Digitalizing the tickets and Crowd Management at Public Bus Stands

A PROJECT REPORT

Submitted by,

Ms. Parinitha M	**20211CSE0271**
Ms. Chandana S	**20211CSE0268**
Ms. Nethra K	**20211CSE0334**
Ms. Yukthi V	**20211CSE0272**

Under the guidance of,

Dr. Ramesh Sengodan

in partial fulfillment for the award of the degree

of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

At

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY

BENGALURU

DECEMBER 2024

PRESIDENCY UNIVERSITY

SCHOOL OF COMPUTER SCIENCE ENGINEERING

CERTIFICATE

This is to certify that the Project report "**Digitalizing the tickets and Crowd Management at Public Bus Stands**" being submitted by Parinitha M, Chandana S, Nethra K, and Yukthi V bearing roll number(s) 20211CSE0271, 20211CSE0268, 20211CSE0334, and 20211CSE0272 in partial fulfillment of the requirement for the award of the degree of Bachelor of Technology in Computer Science and Engineering is a Bonafide work carried out under my supervision.

16/1/25

Dr. Ramesh Sengodan
Professor
School of CSE&IS
Presidency University

Dr. Asif Mohamed H B
Professor & HoD
School of CSE&IS
Presidency University

Dr. L. SHAKKEERA
Associate Dean
School of CSE
Presidency University

Dr. MYDHILI NAIR
Associate Dean
School of CSE
Presidency University

Dr. SAMEERUDDIN KHAN
Pro-Vc School of Engineering
Dean -School of CSE&IS
Presidency University

PRESIDENCY UNIVERSITY

SCHOOL OF COMPUTER SCIENCE ENGINEERING

DECLARATION

We hereby declare that the work, which is being presented in the project report entitled **Digitalizing the tickets and Crowd Management at Public Bus Stands** in partial fulfillment for the award of Degree of **Bachelor of Technology** in **Computer Science and Engineering,** is a record of our own investigations carried under the guidance of **Dr. Ramesh Sengodan, Professor, School of Computer Science Engineering & Information Science, Presidency University, Bengaluru.**

We have not submitted the matter presented in this report anywhere for the award of any other Degree.

Parinitha M	20211CSE0271	Parinitha M
Chandana S	20211CSE0268	Candana S
Nethra K	20211CSE0334	Nethra K
Yukthi V	20211CSE0272	Yukthi V.

ABSTRACT

This project aims to enhance the efficiency of public transportation systems by developing an Android application which is based on digitalization of the ticketing system and crowd management at the bus stand that improves the efficiency of the public transport system. In this application, user-driver-admin are the three layers, with separate interfaces. It enables users to interact well, drivers to drive smoothly, and administrators to manage resources properly.

The user can book the ticket, trace the exact position of the bus in real time using Firebase, even upload images of bus stands for crowd density analysis. Driver's interface allows the option for location sharing in real time and scanning of ticket for safe and quick entry. Admin interface controls drivers' credentials and also handling alerts on crowd management.

The implemented application features an integrated "Crowd Detection System", using Flask coupled with YOLOv8 for object detection. Every picture uploaded by users is supposed to get processed to account for people inside it by sending an alert to the admins on any detection in cases of overpopulation. Pretty modular in its crowd monitoring way, public safety, resource allocations, among other uses. The project, therefore, using a scalable solution to modernize the public transportation infrastructure of convenience for safety among all stakeholders, seeks to make the ticketing process less cumbersome, maintain real-time tracking, and allow for proactive crowd management.

ACKNOWLEDGEMENT

First of all, we indebted to the **GOD ALMIGHTY** for giving me an opportunity to excel in our efforts to complete this project on time.

We express our sincere thanks to our respected dean **Dr. Md. Sameeruddin Khan**, Pro-VC, School of Engineering and Dean, School of Computer Science Engineering & Information Science, Presidency University for getting us permission to undergo the project.

We express our heartfelt gratitude to our beloved Associate Deans **Dr. Shakkeera L and Dr. Mydhili Nair,** School of Computer Science Engineering & Information Science, Presidency University, and **Dr. Asif Mohamed H B**, Head of the Department, School of Computer Science Engineering & Information Science, Presidency University, for rendering timely help in completing this project successfully.

We are greatly indebted to our guide **Dr. Ramesh Sengodan, Professor** and Reviewer **Dr. Pamela Vinitha Eric, Professor**, School of Computer Science Engineering & Information Science, Presidency University for his inspirational guidance, and valuable suggestions and for providing us a chance to express our technical capabilities in every respect for the completion of the project work.

We would like to convey our gratitude and heartfelt thanks to the PIP2001 Capstone Project Coordinators **Dr. Sampath A K, Dr. Abdul Khadar A and Mr. Md Zia Ur Rahman,** department Project Coordinators **Amarnath J L** and Git hub coordinator **Mr. Muthuraj.**

We thank our family and friends for the strong support and inspiration they have provided us in bringing out this project.

Parinitha M

Chandana S

Nethra K

Yukthi V

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS

CHAPTER-1
INTRODUCTION

Digitization in ticketing and efficient crowd-managing systems are a few of the steps needed to improve the ecosystem of public transportation. There is a need for innovations that take convenience to passengers, address overcrowding challenges, avoid fraudulent ticket sales, and smooth operations. Digital solutions offer an opportunity to the authorities to ensure a safe, swift, and efficient commute without wastage of resources. Such technology is important in building smart cities and ensuring seamless urban mobility.

1.1 Digital Ticketing Systems

Digital ticketing introduces a sea-change in how passengers will interact with public transportation. From traditional paper tickets to their digital form, everything gets simplified for speed, efficiency, and environmental friendliness.

1.1.1 Mobile and Online Ticketing Platforms

The main reason for such a change is the introduction of mobile and online ticketing platforms. These platforms have enabled passengers to conveniently book tickets from any part of the country using either their smartphones or computers. Some of the key features contributing to this include:

- Real Time Bus Tracking: Thus, through this app, a traveling customer could track the precise location of buses in real time for better planning with reduced wait times.
- Integrated payment gateways: Multiple payment methods such as UPI, credit/debit cards, and digital wallets ensure hassle-free transactions.

- Digital tickets and QR codes: The system generates a digital ticket that can be scanned at the point of entry; its validity is immediately checked without human intervention.

1.2 Smart Technology for Crowd Management

Efficient crowd management also becomes very important during hours of rush or festivals as it helps in the smoothening and safe passage of passengers going to and from bus stands.

