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Smart Pass Secure Transit

Chinmayi C¹, Supriya Mallad²

Student, 4th Semester MCA, Department of MCA, BIET, Davanagere, Karnataka, India¹

Assistant Professor, Department of MCA, BIET, Davanagere, Karnataka, India²

ABSTRACT: A state-of-the-art digital solution designed to revolutionize urban transportation, the Smart Pass Secure Transit System was first widely implemented by Bangalore Metropolitan Transport Corporation (BMTC), the biggest transit company in India. The entire system enhances transportation speed, accuracy, and security by automating the bus pass life cycle through issuance, purchase, validation, and fraud prevention. Three main user groups are further classified by the system: administrators, users, and drivers. Each of these groups has unique tools and features to support their jobs. Complete control over user registrations, driver activity tracking, fare rate setting, real-time bus location tracking, and digital pass transaction administration is granted to administrators. Customers may easily register, view the many pass options, buy digital passes, and use QR codes to validate them for hassle-free, contactless travel. Drivers are given a straightforward, safe one-time To optimize boarding speed and minimize delays, log in to scan and authenticate digital passes. The platform's intelligent security features, such as real-time fraud monitoring for duplicate or geographically dispersed pass scans, are among its key advantages

KEYWORDS: Digital Bus Pass, Public Transportation, Mobile Application, QR Code Authentication

I. INTRODUCTION

The entire bus pass issuance, purchase, and verification process is automated by the Smart Pass Secure Transit digital platform. Additionally, it greatly accelerates and improves the efficiency of this procedure. The platform provides several special benefits that raise effectiveness and safety of public transit. Administrators, users, and

drivers are the three main categories of users. In addition to managing drivers, administrators can add or remove different bus tickets, view locations and fare information, and keep an eye on user registrations and bus pass sales. To ensure a smooth journey, users can buy passes, register, check the types of passes, and use QR codes for electronic passes.

Bangalore Metropolitan Transport Corporation, also known as BMTC, is the largest transit bus provider in Bengaluru, India. Millions of people who rely on public transit to go around the city are served by it. The BMTC has wide, swift lines that traverse a vast region. providing a variety of citywide transit options for commuters. BMTC is implementing the Smart Pass Secure Transit project to improve the effectiveness, safety, and convenience of riders. The project will replace existing tickets with the first-ever digital, contactless, and secure transit pass for urban transportation. Commuters' commutes will be more convenient and effective as a result of this. A comprehensive solution to increase the effectiveness of bus pass issuance, management, and verification is the Smart Pass Secure Transit System. It is intended to give administrators, users, and drivers a smooth and safe travel experience. From creation and dissemination to verification the system provides numerous features to optimize the whole bus pass lifetime, including fraud protection. In order to scan QR codes and verify the authenticity of the passes, drivers can also select a one-time login interface. The technology recognizes and detects fraudulent activities, including repeated scanning at different sites, to prevent misuse and guarantee security. You may have a dependable and effective bus pass management environment with this integrated solution, which enhances travel safety.

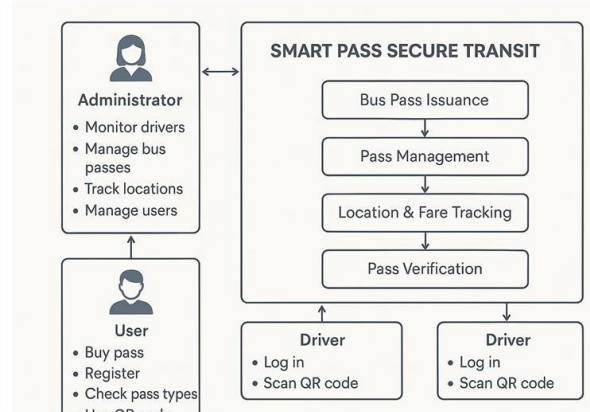


Fig.1. Architecture diagram for the Smart Pass Secure Transit

The figure1 shows the architecture diagram for the Smart Pass Secure Transit System illustrates how the platform unites a number of stakeholders, including drivers, administrators, and users, with the primary digital system for improved administration and pass checking. The Smart Pass Secure is located in the center of the system. The transit platform comprises four primary functional modules: location and tariff tracking, approval check, pass management, and bus pass emission. These modules manage a creation's whole life cycle. Buses are purchased and acquired for antifraud and real-time authentication.

