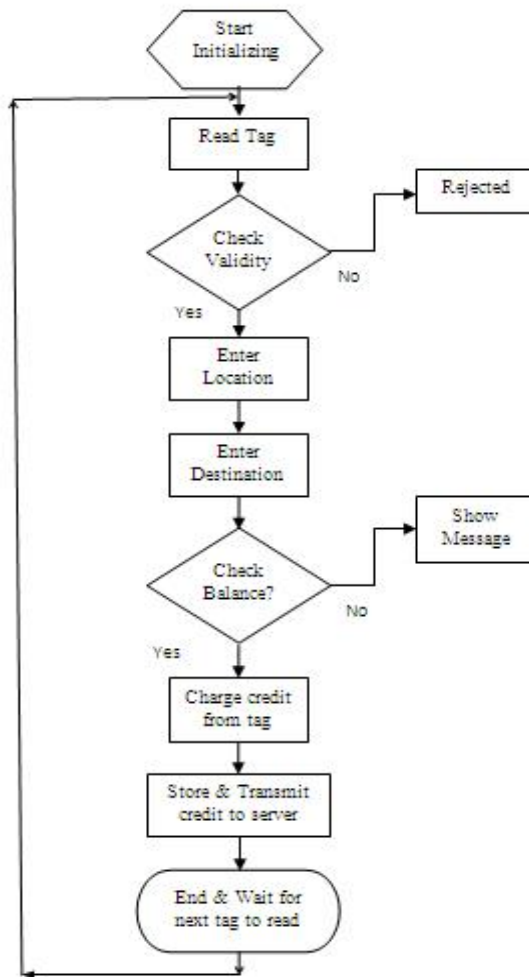


Figure 6. Flow chart for RFID ticket reading & automatic transaction

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