1.2.1 YOLOv8 for Crowd Analytics

Crowd management is enhanced by leveraging pre-defined Python models, in particular YOLOv8, to provide real-time insight into:

- Monitoring of Crowd Density: YOLOv8 counts the number of people in an image clicked from cameras installed at the bus stand. In case the crowd is above the maximum limit, it sends an alert to the administrators to take action without wasting any time.
- Integration of Flask and YOLOv8: The given code snippet allows the Flask framework to act as the API backend while using the YOLOv8 object detection algorithm on user-uploaded pictures to depict how many people have come to the bus stand. It will send on alerts when any overcrowding occurs and enables administrators to take timely action.

CHAPTER-2

LITERATURE SURVEY

1.1 Literature Survey table

Papers	Advantages	Disadvantages
1. M. Bieler, A. Skretting, P. Büdinger and T. -M. Grønli, "Survey of Automated Fare Collection Solutions in Public Transportation," in IEEE Transactions on Intelligent Transportation Systems, vol. 23, no. 9, pp. 14248-14266, Sept. 2022, doi: 10.1109/TITS.2022.3161606.	• Reduces inefficiency by automating fare collection. • Machine learning increases decision-making and customer insight.	• Expensive implementation cost for the advanced systems. • Reliance on reliable infrastructures and technologies.
2. S. Sankarananrayanan and P. Hamilton, "Mobile enabled bus tracking and ticketing system," ***2014 2nd International Conference on Information and Communication Technology (ICoICT),*** **Bandung, Indonesia, 2014, pp. 475-480, doi: 10.1109/ICoICT.2014.6914108.**	Real-time Bus tracking enhances passenger convenience. • Alerts improve travel planning and ticket management.	• Dependent on the accuracy of GPS and RFID. • Continuously dependent on Internet and the device.
3. Sundaramoorthy, Revathy, Yamuna Ilango, and Ananth Kumar Tamilarasan. "Smart bus passengers' information and safety management system." ***International Journal of Pure and Applied***	• Monitors the safety of the passengers. • Gives updates in real time about the bus routes and schedules.	• It is a bit difficult to integrate into the existing systems. • There may be privacy issues due to the collection of vast amounts of data.

***Mathematics* 119.14 (2018): 795-800.**		
4. Fantin Irudaya Raj, E., and M. Appadurai. "Internet of things-based smart transportation system for smart cities." *Intelligent Systems for Social Good: Theory and Practice*. Singapore: Springer Nature Singapore, 2022. 39-50.	• Real-Time Information for passengers to check bus crowd levels and arrival times, enabling informed travel decisions. • The app saves passengers from the frustration of overcrowded buses and helps them locate the nearest bus stop for easy traveling	• The system requires passengers to have smartphones and reliable internet access. • The efficiency of the system depends on the real-time accuracy of bus tracking and crowd information.
5. Nguyen, Nguyen Phong, and Emmanuel Mogaji. "Information technology for enhancing transportation in developing countries." *Management and information technology in the digital era: Challenges and perspectives*. Emerald Publishing Limited, 2022. 81-94.	• With the adoption of IT, routes can be optimized, and congestion reduced, meaning that transport efficiency is enhanced. • New business models and job opportunities can be created through innovation by tech developers and start-ups.	• Inadequate infrastructure could hinder the proper use of transportation technologies. • A digital divide could prevent some populations from enjoying the benefits since there is limited access to technology.
6. Jevinger, Åse, and Jan A. Persson. "Information-based disturbance management for public transport." *Project report* 1 (2016).	• Public transport reduces pollution, congestion, and road wear and promotes sustainability. • Real-time coordination reduces delays and disruptions.	• Disruptions can propagate across transport modes, thus increasing delays. • Lousy information sharing leads to confusion and uncertainty among travellers.
7. Keller, Christine, et al. "Understanding the usefulness	• Tailor-made in-real-time information makes them	• Effective adaptivity, technologies require a much

and acceptance of adaptivity in smart public transport." ***HCI in Mobility, Transport, and Automotive Systems: First International Conference, MobiTAS 2019, Held as Part of the 21st HCI International Conference, HCII 2019, Orlando, FL, USA, July 26-31, 2019, Proceedings 21*****. Springer International Publishing, 2019.**	comfortable • Acceptance rates increase as people enjoy them more	stronger installation infrastructure. • Proper adaptivity is integrated to handle passenger psychology, inappropriate adaptation may make information look overcrowding.
8. Baldauf, Matthias, and Martin Tomitsch. "Pervasive displays for public transport: an overview of ubiquitous interactive passenger services." ***Proceedings of the 9TH ACM international symposium on pervasive displays*****. 2020.**	• Digital services make routing easier, ticketing more effective, and intermodal transport easier to manage. • Personalized and trustful services will be the focus of future research.	• Social and interactional aspects are not advanced. • Issues of privacy and reliability limit full usage.
9. Kaushik, Varun, and P. Suhas. "Fool Proof ticketing System for public transport." ***2018 3rd International Conference on Communication and Electronics Systems (ICCES)*****. IEEE, 2018.**	• RFID systems are affordable and reliable for automation. • Two-way authentication deters ticketless travel.	• Delays in passenger authentication can cause inefficiencies. • Major upgrades may face resistance from users.
10. Kočárková, Dagmar, Vojtěch Novotný, and Jana Jíšová. "Design of public transport stops and stations	• Well-designed stops boost usage and urban mobility.	• Inclusive designs are expensive and cumbersome in dense areas. • High-traffic stops need

and its contribution to attractive and accessible public transport." ***2019 Smart City Symposium Prague (SCSP)*****. IEEE, 2019.**	• It beautifies public spaces, attracting foot traffic and inclusion.	continuous upkeep and safety measures.

CHAPTER-3

RESEARCH GAPS OF EXISTING METHODS

1. Poor Integration of Systems

Fragmented Systems: Most of the bus ticketing and crowd management systems presently lack real-time integration. Many of these systems do not combine the facets of ticketing, crowd monitoring, and tracking of buses in an integrated manner and hence are ridden with operational inefficiencies.

Poor Interoperability: The traditional systems do not support smooth integration with other modes of public transport, like metro or rail. This acts as a barrier to smooth multi-modal travel for passengers and makes it cumbersome for them.

2. Inability to Leverage Real-Time Data

Crowd Prediction: Most of the existing systems do not use real-time data or advanced analytics to predict crowd surges or demand fluctuations at bus stands, leading to inefficient crowd management.

Dynamic Pricing: Few have integrated dynamic pricing, whereby the price of tickets would vary with demand for the service. This could imply better optimization of resources and crowd balancing.

3. Insufficient use of advanced technologies

YOLOv8 Object Detection: Previous systems lack utilizing fully advanced techniques like YOLOv8 in Object Detection while monitoring the Crowd and hence will fail when detecting crowd density with good-enough accuracy to avoid a state of overpopulation.

4. Privacy and Security Issues

Data Protection: Most of the existing systems do not have mechanisms in order to handle passenger data in a privy manner, or to comply with requirements of regulations such as GDPR.