The system is used by administrators to keep an eye on drivers, manage various pass kinds, locate vehicles, and manage user behavior and data. For flawless and contactless travel, users, or passengers, register, look at possibilities, purchase passes, and utilize them via QR codes.

Drivers scan digital user QR codes on a login screen to rapidly verify them. The diagram shows a gradual transfer of knowledge and accountability across all positions in order to achieve a secure, a well-organized and effective public transportation experience.

II. RELATED WORK

The objective of this work is to create a database system that efficiently handles bus pass data. The system has two logins: one for the administrator and one for the user. The online bus pass is a web application that makes it possible for people to get online bus passes. system of generation. This system's original objective was to develop an application that could obtain basic authentication information and grant bus permits to designated users without requiring them to stand in line. An online system that can create bus passes would be convenient since it would reduce paperwork and facilitate bus pass receipt. This would simplify the process of obtaining bus passes and reduce paperwork. The user can top off their account and extend the validity of a pass at any point before it expires. By logging in, the administrator has access to all balances and user information. Bus passes can be obtained through the system by anyone in Karnataka, and there is no requirement to renew the pass [1].

Online bus permit creation is advantageous for students who are struggling with the current manual registration and renewal process. Students are needed to register online. After registration is complete, an OTP code will be sent to the student's email. Following After examining the student's data, the administrator will decide whether to grant or deny the bus permission. The created pass will be sent to the student's mail. Students can renew their accounts online by providing their college ID and password. There are several details provided about the buses, qualifying conditions, costs, and timetables. Information about the bus timetable, cost, and pass booking mechanism will be provided to us. In the past, there was no online application form. By hand The process must be carried out. Thus, it requires more time [2].

In order to help bus operators operate their businesses more effectively, this work aims to investigate and build a web portal for an online bus ticketing system that both consumers and bus operators may use to buy and sell tickets online. E-commerce's explosive expansion has altered how In the past, bus tickets were purchased at the counters located in bus terminals. Therefore, before developing the system, this study examines the factors that led to the development of the current e-ticketing systems and evaluates them critically. This initiative will address frequent problems for both passengers and bus operators, such as long lineups for ticket purchases, unsafe working conditions, and illegal bus operators. The study looks at a number of implementation issues and offers suggestions for the Online Bus Ticketing System web portal's effective launch. According to this analysis, a star grading system that considers monthly sales, bus operators' popularity, and legal traffic infractions. This study also recommends a decision support system that provides the customer with reliable options to pick from in order to meet their needs. The development of an online bus ticketing model is one facet of this study. a website that will support the research objective. The development and upkeep of an integrated system that links bus companies with other bus companies, customers, other transportation providers, businesses, and government agencies will be made easier by this internet hub [3].

The objective of this task is to create a database system that efficiently handles bus pass data. The system has two logins: one for the administrator and one for the user. A system that operates online could help commuters save time and escape long queues by producing bus licenses. This method aims to make it easier for commuters to acquire basic authentication information and issue bus permits without making them stand in long lines. The bus official could easily verify the validity of the pass [4].

GPS is a more widely utilized technology with numerous uses. The position of the vehicle and the path taken by it are provided by the current system, which can be monitored from any distant location or place. GPS and GSM technology are essential to this system. Certain functions, such as the track vehicle, are only available on PCs and not on mobile devices. Additionally, there is no app that uses a mobile device to monitor and view a target or vehicle in real time.[5] Kidwell demonstrated an algorithm that uses real-time car position to forecast bus arrival timings. Each path was divided into zones by the algorithm, which then recorded the amount of time each bus spent in each zone. The most recent observation of a bus traveling through each zone served as the basis for the predictions. Nevertheless, this approach was not appropriate for big cities where there may be significant fluctuations in both travel and residence times.[6]

The aforementioned current approach is predicated on bus passengers' ticketing identifications on public transportation. Many passengers are experiencing more It causes misunderstandings regarding fares and corruption. The system will automatically collect passengers' fares based on the distance they have traveled. This method makes travel extremely accurate by using RFID and GPS for transactions. This system has certain drawbacks, such as the fact that it only offers automated ticketing and no bus tracking features. Furthermore, there is no provision for measuring the density of the throng. There is no user application of any type on this system that allows passengers to track buses and read bus schedules[7].

