# RFID based Smart Transportation System with Android Application

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*Abstract*—**Public bus transport remains as the most commonly used transportation service in country like Bangladesh. Due to the traditional paper-based ticketing system, there exists an inappropriate fare appointment with which it hassles with the bus conductor have been a major concern nowadays. Moreover, there is no proper monitoring system in existence. In this paper, a methodology has been introduced for introducing RFID based smart transportation system. The main of this research work is to offer an effortless transportation facility by minimizing the problems faced by passengers, drivers and the concerned authorities with the help of a handy android application. Our system uses Radio Frequency Identification [RFID], Global Positioning System [GPS], and an android application for passenger management and real-time tracking features for offering a satisfying bus fare calculation.**

*Keywords— RFID, GPS, real-time tracking, transportation, android application*

## I. INTRODUCTION

A country's progress is determined by one of the most important factors like its transport infrastructure. Bangladesh stands as the 8th most populous country in the world with an estimated population of 163.05 million whereas Dhaka is occupied with a population of 14.4 million. The public transportation system remains as one of the most primary income sources for a developing country like Bangladesh. On the other hand, the public transportation service has become so agonized in terms of quality, complacent, and reliability in Dhaka city. Dhaka has become one of the cities in the world without having a properly planned, designed, managed, and well-constructed mass public transit system.

Now-a-days technology has become so efficient that it has provided access to gather information from the surroundings and thus helped to provide essential and useful facilities to the users. To ensure the goal of a smart transportation system, the public transport system must provide real-time services. Due to the lack of proper information about the exact arrival and departure time of a public transport, travelers always face the miserable condition of waiting for the bus for a long time. Though the passengers have to wait for a long time to get into the bus, still they have no assurance whether they will occupy themselves with a seat or not. As a densely populated city like Dhaka, during the busy hours, it may become the most difficult situation to travel by a mode of public transport.

This paper suggests a user friendly and fully automated system with Android application, RFID [1] and GPS [2] technology. Two applications have been developed in total. One application is for the user and another one is for the driver. A user application has been developed which provides real-time information to the passenger that ensures an efficient public transportation system. This system eliminates the usage of paper-tickets. In the conventional transport system, the bus conductor manually issue tickets and the fare is calculated manually while issuing the tickets. The problem is eliminated with the use of RFID card, the passenger can take a hassle-free and cashless ride.

The passenger can reserve a seat and see the available seat information of a bus through their android application. Besides, the real-time distance information of the bus is provided to the passengers so that the passenger can easily track the current location of a bus which is done by GPS (global positioning system). After getting into a bus, the passenger needs to swipe the RFID (radio frequency identification) card through which a unique key will be transferred from the RFID module to the driver application through GPS module, so that real-time passenger count can be implemented. The estimation of the travel cost is also done by RFID technology. A web application is also developed to monitor the whole system so that this system

can ensure the security of the passenger. Hence, the commuter of this system is ensured with a journey.

## II. SYSTEM OVERVIEW

Our proposed smart mode of transportation is based on the infrastructure of real-time database and real-time tracking to ensure a friendly and easily accessible transport system. The users of this system will be able to get all the real-time information through their android application. The users will also get the advantage of tracking the bus location. This system uses GPS to track the real-time location, so that the users can easily track the bus location. GPS is considered as one of the most useful and effective way to track the current position of an object. This system also provides the feature of real-time passenger count.

The users of this system will be able to know the available seats on a bus in real-time. The count of the passenger on real-time is done through RFID technology by calculating the total number of passengers currently boarded into the bus. Moreover, this technology is also used for the transaction process of the bus fare. Our smart transportation system is composed of different components [Fig. 1] that are mentioned below:
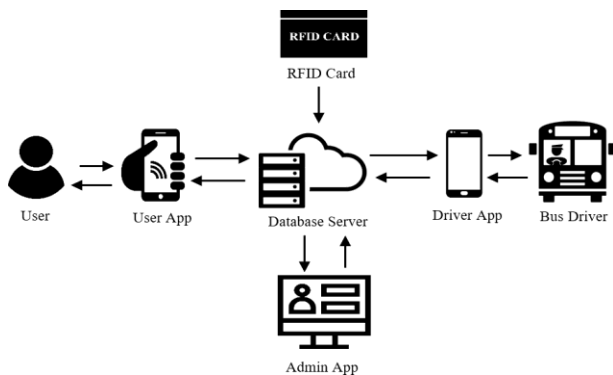


Fig. 1.  RFID based smart transportation system with android application

### A.  Tools and Technology

RFID [1], GPS [2], firebase [3] and google map [2] technologies are used in our system.