Cybersecurity Risks: There are so many vulnerabilities in traditional ticketing systems that could expose them to fraud, data leakage, or unauthorized access and thus damage the security of passengers and operators.

5. Limitations in UX

Limited: At best, there are limited feedback mechanisms provided by current systems for passengers to identify any issues or provide the needful feedback in real time, which hinders operators in a timely manner from catering to the concerns.

6. Focus on narrow or limited sustainability

Environmental Impact: Most of the traditional systems are still dependent on paper-based ticketing, which is very contributing to waste. We try to reduce the usage of paper by providing a digital ticket instead of a physical one in our solution.

Energy Efficiency: Most of the systems already deployed have not considered energy efficiency in hardware or infrastructure. In our solution, shifting toward more sustainable, highly energy-efficient technologies will be strived for.

7. Lack of Data Analytics

Insight Generation: Most of the traditional systems lack the utilization of collected data to generate insights that could be used in optimizing the routes, schedules, and resources of buses. Our system will collect data about crowd density and bus schedules for improving the efficiency of operations.

Passenger Behavioral Analysis: Most of the current systems are at a low level of analytics in terms of tracking passenger behavior with respect to the most crowded times of travel, among others, that may enhance service and passenger experience.

8. Resistance to Adoption

Stakeholder Resistance: Most traditional bus operators resist this shift to digital solutions due to perceived costs, technical complexity, or resistance to new technologies. Our system allays these fears through a user-friendly interface and long-term operational benefits.

Gaps in Policy: Absence of regulatory frameworks or incentives for digitization in public transport systems normally acts as a barrier to adoption. Our project would seek to work with the authorities to advocate the benefits of digital ticketing and crowd management systems.

CHAPTER-4
PROPOSED METHODOLOGY

4.1. User Interface

Ticket Booking: Tickets are easily booked directly through an application.

Real-time Location Access: Firebase can be used to share location data for the tracking of the buses.

Crowd Management Feedback: The user can upload the image of the bus stand through the application. The uploaded image is processed at the backend using Flask, which will give the number of persons present in that particular picture. It then calculates crowd density; in case of an overcrowded bus stand, a message will be sent to the admin about the issue.

4.2. Driver Interface

Location Sharing: Drivers will be able to share their location in real time with the help of Firebase so that the users can track buses with much more efficiency.

Ticket Scanning: Drivers can scan tickets to verify that all passengers board in a very safe and efficient manner.

4.3. Admin Interface

Driver Management: An administrator will be able to manage credentials of drivers so that the proper personnel operate buses.

Crowd Management Actions: There are messages received by administrators about crowd density, through which they take necessary actions concerning any situation of overcrowding.

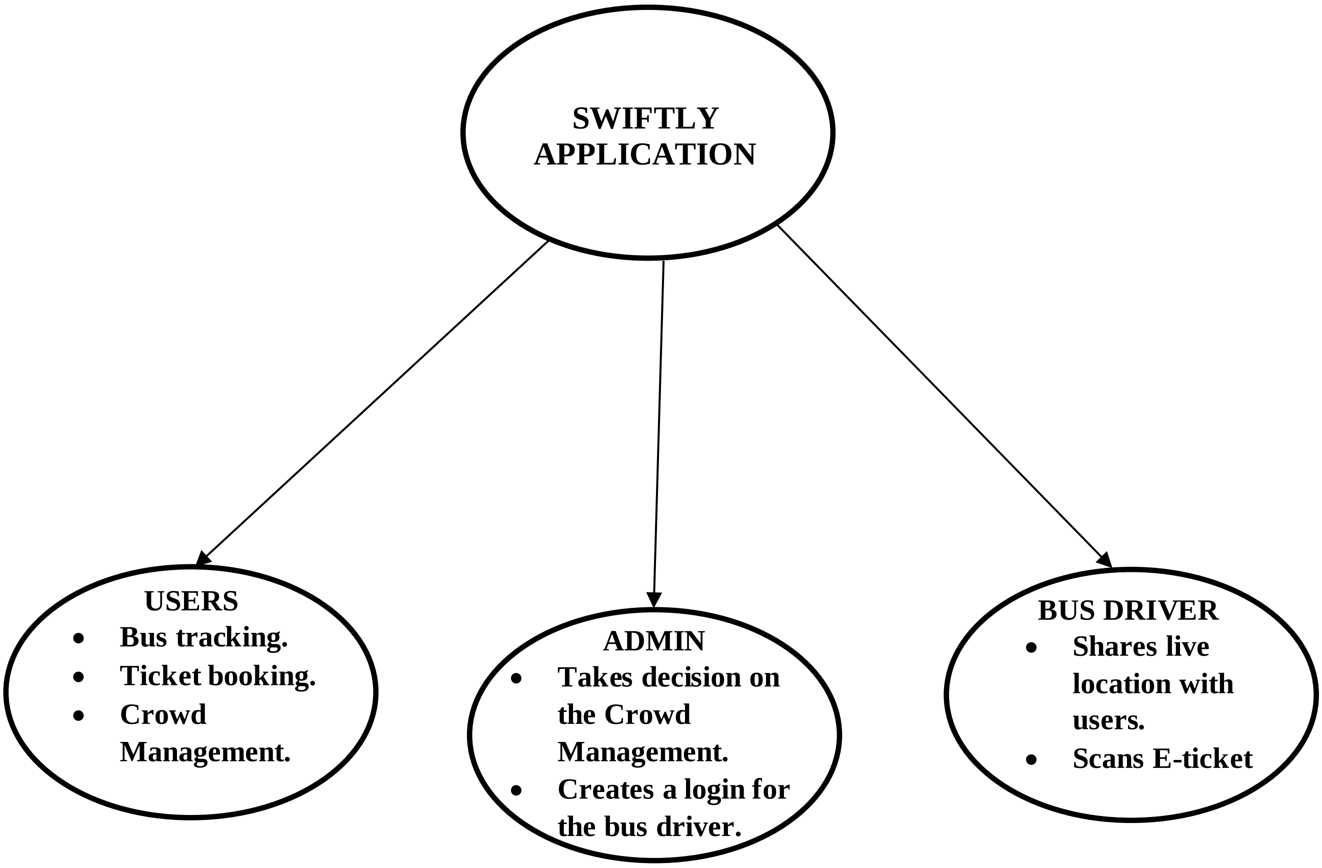


Figure 1.1 Proposed Methodology

CHAPTER-5
OBJECTIVES

• **Enhance passenger convenience:** With a mobile app, ticket buying becomes easier and real-time updates mean that passengers can plan their travel efficiently using their phones, reducing waiting time and improving the comfort of the whole travel.