The process and the outcomes of applying it to Porto bus service data. The information relates to an automatic vehicle location system that is connected to an AFC system. keeps track of every transaction made by a passenger getting on a bus, including information about the route, the car, the travel card used, the time, and the starting point of the trip[8].

There are very few tracking systems on the market, and the ones that are available are expensive and of poor quality. The approach mentioned above is far more cost-effective than there are other systems on the market right now. This proposed solution makes it easier to use a smartphone or mobile device to find the position and information of the college bus. However, this system has some shortcomings; it only has a tracking feature that relies solely on SMS. There is no smartphone application for tracking buses, nor is there a real-time view of their location[9].

The difficulty of developing an electronic ticketing system for transportation networks that can operate entirely or in part on the cloud was covered by F. Araujo et al. This difficulty is specified inside an industrial project's parameters. Using the flexibility of cloud-based resources, the resulting system should be able to serve a wide range of clients and offer two main benefits: reduced operating costs, particularly for small clients without IT departments, and quicker execution of queries for monthly or other types of analysis. A system with highly standardized technology and processes was suggested in order to achieve the project's objectives: a three-level structure; a division an Enterprise

Service Bus to receive input from a wide range of hardware and software stacks, as well as online and analysis databases. This research examined a number of choices for where to put these cloud-based facilities and assessed the associated costs[10].

III. METHODOLOGY

The development of the Smart Pass Secure Transit System followed a structured and systematic approach based on the Software Development Life Cycle (SDLC) model. The methodology ensured a smooth transition from idea to deployment, enabling an efficient, secure, and user-friendly platform for public transport management.

A. Requirement Analysis: The project commenced with a detailed requirement analysis phase, where data was gathered from key stakeholders such as BMTC officers, drivers, and daily commuters. This engagement helped to identify essential functionalities, including the digital issuance of transit passes, QR code-based validation, user registration, fraud detection mechanisms, and a centralized administration interface. The focus was to ensure that the system addressed real-world needs and challenges faced by the public transport ecosystem in Bengaluru.

B. System Design: Once the requirements were finalized, the design phase involved creating detailed architectural specifications. These included Data Flow Diagrams (DFDs) to map the flow of data within the system, Entity Relationship Diagrams (ERDs) to define the database structure, and wireframes for both web and mobile interfaces to plan the visual layout and user interactions. The system was designed to cater to three main user roles—administrators, drivers, and commuters—each having distinct functionalities and access rights. This ensured a clear and efficient interaction model across all stakeholders.

C. Implementation: During the implementation phase, the system was developed in a modular manner to facilitate scalability and easier maintenance. Technologies such as React Native were used for developing cross-platform mobile applications, ensuring compatibility with both Android and iOS devices. Backend services were built using either Node.js or Django to handle application logic and APIs. For data management, MySQL/PostgreSQL was used along with Firebase to provide both structured storage and real-time updates. QR code scanning functionalities were integrated using standard libraries like ZXing. The complete system was hosted on secure cloud platforms such as AWS or Google Cloud to ensure reliability and high availability.

D. Testing: The testing phase involved multiple layers of validation to ensure system reliability and correctness. Unit testing was performed to validate individual software components, followed by integration testing to ensure that the modules interacted correctly. System testing was then conducted to check the entire system's functionality as a whole. Finally, a real-world User Acceptance Testing (UAT) phase was carried out involving BMTC drivers and selected users. Their feedback was collected to evaluate usability and ensure that the platform met practical expectations and operational standards.

E. Deployment: Following successful testing, the system was deployed in a live production environment. The mobile applications were made available through official app stores, allowing users to access the services easily. A central monitoring and administration dashboard was established at the BMTC headquarters, providing real-time oversight and system management capabilities. The deployment marked a significant shift from manual processes to a digital transit ecosystem.