Our proposed system deals with two ends. One is user end and another one is the driver end. To ensure a better user experience, our system tracks the location of the passenger and the driver so that the passenger can choose his/her convenient transport and also the driver can count on occupied seats. The system tracks the passenger's location and the location of a bus on a real-time basis with the help of GPS. Then, our system will send all the updated location information (latitude and longitude) to the cloud into the

Firebase database. The location information of the passenger helps the driver and admin as well to find the current location of the user and the location information of the bus helps the passengers to find the nearby bus.

Our system uses RFID technology. Each RFID tag has a memory chip installed which will contain a unique id number (e.g.123456). By reading this id number from RFID card, the RFID module can access the user data in database to update information accordingly. Thus, RFID card helps to count the total number of passengers boarded on each bus. This technology is also used for collecting the bus fare. Every passenger needs to reserve a seat through their android application to access the bus. Then, the passenger needs to punch the RFID card at the entrance of the bus. After that, the fare is deducted according to the destination point selected by the passenger while booking the seat. Fig. 2 shows the scenario between the real-time count of passengers and available seats.

The total number of passengers will also get incremented by 1 for each passenger boarded into a bus after punching the RFID card. Again, while exiting from the bus at the destination point, every passenger needs to punch the RFID card. For each passenger's exit, the system decreases the count of the boarded passenger. Every bus has a specific amount of seats to allocate the passenger in total. If the number of boarded passengers is equal to the number of total seats, then there is no available seat on the bus. On the other hand, if the total number of boarded passengers is less than the number of total seats, then there is an available seat(s) on the bus.
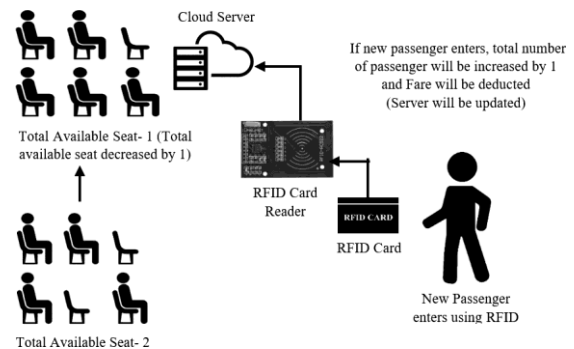


Fig. 2.  Real-time count of passenger and available seat

The real-time database gets all the information in real-time and thus provides the updated information to the passengers accordingly.

### B.  User Features

An android application is used by the passenger to book a seat according to their preferable time from the provided bus schedules. The passenger also gets the updated information

about the seat availability on the bus. Using this application, the passenger can also know the current location of a bus and get the notification about the arrival of a bus. The passenger will also get the notification after the successful transaction of the bus fare. If the balance falls below the appropriate level or the passenger's identification becomes unsuccessful, then the passenger will be notified accordingly.

Another android application is installed on every bus which will be used by the driver of the bus. Whenever a bus starts a ride for a destination, the ride will get started and all the passengers whoever booked a seat on that bus will get notification on departure of the bus in real-time. When the distance of the bus is within 3 km from a passenger, the passenger will get notification about the arrival of the bus.

The admin of the system is provided with a web application for providing the bus schedule and the route of the source and destination point of a bus. The admin is also responsible to register the driver of the bus and to ensure the security purpose of the system. Through this web application, the admin can add and update the bus schedule, which will be visible to the passengers' android application. Every bus is provided with a unique id and with this id the driver can access the driver application. If a passenger faces any security issue, he/she can complain about that problem through their android application. Admin app will handle all the security issues by evaluating the feedback obtained from the passenger. This system gives a security assurance to the transport system

## III. COMPARISON AND BENEFITS OVER THE CONVENTIONAL SYSTEM

In the conventional system, buses are overcrowded with passengers. People are not informed about the number of seats available on the bus. Nevertheless in the proposed system, every passenger will be able to check the seat availability on the bus. Henceforth, the passengers can choose a bus that contains unoccupied seats.