• **Reduce operational costs:** With electronic ticketing, there's no need to print those paper tickets and maintain ticket booths, hence saving transport authorities money on material as well as manpower.

• **Real-time data and insights:** The app can provide transport operators with real-time analytics on bus capacity and passenger loads, enabling better decision-making and dynamic scheduling to optimize service.

• **Enable contactless and secure transactions:** Passengers can use mobile payments, QR codes, or digital wallets. This assures fully secure, contactless transactions that minimize the fraud risk and increase convenience.

• **Improve crowd management and safety:** With real-time crowd data, both the passengers and the operators can make informed decisions regarding bus stop congestion and load size, thus improving crowd control and safety as well through non-overcrowding buses or stations.

• **Support sustainability and eco-friendly practices:** With digital ticketing, paper-based tickets in transportation will be eradicated and less paper usage will be required for the premises of physical ticket booths.

• **Implement seamless, paperless ticketing:** With an all-inclusive online system, passengers will be able to buy and validate tickets from their phones, removing the paper requirements and quickening the speed of boardings.

• **Enhance sustainability with digital-only solutions:** Transitioning to a digital-only solution cuts down on paper use and lowers the environmental impact of public transport operations, therefore making city infrastructure more sustainable.

CHAPTER-6

SYSTEM DESIGN & IMPLEMENTATION

6.1 System Architecture Overview:

It can be divided into three major parts: the mobile client, the back-end infrastructure, and the external APIs.

6.1.1 Mobile Client (Android Application):

- Android Studio: The application is developed in Android Studio - the IDE for native Android application development, focusing on e-ticketing, bus tracking, and crowd management.
- Google Maps: This is integrated into the application to track the bus's exact position in real-time over an interactive map, with the purpose of live bus tracking. It will help in planning the journey of the passengers.
- Firebase: real-time storage and communication agent for mobile apps and their interaction with the back-end; essential data stored is in regards to user profiles, bookings, bus schedules, and people count analysis.

6.1.2 Back-End: Firebase Database and Cloud Functions:

- Firebase Realtime Database: The data, such as bus schedules, user information, ticket information, and crowd data, is stored in real time in the database. It allows for the smooth retrieval and updating of data.
- Firebase Authentication: It takes care of user registration and login securely, handles authentication, and provides safe user access to the app.
- Cloud functions by Firebase: This handles server-side logics- ticket booking, data maintenance concerning the crowd, sending alerts upon congestion at a place.

6.1.3 External APIs:

- Payment Gateway: Integrated for e-ticket payment processing, utilizing platforms like Stripe, PayPal, or custom solutions to allow secure payments for ticket reservations.
- Google Maps API: Provides real-time bus location tracking, plotting of the route of buses, and showing locations to the users. The integration would ensure that in your application, passengers can tell where the buses are any instant.

6.2 System Design Breakdown:

6.2.1 UI/UX Design:

The interface of the app is designed in such a way that it is user-friendly, focusing on usability and intuitive navigation to make interaction easy for the users.

- Login/Sign-up: It gives users the option to log in or sign up via email, phone number, or social media accounts.
- Home Screen: This displays the list of available buses, schedules, and options for booking tickets for easy comprehension by the users.
- Book Ticket: This would allow a user to select the schedule of a bus, provide the number of passengers, and make payments for tickets.
- Live Bus Tracking: This involves real-time location tracking of a bus on Google Maps, thereby enabling users to keep track and decide accordingly.
- Crowd Management: Integrates real-time data of crowd density at bus stands and includes waiting time and bus capacity for users to avoid crowded areas.
- Confirm the ticket: After booking the ticket, a confirmation screen will appear in front of the users, showing them the details of their ticket, along with the QR code for embarkation.

6.2.2 Core Features & Modules:

Phase 1: User Registration and Authentication

- Firebase Authentication: This handles user sign-in and sign-up securely.

- Database: This will store user's profile and authentication details using Firebase.

- Token Management: Ensures security in communication and session management.

Phase 2: E-ticketing and Payments:

- Reservation Ticket: Allow the user to book their tickets with chosen schedules and pay the purchase price by using embedded payments via Stripe/PAY PAL and creating a unique QR code upon validation.

- Database: In charge of storing information about the users and tickets, then connecting the tickets to users using the Firebase Realtime Database.

Phase 3: Bus Tracking and Crowds Management

- Bus Location Tracking: The buses periodically send updates regarding their locations to Firebase so that their locations can be shown in real time through the application.

- Crowd Management: Analyze the density of the crowd through YOLOv8-processed images uploaded by users. It can flag certain conditions of overcrowding that may require administrative interventions.

6.3 Firebase for Back-End Development:

6.3.1 Cloud Functions:

- Booking Logic: This deals with a case wherein a user books a ticket. Hence, Firebase Cloud Functions validates the payment, generate tickets, and store data in the database.

- Bus Location Updates: Periodical location updates sent by the buses are processed through Firebase Cloud Functions and pushed to the app in real time.

- Crowd Analytics: Processing of crowd data from sensors or uploaded images via cloud functions to compute the crowd density at bus stands. These systems will send alerts automatically if overcrowding is observed and intimate the administrators on this.

6.4 Testing and Deployment:

6.4.1 Testing:

- Unit Testing: Individual components like authentication, ticket booking, and crowd management will be tested to ensure each function works independently.

- Integration Testing: This is the testing for the integration of Firebase with a payment gateway and with Google Maps to ensure that the modules interact well.

- User Acceptance Testing (UAT): This ensures the application is usable and meets user requirements in a real-world environment. It provides feedback that helps in resolving usability issues.

- Stress Testing: Tests the high load capability of the back-end; simulates peak usage times to assure scalability and robustness within the system.