F. Maintenance: Post-deployment, the project included a maintenance phase to ensure the system remained up-to-date and fully functional. Regular updates were scheduled to introduce new features, optimize performance, and resolve any issues reported by users. Continuous monitoring was implemented to ensure security and system uptime. These efforts contributed to creating a resilient and sustainable platform that could adapt to evolving user needs and technological advancements.

IV. SYSTEM IMPLEMENTATION

The implementation of the Smart Pass Secure Transit System involved developing a modular and role-based architecture figure 2 shows the system implementation diagram, where functionalities were clearly separated across three major modules: Admin, User, and Driver. Each module was implemented using a mobile interfaces.

In the Admin module, core administrative controls were implemented to manage the system's data and operations. Using secure login credentials, administrators can add or remove different types of bus passes, manage driver records (including auto-generating secure login credentials), and dynamically update the list of travel locations. A key feature implemented for admins is the ability to set pricing rules based on source-destination pairs, helping to maintain accurate fare structures. The admin panel also includes features to monitor user activity, view or delete pass purchase records, and ensure data integrity through centralized access.

The User module was built with a focus on usability and security. Registration and login processes are safeguarded using encrypted passwords. Once logged in, users can view all available bus pass categories and purchase the one that best fits their travel requirements. Each purchased pass is automatically generated with a unique QR code, stored securely in the user's profile, and retrievable at any time. Users can also update their profile details and passwords, ensuring that personal data remains current and protected.

The Smart Pass Secure Transit System was successfully developed and deployed as a complete digital solution for managing bus passes. The system enables smooth operations for all users—administrators, commuters, and drivers—by automating the process of issuing, validating, and monitoring passes. Users were able to register and purchase passes easily through the mobile application, and each pass was assigned a unique QR code for secure validation. Drivers were able to verify these passes using a built-in QR scanner, and the system effectively detected any fraudulent behavior, such as repeated scans. Administrators had full control over pass types, pricing, location settings, and user management. During testing, the system showed high accuracy in QR code validation, fast data syncing through Firebase, and strong performance across Android devices. Overall, the system met all functional requirements and improved both the efficiency and security of the public transport pass system.

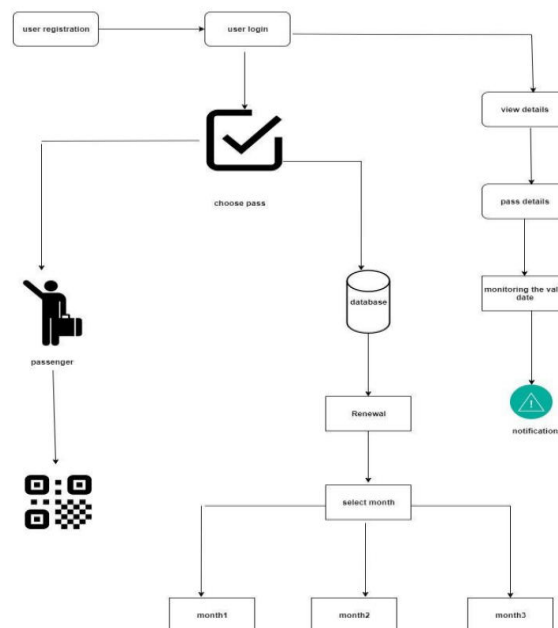


Fig.2. system implementation diagram

The Driver module was implemented to allow efficient pass verification. Drivers receive system-generated credentials that allow them to log in securely to their accounts. The app integrates QR code scanning functionality that enabling quick and reliable verification of digital passes. The system includes fraud detection mechanisms that automatically flag suspicious behavior, such as the repeated scanning of a QR code at multiple locations. Drivers can also manage their profile and reset their passwords, giving them control over their credentials.

V. TECHNOLOGIES USED

A. Android

Android is an open-source mobile operating system developed by Google, based on the Linux kernel. It is the most widely used operating system in the world for mobile devices, including smartphones, tablets, smart TVs, and wearable devices. Android provides a flexible and powerful platform for app development, allowing developers to build applications using the Java, Kotlin, or C++ programming languages. It offers a rich set of APIs (Application Programming Interfaces), tools, and libraries for designing responsive and feature-rich mobile apps.

