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Smart Bus Ticketing System through IoT Enabled Technology

Agyan Panda[1,*], Antônio Clécio Fontelles Thomaz[2]

[1] Department of Computer Science and Engineering, OEC Engineering College, OD, India; hmpendrive@gmail.com.
[2] State University of Ceará, Fortaleza, CE, Brazil; clecio@itic.org.br.

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Abstract

This project is concerned with using a digital rather than a manual approach to providing bus passes. The major goal of this technology is to digitally manufacture bus passes and eliminate the need for handwritten paperwork. Commuters will be able to acquire their passes in a fraction of a second, eliminating the need to wait in lines. It will also make it easier for customers to pay for their passes online. As the project grows in size, all of the data will be transferred to the cloud. As we advance toward a smart bus pass generation system, the trouble of keeping change in pockets will soon be a thing of the past. The online-based bus pass generation and payment system will not only be a step toward a paperless green city approach, but it will also be a tremendous relief for daily commuters, saving them time and eliminating the daily bother of waiting in lengthy, tiring lines for their passes. Not to mention our senior citizens and female commuters.

Keywords: Digital, Smart pass, Android, Bus e-pass.

1 | Introduction

In the world of ever-growing population, the need for transportation is increasing day by day. Talking about India, the population distribution by wealth is such that 67 million of Indians falls under the category of lower class and more than 40 million falls under middle class category [1]. Meanwhile, these groups of people prefer travelling by public transport rather than buying or using their own vehicle as a means of transportation. It is also recommended to do as it would help saving a good amount of fuel. If we look at this scenario in a fast- growing city–Bangalore, bus is one among the most preferred means of transportation having the ridership of 35.8 lakhs on a daily basis [2]. As the process of issuing bus pass is manual, it results in usage of paper on a huge basis each day. This work eliminates the use of paper thus helps in saving trees and fuel contributing to the green city approach. Advanced technology has become the integral part of our life. The enhancement of science and technology leads to make the life more comfortable than older days.

Corresponding Author: hmpendrive@gmail.com
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The emerging technologies like software engineering [3] and [4], energy management [5]-[7], transportation problem [8]-[10], wireless sensor network [11]-[18], uncertainty problem [19]-[24], face recognition [25], bellman algorithm [26], neural network [27], routing [28] and [29], fuzzy shortest path [30] and [31], cloud computing [32], distributive environment [33], mixed environment [34] programming language [35], neutrosophic shortest path [36]-[38], optimal path [39], multi-objective optimal path [40], powershell [41], answer note [42], making the products more intelligent and self-healing based. The smart city [43] and [44], applications like smart water [45]-[47], smart agriculture [48] smart grid [43] and [44], smart parking [49], smart resource management, etc. are based on IoT [50]-[52] and IoE technologies. So, all the organizations, industries and also every individual are using computer systems to preserve and share the information. The internet security plays a major role in all computer related applications. The internet security appears in many real-life applications, e.g., home security, banking system, education sector, defence system, Railway, and so on. In this manuscript we discuss about the protection of authentication which is a part of internet security. From the deep literature survey, we have understood that ticketing and issuing passes through digital or smart cards is not a new concept. Countries like Europe, Russia, Hong Kong, United States, Canada, etc. have already implemented this model. Depending on the mode and vehicle of transportation, these cards are used by the commuters for daily ticketing, bus passes and discounts for different section of the population (students, women, senior citizens, especially abled, etc.). Commuters need to carry these cards with themselves for using it as a pass to avail a public transport service. Minor problem with this existing system occurs when commuters, at times, forget to carry their passes with them or gets it misplaced. This issue can be eliminated by digital passes. *Fig. 1* shows the bus revenue generation statistics [53].

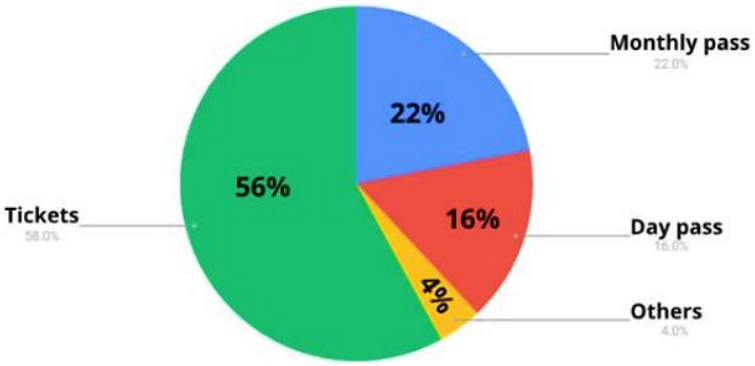

Fig. 1. Bus revenue.