6.4.2 Deployment:

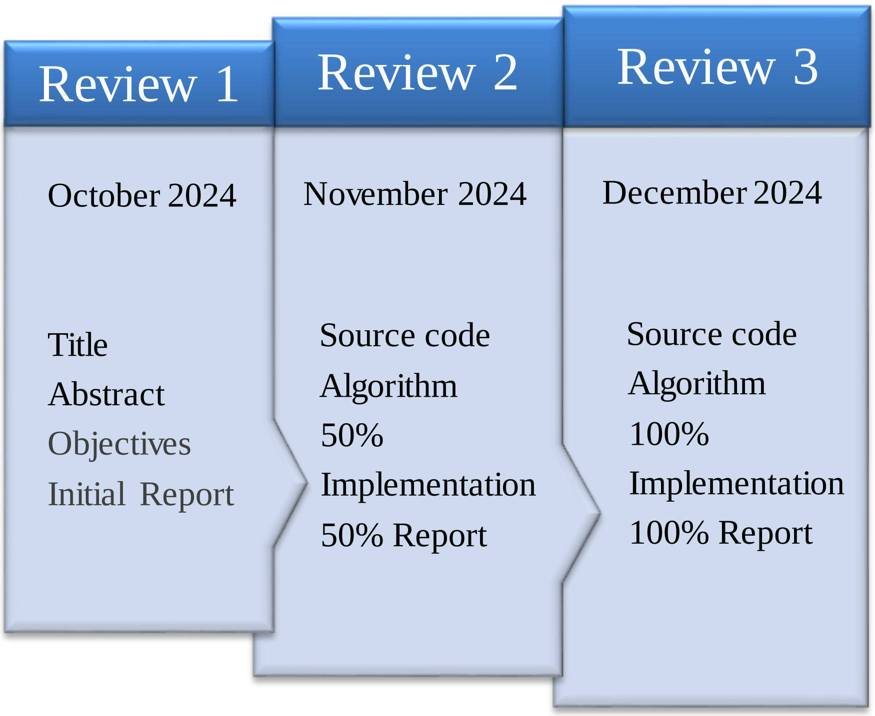
- Admin Dashboard: The admin dashboard will be hosted on Firebase Hosting, allowing administrators to monitor the system and manage data related to crowd management, bus schedules, and tickets.

- Android Application Deployment: After rigorous testing, the application will be on the Google Play Store where it will be available to download for any user.

CHAPTER-7

TIMELINE FOR EXECUTION OF PROJECT

(GANTT CHART)



CHAPTER-8
OUTCOMES

• **Reduced wait times:** Digital ticketing speeds up the boarding process by allowing passengers to purchase and validate tickets via a mobile app, minimizing the time spent in lines.

• **Real-time information:** The app provides live updates on bus schedules, delays, and passenger loads, helping users make informed travel decisions and avoid unnecessary waiting.

• **Dynamic bus scheduling:** Transport operators can update their bus schedules dynamically with real-time data on passenger demand so that buses are dispatched more efficiently.

• **Cashless transactions:** Mobile payments increase the speed, security, and convenience of transactions for both passengers and operators as cash is eliminated.

• **Better crowd distribution:** Mobile payments increase the speed, security, and convenience of transactions for both passengers and operators as cash is eliminated.

• **Lower maintenance and staffing costs:** Mobile payments increase the speed, security, and convenience of transactions for both passengers and operators as cash is eliminated.

• **Smart city integration:** The system can interoperate with larger smart city infrastructure to better coordinate with services such as traffic management and urban planning.

• **Increased passenger satisfaction:** Passengers feel smoother tickets, get real-time updates, and experience smooth crowd management while commuting, thereby enhancing their satisfaction of the ride.

CHAPTER-9

RESULTS AND DISCUSSIONS

1. Increased Operational Efficiency

Results:

Digital ticketing systems significantly reduce the time spent on manual ticket issuance. Passengers can book their tickets through mobile applications or kiosks, minimizing queues at ticket counters. Automation helps streamline boarding and reduces human error.

Discussion:

The reduced reliance on manual processes enables faster turnarounds for buses, improving overall efficiency. This also allows staff to focus on other critical tasks such as addressing passenger queries or ensuring safety protocols. Advanced QR-code scanners can further speed up entry by eliminating the need for physical ticket checks.

2. Enhanced User Experience

Results:

Passengers report higher satisfaction levels due to the convenience of digital payment methods and real-time access to bus schedules. Features like online ticket cancellations and refunds make the service more user-friendly.

Discussion:

The shift from traditional ticketing to digital platforms aligns with evolving consumer preferences. Mobile apps with crowd prediction features allow users to plan their journeys better, avoiding rush hours. This proactive approach enhances passenger comfort and trust in public transportation systems.

3. Effective Crowd Management

Results:

Crowd prediction algorithms analyze real-time data from sensors, ticketing records, and historical travel patterns. This data helps authorities anticipate peak times and deploy additional buses or staff to manage surges.

Discussion:

Integrating python inbuilt model provides accurate data for crowd monitoring. Real-time updates via mobile apps or digital displays inform passengers about crowded bus stands, reducing congestion and improving safety. Additionally, controlled boarding through digital tokens or QR codes ensures orderly management.

4. Environmental Impact

Results:

Eliminating paper tickets leads to a significant reduction in paper waste. The use of digital systems also encourages eco-friendly practices among passengers.

Discussion:

This initiative supports sustainability goals by minimizing the environmental footprint of transportation systems. Long-term adoption of digital systems contributes to cleaner and greener operations, making public transit a more sustainable option.

5. Challenges and Limitations

Results:

Some challenges include the need for robust internet connectivity, user adaptability, and initial costs of infrastructure setup. Not all passengers may be tech-savvy or own smartphones, which could create accessibility issues.

Discussion:

To address these challenges, hybrid systems offering both digital and manual ticketing options can ensure inclusivity. Conducting awareness programs and training sessions can help passengers adapt to the new system. Additionally, governments can provide subsidies or partnerships to manage high initial costs.

6. Data Security and Privacy

Results:

Digital ticketing systems collect sensitive data such as personal information and payment details. Ensuring this data's security is critical to maintaining user trust.

Discussion:

Deploying secure encryption protocols and regular audits can mitigate data breaches. Implementing anonymization techniques for crowd prediction data ensures compliance with privacy regulations while still providing actionable insights.

7. Economic Impact

Results:

The initial investment in infrastructure and technology creates short-term expenses, but over time, digital ticketing reduces operational costs. Savings arise from lower labor costs, reduced printing needs, and optimized resource allocation.

Discussion:

The economic viability of digitalization depends on passenger adoption rates and efficient system maintenance. Public-private partnerships can accelerate technology adoption and share financial burdens.

8. Long-Term Scalability

Results:

Once established, digital ticketing systems can be expanded to include additional services such as multi-modal transport integration, loyalty programs, or route optimization.

Discussion:

The scalability of these systems makes them future-proof. For example, integrating metro, rail, and bus ticketing into a unified platform can simplify travel and encourage public transit usage, reducing traffic congestion and pollution.

CHAPTER-10
CONCLUSION

In conclusion, this project depicts modern technology resizing the face of public transports by integrating digital ticketing for real-time tracking of their buses and efficiently managed masses. The project offers to provide a unified solution of the main issues-public transport faces including over-occupation, inefficiency, as well as lack of real-time integrations, by taking android studio, Firebase, or advanced object detection on YOLOv8.