In Bangladesh, most buses deal in the fare collection process with their bus conductor. It is the most conventional and primitive way for collecting bus fare. It is often very difficult for a conductor to collect money when the bus becomes overcrowded especially in office-hours. Passengers find it really incommodious. There are some buses which have newly introduced paper-based ticketing system. Passengers can lose the ticket anytime. To overcome this, in the proposed system we have introduced an RFID transaction process. The passenger needs to keep an RFID card and the transaction will be done by swiping the card in the RFID card reader. An RFID card reader will be embedded in the bus.

Our conventional system has a lack of security for the passengers. Women sometimes get victimized by physical harassment [4]. In case of any emergency, they can immediately call or message to the administrator of the

system directly. Our system has an admin application for this kind of unexpected incident. Admin can track each and every bus and also the passengers. So, any kind of misconduct by the passengers or the drivers will be informed to the administrator and penalized accordingly.

## IV. RELATED WORK

In a study in [5], the authors have proposed an idea for a smart ticketing system, which is a combination of RFID and GPS technology for the commuters of the system. When a passenger gets down from the bus, the bus fare between the starting and destination point is calculated and deducted from the passenger balance.

In another study [6], the authors portray the RFID based public transport system, which introduces an automated transaction process. The proposed system emphasizes on conductor-less driving, which overcomes the major problems of the conventional public transport system.

In [7], the authors suggested an IOT based smart fare collection system implemented by RFID technology. They have also implemented a web-page monitoring system that will maintain all the information of passengers and the details of the bus by using the MySQL database. RFID based payment system has also been introduced which will make the journey more comfortable to the passenger.

The authors in [8] suggested the use of RFID technology to make the ticketing system of public transport more efficient. For the purpose of measuring the total distance travelled by the passenger, the system uses a Cyclometer that is connected to the wheels of the bus for implementing the automated ticketing system, but it seems to be a complex system to implement. The bus fare is deducted according to the distance travelled automatically.

In a study [9], the authors have proposed a GPS based transportation that tracks the real-time location of the passenger and the bus and thus calculates the distance between the two. The system also gives access to monitor the real-time location of the bus and uses Artificial Neural Network [ANN] technique for making the prediction on the bus arrival time.

In [10], the authors have proposed an IoT based system for monitoring the school bus. The system tracks the location of the students on a school bus, and it uses the technologies like RFID, GPS, GSM, and General Packet Radio Service (GPRS). It has also implemented a prediction algorithm for estimating the arrival time of the school bus and the parents can easily monitor the bus route using an android application.

The authors [11] have introduced a cost-effective passenger tracking system that is based on GPS and GSM. The tracking of the passenger depends on the valid bus ticket numbers and displays the location information on Google Map.

In another study [12], the authors have proposed a system of automatic ticketing system, which is established with the use of RFID technology. The bus fare is deducted from the user's account according to the distance travelled by the passenger. The main benefit of the system is that the transaction process and fare calculation is made more secured, reliable, and automated.

In a study in [13], the authors developed a system that focuses on the implementation of a bus tracking system that can easily track, display the real-time location of the bus, and it can also estimate the arrival time of the bus at any selected bus stop. The proposed system uses GPS (Global Positioning System) technology for location tracking, and the location information is sent to the cloud, and the user can find this information in a web application. The system also uses Google Maps to display the updated location information of the bus.

The authors in [14] proposed an algorithm based methodology of providing the facility to the passengers to meet the preferred public transport. The system uses real-time information (for example, the total number of empty seats, transport's current location) to provide the available seat information and the real-time location information of the bus to make it an efficient transit system.