Features of Android:

- Open-source: Android is open to developers, which allows full customization and freedom to modify the system as needed.
- Google Play Store: A centralized platform for distributing apps to users.
- Multi-device Support: Android runs on a wide range of devices from different manufacturers (Samsung, Xiaomi, OnePlus, etc.).
- User Interface (UI): Highly customizable and touch-optimized UI for user interaction.
- Support for Sensors and Hardware: Android can access device hardware like GPS, camera, microphone, NFC, fingerprint scanner, etc.

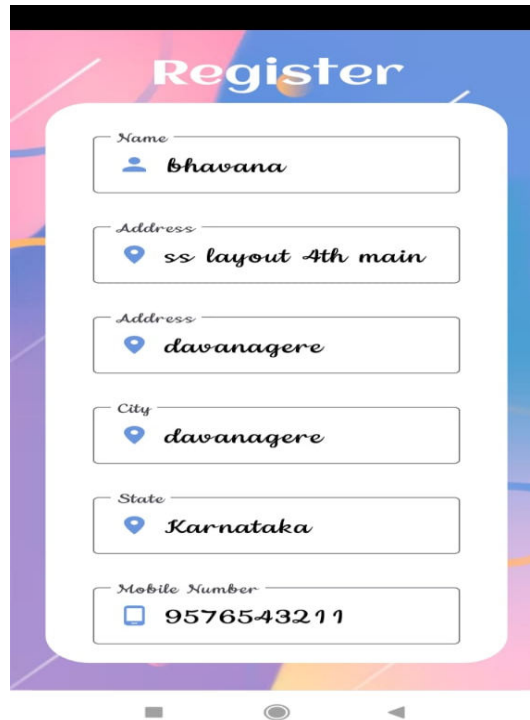
B. Android SDK: Google created the Android SDK (Software Development Kit), a set of resources that let programmers create applications for the Android operating system. One of the most crucial aspects of creating an Android app is this, which is typically utilized in tandem with the official Android IDE (Integrated Development Environment), known as Android Studio.

C. Laravel: Laravel is an open-source PHP framework that is both dependable and easy to use. It adheres to the design pattern for model-view controllers. Laravel makes it easy to reuse existing components from other frameworks while creating online apps. The online application is therefore helpful and well-structured. The Laravel's vast feature set includes essential components of PHP frameworks like CodeIgniter and Yii as well as other programming frameworks like Ruby on Rails. The wide range of functionality offered by Laravel will speed up the process of creating websites. You will find Laravel easier to use if you are familiar with Core PHP and Advanced PHP. Starting from scratch when creating a website saves time. Second, a website built using Laravel is secure and guards against certain online threats.

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VI. RESULT

A screenshot of a mobile application's registration form. The form is titled "Register" and is set against a colorful background. It contains several input fields with labels and icons: "Name" with a person icon, "Address" with a location pin icon, "City" with a location pin icon, "State" with a location pin icon, and "Mobile Number" with a phone icon. The fields are filled with the following text: "Bhavana", "ss layout 4th main", "davanagere", "davanagere", "Karnataka", and "9576543211". The form is displayed on a mobile device screen with a black navigation bar at the bottom.

This page is developed for the users. New users can be registered to the application with valid user details by using this page.

A screenshot of a mobile application's "Pass QR Code" screen. The screen has a blue header with the text "Bus Pass C" and a blue bar with the text "Pass QR Code". Below this, there are two labels: "ID" and "To Date". A blue button labeled "Generate QR Code" is positioned below these labels. At the bottom of the screen, a large QR code is displayed. The screen is shown on a mobile device with a black navigation bar at the bottom.

This page is used to show generated QR code.

VII. CONCLUSION

The Smart Pass Secure Transit System offers a complete and cutting-edge way to convert conventional bus pass operations into a safe, digital, and easy-to-use procedure. The solution improves operational efficiency for administrators, commuter convenience, and driver functioning by simplifying the complete lifecycle, from issuance and distribution to real-time validation and fraud detection. The platform guarantees smooth and safe travel with features like sophisticated fraud monitoring, one-time driver login, and QR code scanning. In addition to lowering human labor, this integrated, contactless transit system enhances public transportation's security and transparency, making commuting in cities like Bengaluru more dependable and effective.

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