It provides digitalization in ticketing to enhance passenger convenience with seamless, paperless transactions, along with operational efficiency for the transit authorities. It will also provide passengers with real-time bus tracking updates about their journey and lessen waiting and uncertainty. Driven by YOLOv8, this crowd management system analyzes the crowd density for its timely alerts to enhance utilization of resources for public safety in peak hours.

sA large part of the project's solution uses scalable and sustainable integrations of these components, whose adaptation is able to apply to various means of transport-from buses up to metro networks-contributing to building smart cities. The project really will be able to contribute immensely to the transformation of urban mobility in the future in terms of streamlining, decreasing environmental impact, and making passengers' lives easier. This system is a whole new concept for the future of public transportation, making this latter more efficient, safer, and user-friendly. With cities continuing to expand and demands on urban mobility, such solutions will be key players in creating transportation systems that are technologically advanced, responsive to passenger and operator needs, and sensitive to environmental concerns.

REFERENCES

- M. Bieler, A. Skretting, P. Büdinger and T. -M. Grønli, "Survey of Automated Fare Collection Solutions in Public Transportation," in IEEE Transactions on Intelligent Transportation Systems, vol. 23, no. 9, pp. 14248-14266, Sept. 2022, doi: 10.1109/TITS.2022.3161606.
- S. Sankarananrayanan and P. Hamilton, "Mobile enabled bus tracking and ticketing system," *2014 2nd International Conference on Information and Communication Technology (ICoICT)*, Bandung, Indonesia, 2014, pp. 475-480, doi: 10.1109/ICoICT.2014.6914108.
- Sundaramoorthy, Revathy, Yamuna Ilango, and Ananth Kumar Tamilarasan. "Smart bus passengers information and safety management system." *International Journal of Pure and Applied Mathematics* 119.14 (2018): 795-800
- Fantin Irudaya Raj, E., and M. Appadurai. "Internet of things-based smart transportation system for smart cities." *Intelligent Systems for Social Good: Theory and Practice*. Singapore: Springer Nature Singapore, 2022. 39-50.
- Nguyen, Nguyen Phong, and Emmanuel Mogaji. "Information technology for enhancing transportation in developing countries." *Management and information technology in the digital era: Challenges and perspectives*. Emerald Publishing Limited, 2022. 81-94.
- Jevinger, Åse, and Jan A. Persson. "Information-based disturbance management for public transport." *Project report* 1 (2016).
- Keller, Christine, et al. "Understanding the usefulness and acceptance of adaptivity in smart public transport." *HCI in Mobility, Transport, and Automotive Systems: First International Conference, MobiTAS 2019, Held as Part of the 21st HCI International Conference, HCII 2019,*

Orlando, FL, USA, July 26-31, 2019, Proceedings 21. Springer International Publishing, 2019.

- Baldauf, Matthias, and Martin Tomitsch. "Pervasive displays for public transport: an overview of ubiquitous interactive passenger services." *Proceedings of the 9TH ACM international symposium on pervasive displays*. 2020.
- Kaushik, Varun, and P. Suhas. "Fool Proof ticketing System for public transport." *2018 3rd International Conference on Communication and Electronics Systems (ICCES)*. IEEE, 2018.
- Kočárková, Dagmar, Vojtěch Novotný, and Jana Jíšová. "Design of public transport stops and stations and its contribution to attractive and accessible public transport." *2019 Smart City Symposium Prague (SCSP)*. IEEE, 2019.

APPENDIX-A
PSUEDOCODE

Algorithm for Sharing and Accessing Location:

1. Initialization

- Integrate Firebase and Google Maps API into the Android project.
- Add the dependencies for ‘FusedLocationProviderClient’ and Google Play Services.

2. Permission Management

- Check and request runtime permissions ‘ACCESS_FINE_LOCATION’ and ‘ACCESS_COARSE_LOCATION’.
- Handle the permission results for proper access.

3. Get User's Location

- Initialize the ‘FusedLocationProviderClient’ for device location access.
- Use ‘getLastLocation()’ for the most recent location or ‘requestLocationUpdates()’ for continuous tracking.
- Implement a ‘LocationCallback’ to handle updates; process the ‘Location’ object for latitude and longitude.

4. Location sharing

- Save fetched location (latitude, longitude) to Firebase Realtime Database under a unique user ID.
- Include timestamps, to track changes.

5. Accessing Shared Locations

- Use Firebase's ‘ValueEventListener’ to read and listen for location changes in real time.

- Get the data with the particular user ID to get their shared location.

6. Display on Map

- Load Google Maps through ‘OnMapReadyCallback’ in the application.

Add markers for the user and shared locations using ‘mMap.addMarker()’.

7. Error-handling

- Error handling for location fetch, for example, unavailability of GPS or network.
- Handle Firebase ‘DatabaseError’ objects during reads and writes.

8. Enhancements

- Add geofencing for location-based alerts.
- Ability for the user to share links to location with external messaging applications or via QR codes.

Pseudocode for Sharing and Accessing Location:

Driver Side:

```
START

DEFINE constants (MIN_TIME, MIN_DIST)

FUNCTION onCreate():
   REQUEST location permissions
   INITIALIZE map fragment
   GET "driverId" from Intent
   INITIALIZE Firebase database reference

   SET listeners for shareButton, stopSharingButton, logoutButton, and scannerButton

FUNCTION shareCurrentLocation():
   CHECK permissions
```

```
   IF granted, REQUEST location updates
   GET last known location
   IF valid, UPDATE Firebase and MAP with location
   ELSE, SHOW error message

FUNCTION stopSharingLocation():
   REMOVE Firebase location data

FUNCTION logout():
   SIGN OUT and NAVIGATE to login activity

FUNCTION onMapReady(map):
   INITIALIZE LocationListener to get and update location
   REQUEST location updates
END
```

User Side:

```
START

DEFINE constants (REFRESH_INTERVAL)
DECLARE mMap, databaseReference, handler, locationUpdateRunnable

FUNCTION onCreate():
   INITIALIZE Firebase reference
   INITIALIZE map fragment
   SET handler and locationUpdateRunnable to fetch location at intervals

FUNCTION locationUpdateRunnable():
   CHECK permissions for location access
   IF permissions granted, FETCH location from Firebase
   UPDATE map with markers for all users' locations
   MOVE camera to first marker if not moved yet

FUNCTION fetchLocationFromDatabase():
   READ Firebase data and extract latitude and longitude
   CLEAR previous markers and add new ones to the map
   MOVE camera for the first marker only

FUNCTION requestForPermissions():
```

```
   REQUEST location permissions from the user

FUNCTION onMapReady(map):
   INITIALIZE Google Map and set location update runnable

FUNCTION showMarkerDetails(marker):
   SHOW dialog with marker info

FUNCTION onDestroy():
   REMOVE location update runnable
END
```

Algorithm for Bus Ticket generation:

1. Initialize Application

- Set up the UI elements, Firestore, and a QR code generator.
- Load fare details into some hashmap for efficient retrieval.

2. Setup UI Components

- Design spinners using dropdown menus for source and destination selections.

Add input fields for passenger count and amount, and a QR code image view.