## V. METHODOLOGY OF PROPOSED SYSTEM

Our system is basically composed of two applications, one is user application and the other one is the bus driver application. Users have to register themselves by providing the necessary information mentioned in the user application. After the verification process of the registration, the user will be provided with an RFID card. The driver of a bus will get registered through the administration of the web application. Every driver of a bus will be provided with a unique id with respect to that bus and with that id, the driver can access the driver application. Fig. 3 shows the flowchart of the system architecture where it describes how the data of the user application and the driver application gets updated through the cloud database.

After successful log-in by providing the proper internet connection, the user can see the nearby bus on his/her route on the Google Map and by clicking on the bus icon, the user can see the name of the bus. In the user application, the user will be provided with the seat booking option on a bus and he/she can reserve a seat on easily. The user will also be provided with the bus schedule so that the user can have the flexibility of reserving a seat according to their comfort. Moreover, on the application, they can find the information about seat availability of a bus, payment status, and complain option.
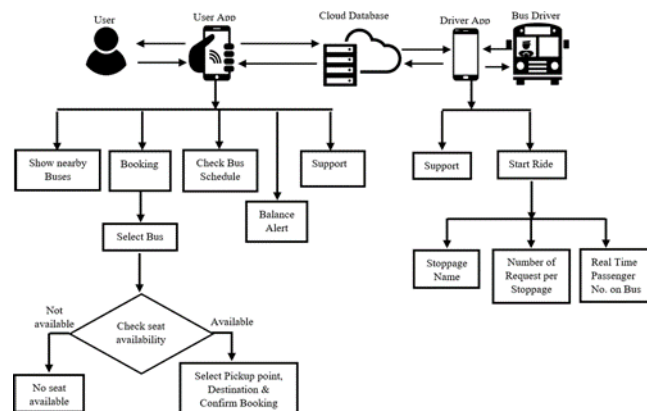


Fig. 3. Flowchart of the System Architecture

The user can easily track the location of a bus which is done by GPS. To visualize the bus onto a map, Google map API service is used. All the information related to the system will get updated in the cloud server. When the driver starts a ride from a starting point to a destination point, the driver needs to select the start ride option on his application. After starting the ride, the bus location will get updated in our system and the passenger will be able to know the exact location of the bus.
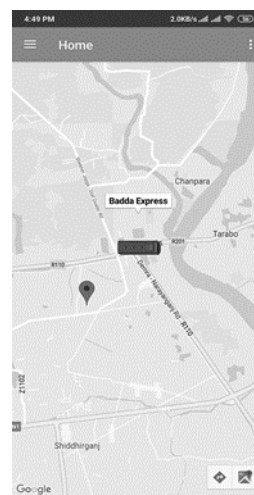


Fig. 4. Real-time location tracking of bus by user

As the bus moves, the latitude and longitude of its current location also gets changed, and the data are stored in the cloud and and the location of the bus gets updated in real-time to track the bus location by the user. The driver can view the number of passenger requests along with the stoppage name with respect to his route. Fig. 4 shows the real-time tracking of the bus location by the user.

The web application for the authority is provided as the safety feature to monitor the overall system. The authority of the system will monitor the authentication of the system to ensure a secure journey. The bus schedule will be provided in

the web application by the admin and will get updated through the firebase database to be visible in the user application. The web app also consists of user feedback feature to get people's feedback in case of an emergency and also in nonemergency purpose. The admin holds all the data of passengers, drivers and vehicles in the web application. Admin can add or erase data as per need through the web app.