1.1 | Motivation

Awareness for green city has been a great motivating factor during this work. The existing manual system uses bulks of paper in each year becoming one of the main reasons behind depletion of trees and forests. On implementing a digital pass system, we would be able to help the environment to some extent. This work also offers a contribution in digital India campaign. It helps reducing paperwork, manual-work, and saves time. In this work, digital bus passes are generated using android application which would help commuters on a daily basis to issue passes, renew it and pay for it in a much more efficient and easy way.

The organization of paper is as follows. Section 2, containing the literature review, followed by Section 3 having proposed model, the architecture, and features of digital bus pass application whereas Section 4 discusses about the future scope, and Section 5 concludes the paper followed by references.

2 | Literature Review

With a digital approach, we can remove the drawbacks of a traditional system. The scope of having a digital pass is vast as it is going to eliminate the hassle of getting a physical pass on a daily basis, and also

at the same time, it reduces manual intervention keeping the system very much safe and secure. The commuters will not have to worry about carrying such small denomination of money with themselves, rather they can easily pay through their cards or their UPIs. This digital system, though, is not only useful for the commuters, but it will also be a great help to the bus authority as they will no longer suffer from any losses caused due to misuse of passes and thereby increasing their revenue [53]. The passengers can also benefit by the offers or discounts that the bus company may provide occasionally over the digital platform.

Digital pass system for buses either use a website or an application to provide services to commuters. For the development of this system, analysis of traditional system is needed. And to overcome its shortcomings, a digital bus pass application is proposed with various features such as pass renewal, pass generation, payment, category wise pass (student, women and elderly, especially abled), editing of pass etc. Both, bus authorities as well as the passengers can enjoy benefits of this digital approach. This new e-pass system is not only advanced but also effective and efficient. The objective of this approach is to automate the payment as well as pass issuing procedure with more safety and security than it was before. The passengers get the independence of using any fare paying model that is allowing full self-administration. The primary key success factor of the digital pass is the interoperability and simplicity of the system from the passenger's point-of-view [54]. The passengers can be sure that they will be guided safely to use this e-pass application and get the most of it.

This type of digital approach exists in one of the European countries i.e., Germany and their success is very huge and motivating. Countries like Germany is using e-ticketing for public transportation by associating with their public transport companies such as Verband Deutscher Verkehrsunternehmen (VDV) who founded the VDV core application for bringing the e-ticketing approach in their country. With such a hit, other countries have started to evaluate the VDV core application. Australia has successfully developed a pilot model for the same as well [55]. As the time progresses, more countries will be coming forward and will become aware of the need of a digital approach in their transportation as well.

3 | Proposed Model

The proposed model brings flexibility of issuing bus passes online and solves the problem of stolen and misplaced bus passes. Not only does it help in saving time for the office and college going commuters, but it also serves the passengers with an easy online system that issues hassle free bus passes with the method of online payment. The modules included in this digital bus pass system are – pass generation, pass renewal, pass selection (daily pass, monthly pass, yearly pass, student pass, ordinary pass, gold pass, premium pass, dedicated pass), pass editing, pass cancelation and online payment module. *Fig. 2* shows architecture of various modules included in the proposed model.

3.1 | Passenger Interface

Login module. In this module, the passengers will login into the digital bus pass application using their mobile phone and get themselves registered on the application [54]. For registering they need to provide the following details:

- *Name.*
- *Contact number.*
- *Password.*
- *Payment method.*
- *Address.*
- *Email id.*
- *OPT generated.*

After filling in the above information, they need to login using their credentials. This login data will move to the next module for authentication and if the authentication is successful then the user will be taken to the initial page of the application from where they can proceed further.

Authentication module. This module is responsible for authenticating a passenger based on their credentials information to check if the passenger is a registered user or not. This module is also checks if the payment method entered by the user is correct or invalid. In case if any of the checking parameters are not met, then the passenger will be prompted regarding the incorrect entered data and will be asked to re-enter them. The passengers will select the type of pass according to their requirement and then proceed for pass creation section. In the pass creation section, the passenger needs to fill in details such as destination, pass number and pass validity needed. Once the details are filled, the passenger needs to pay for the pass in the payment section of the module. At last, the passenger has to go to the pass generation module for getting the pass generated.