3. Populate and Handle Location Selection

- Dynamically calculate fare based on source and destination selections.
- Fill in the amount field using the fare map for the updated fare.

4. User Input Validation

- Ensure source, destination, passenger count, and amount are not empty.

Logical validity check of entered values, e.g., Positive fare.

5. Initiate UPI Payment

-Create UPI payment intent by mentioning the amount and UPI ID.

- Launch the UPI payment interface to process the transaction.

6. Handle Payment Result

- Check if the payment status is successful or failed.
- Go ahead and generate a QR code when the payment has been confirmed.

7. Generating QR Code

- Preparation of ticket data is provided, including details like the Transaction ID, Route, Fare Details.
- Encode information about the ticket into a QR code and set it for the image view.

8. Save Ticket Data

- Store information about a ticket through Firestore, such as transaction ID and route.
- Record keeping for auditing purposes, analytics, or for the convenience of the user.

9. Handle Errors, Give Feedback

- Handle runtime exceptions like invalid inputs or payment failures.
- Provide meaningful messages to the user in case of errors.

10. Exit or Restart Application

- Allow users to create another ticket once they have finished.
- Provide an option to exit the application gracefully.

Pseudocode for Bus Ticket generation:

```
START

DEFINE constants (UPI_PAYMENT_REQUEST_CODE)
DECLARE sourceSpinner, destinationSpinner, passengerCountInput, amountInput, generateButton, qrCodeImage, fareMap, db

FUNCTION onCreate():
   INITIALIZE Firestore and fare map
   SET spinners and their listeners
   SET generateButton to trigger UPI payment

FUNCTION initializeFareMap():
   ADD predefined routes and fares to fareMap

FUNCTION onSourceDestinationSelected():
   GET selected source and destination, calculate fare and set amountInput

FUNCTION generateQRCode():
   VALIDATE inputs, calculate total amount, generate QR code with transaction ID

FUNCTION payUsingUpi():
   GET amount, validate it, create UPI URI, and open UPI intent

FUNCTION onActivityResult(requestCode, resultCode, data):
   IF payment successful, generate QR code, ELSE show failure message

FUNCTION toBitmap(bitMatrix):
   CONVERT BitMatrix to Bitmap for QR code

FUNCTION onDestroy():
   CLEANUP resources
END
```

Algorithm for Crowd Management:

1. Initialization Phase

- Load Dependencies:

Import libraries like Flask, Pillow, NumPy, YOLO, Flask-CORS, and pyngrok.

- Load YOLOv8 Model:

Initialize the YOLOv8 model for object detection using yolov8m.pt.

2. API Server Setup

- Initialize Flask Application:

Create a Flask application to serve API requests.

Enable CORS for Cross-Origin Resource Sharing.

- Expose Local Server:

Now, utilize pyngrok to publish the Flask server with a public URL to the internet.

3. Object Detection Workflow

- Upload Image:

The client sends a POST request to the /detect endpoint, with an image file included in the request body.

- Image Preprocessing:

Get the uploaded image from the request.

Convert the image to RGB format using Pillow.

Convert the image into a NumPy array so that it is YOLO-compatible.

- Run YOLO Detection:

Pass the preprocessed image to the YOLO model.

Extract the bounding boxes, class probabilities, and class IDs from the results in the detection.

- Filter for People:

Get the class ID of YOLO's class dictionary for a "person".

Filter the detections to include only the objects that have been classified as "person."

- Count People:

Sum the total number of detections over the "person" class.

4. Response Generation

- Prepare JSON Response:

Create a JSON containing:

People count: Number of people detected.

- Send Response:

Return the JSON response to the client.

5. Flask Routes

- Home Route (/):

Displays a welcome message for the API.

- Detection Route (/detect):

Accepts an image file via POST request and returns the number of people detected.

- Favicon Path (/favicon.ico):

Returns an empty response to handle unnecessary requests.

6. Execution Phase

- Run Flask Server:

Start the Flask server on port 5000.

- Access via ngrok:

Share the public URL provided by pyngrok for external API access.

Pseudocode for Crowd Management:

```
START

INITIALIZE Flask app
ENABLE CORS for cross-origin requests
LOAD YOLOv8 model ('yolov8m.pt')

DEFINE FUNCTION process_with_yolov8(image):
    Run YOLOv8 model on the input image
    GET detection results
    MAP detection class labels to their respective indices
    IDENTIFY 'person' class index
    FILTER detections to only include 'person' class
    COUNT the number of 'person' detections
    RETURN people_count

DEFINE ROUTE '/':
    RETURN "Welcome to the Crowd Detection API"

DEFINE ROUTE '/favicon.ico':
    RETURN HTTP 204 (No Content)

DEFINE ROUTE '/detect' with POST method:
    GET image file from request
    OPEN image and convert to RGB format
    CONVERT image to numpy array
    CALL process_with_yolov8 with image to get people_count
    RETURN JSON with people_count
```