The system is also equipped with RFID technology. A combination of an RFID module and ESP8266 WI-FI module makes the hardware setup [Fig. 5] for this system. When a passenger gets into the bus or down from the bus, a passenger needs to punch his/her RFID card. After punching the RFID card, at first the validity of the card is checked and then it is checked whether the card is punched for an entry point or an exit point. By punching at the entry point of a bus, our system increments the total number of passengers boarded into the bus. This information gets updated into the cloud server and the updated information of the available seat on a bus is viewed by the passenger. So, the RFID technology has secured a smooth journey for the travellers.
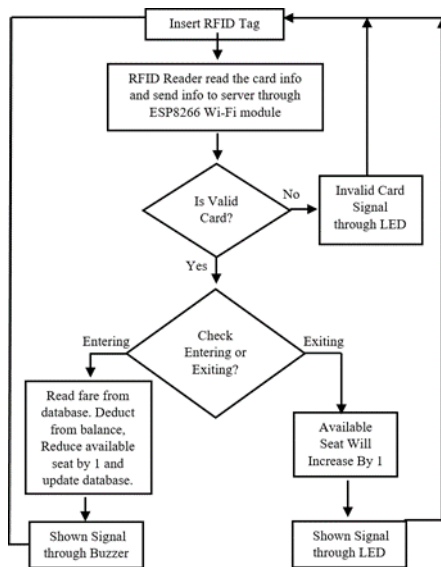


Fig. 5. Hardware setup of RFID

One of the main features of our system is the RFID payment system. The automatic transaction process [Fig. 6] also takes place while punching the RFID in the entry point by calculating the travelled distance from the source to the destination point selected by the passenger through their application while reserving a seat. After successful transaction of the bus fare, the user will get the notification. Again, while exiting from the bus in the destination point, every passenger needs to punch the RFID card and the system decreases the number of the boarded passenger and the cloud server updates the information accordingly. User will be notified for the exceptions if balance falls below

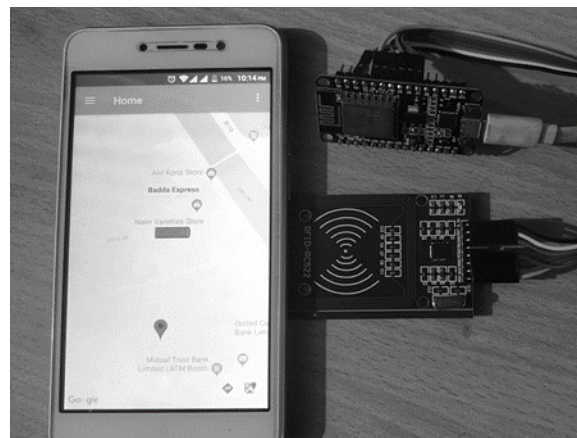appropriate levels or the user's identification becomes unsuccessful.



Fig. 6. Flowchart of the transaction process

## VI. PERFORMANCE OF PROPOSED SYSTEM

The benefits of our proposed work is given below:

TABLE I.    EVALUATION OF THE ADVANTAGES OF PROPOSED SYSTEM

| | Parameter | Conventional Transport System | Proposed System |
|---|---|---|---|
| 1. | Ticketing system | Conventional system has paper based ticketing system. | Our proposed system provides RFID based ticketing system. |
| 2. | Bus Fare | Existing transport system practices manual collection of bus fare by bus conductor. | Our system provides RFID based automatic payment system. |
| 3. | Security | Traditional public transportation system is not secured at all. | By monitoring the overall system, proper security system is assured through the admin application. |
| 4. | Seat availablity | Most of the time, people have to travel by standing in the public transportation because they are not provided with any kind of seat availability information. | Users of the system will have the flexibility to know the seat availability of a bus. |
| 5. | Location tracking | Traditional transportation system does not provide any feature of tracking the real-time location of a bus. | The users of our system can track the real-time location of the bus to know the current location of a bus. |
| 6. | Real-time information | In the conventional transportation system, the travelers do not get any kind of update about their journey. | In our system, the commuters will be provided with all updated information in real-time. |

## VII. CONCLUSION

RFID Based Smart Transportation System enables the passenger to travel hassle-free. Passengers need to swipe their individual RFID card for transaction. Passengers can also choose bus according to the number of available seats. Passengers can also immediately send their feedback to the administrator of the system.

Our system will make public transport more convenient for the passenger. Easy accessibility to the system will draw passenger's interest to use the public transport rather than using private cars or any other private vehicles. As a result, the system will significantly reduce the traffic flows in the road. RFID card can also be used as a universal travel pass card that will allow the user to use any transportation on any route. Any private transportation business organization can easily integrate this system into their existing infrastructure. The system will remain as a fully automated, reliable, transparent, and convenient for the commuters of the system.

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