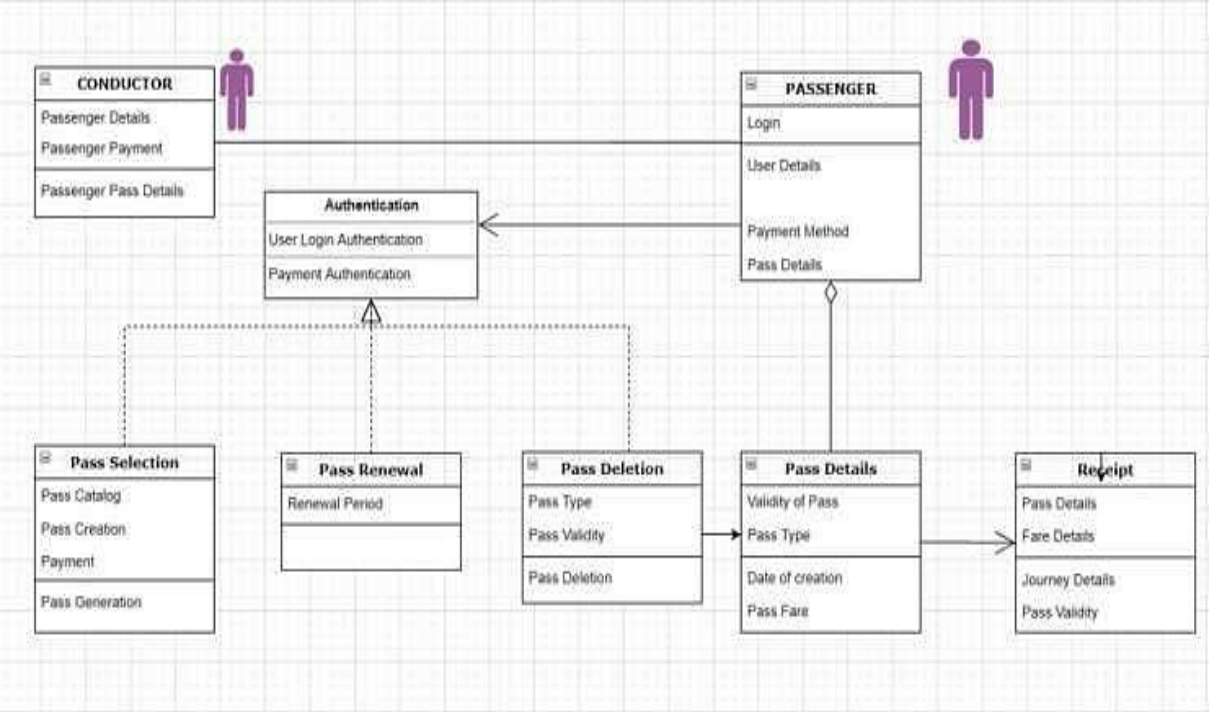

Fig. 2. Architecture of modules in digital bus pass system modules.

Pass selection module. In this module, the passenger has to select from the types of passes available in the pass catalogue section of the module such as:

Daily pass	Yearly pass	Student pass	Premium pass
Monthly pass	Ordinary pass	Gold pass	Dedicated pass

Pass renewal module. Most of the time the passenger forgets the validity of their passes and gets into difficulty [37]. This module deals with renewing the pass if the passengers wish to get the validity of their passes extended. If the passenger's pass has expired and no longer active, then they can get their passes renewed again by visiting this module.

Pass deletion module. If the passenger wants to get their pass deleted. This module comes into play when the passenger no longer requires the pass they had issued and wanted to get it deleted. The passenger needs to fill in the details like pass type and pass validity. If the pass is still unused, then the passenger gets the refund.

Pass details module. This module will have all the information related to the pass that the passenger has issued. It will contain the following details:

- *Type of pass.*
- *Date of pass creation.*
- *Validity of pass.*
- *Fare details.*

Receipt module. The receipt module contains the final receipt of the pass generated along with the details such as:

- *Pass details.*
- *Fare details.*
- *Pass validity.*
- *Journey details.*

Conductor interface. In the conductor interface, the conductor receives all the details about the passenger who have registered, got their passes generated and played for the passes. The conductor is the one who manage the interface containing the following section:

- *Passenger details.*
- *Passenger pass details.*
- *Passenger payment details.*

4 | Conclusion and Future Scope

This paper proposes a smart digital bus pass and payment system by using android as a platform for development. The digital bus pass system contains features that would help the daily commuters in their day-to-day bus journey not only with ease of use, but also is proved to be a cost-efficient approach in comparison to the traditional system. This work not only contributes to the society but also to the green India campaign eliminating the use of paper. The paper demonstrates the use of android application that eases the hassle of passengers travelling across the city. It also offers a safe way of travelling.

This model can be further modified and changed depending on the future needs. Many additional modules and features can be enhanced in the proposed model such as pass category, additional feature of the application, user interface, payment category etc. In this fast-paced growing world, the needs of the people are as ever growing, and it is necessary to keep the technology updated that would match the current requirements. That is why the version of this proposed model has a wide scope of modification and upgradation in the future.

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