START ngrok to expose the app to the public network and GET public URL

PRINT public URL for accessing the API

START Flask app with host '0.0.0.0' and port 5000

END

APPENDIX-B

SCREENSHOTS

2.1 User Interface

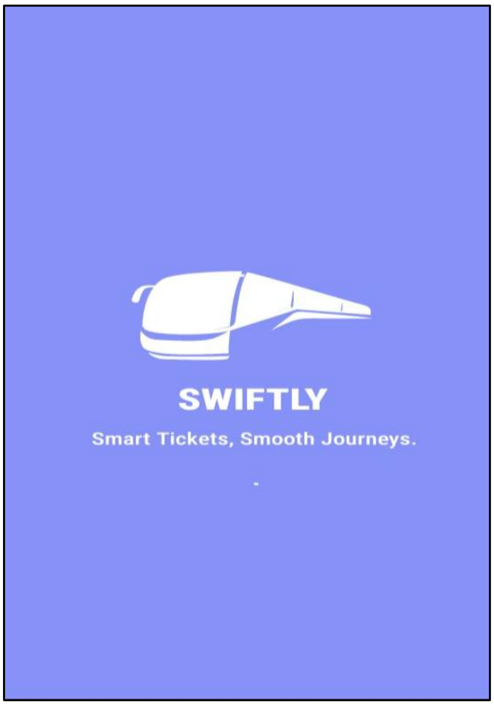


Figure 2.1.1 Splash Activity

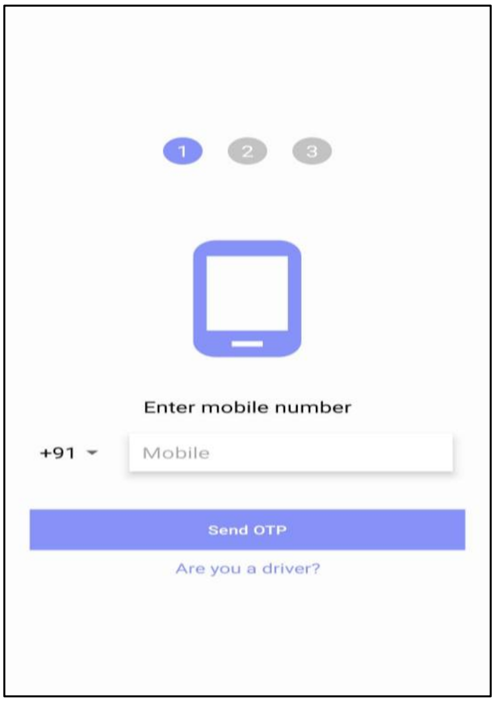


Figure 2.1.2 Enter Mobile number

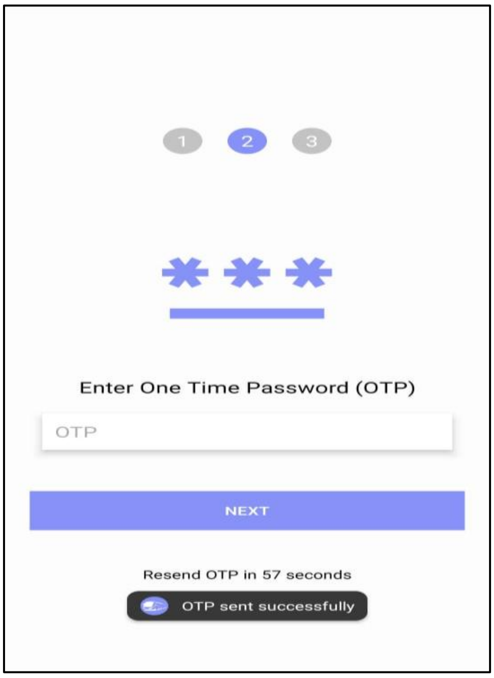


Figure 2.1.3 Enter OTP

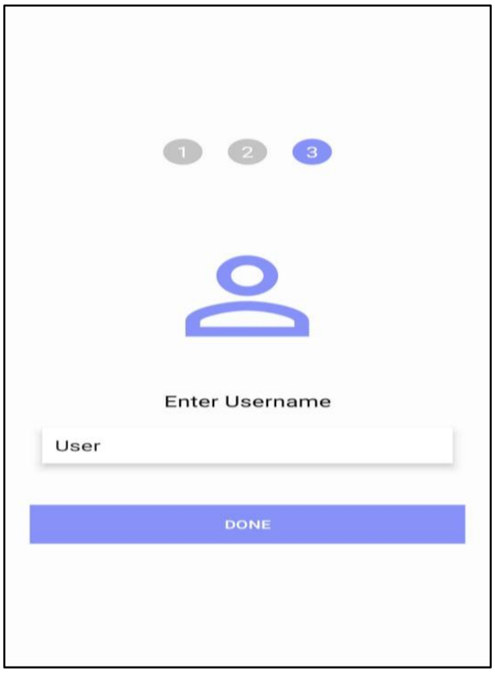


Figure 2.1.4 Enter Username

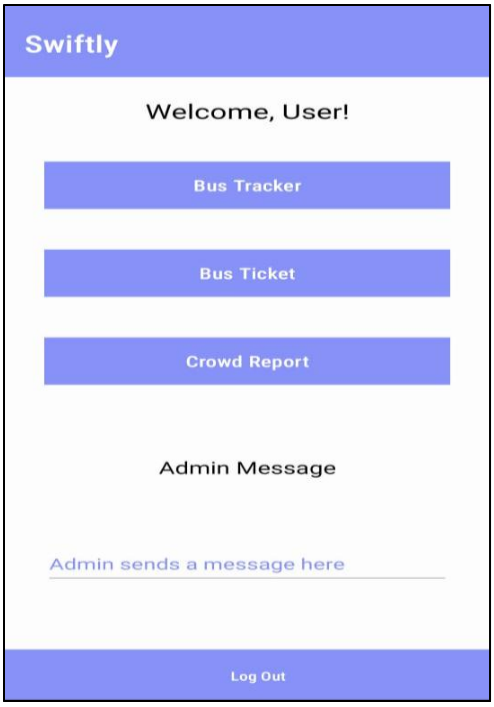


Figure 2.1.5 Main Page

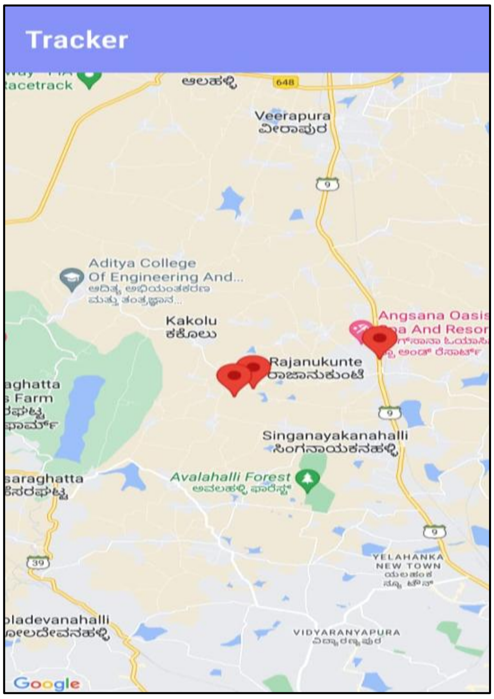


Figure 2.1.6 Bus Tracker

Figure 2.1.7 Ticket Booking

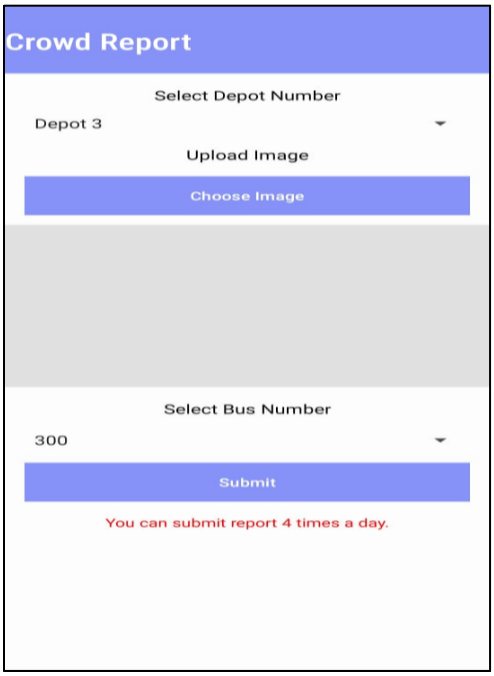


Figure 2.1.8 Crowd Report

2.2 Driver Interface

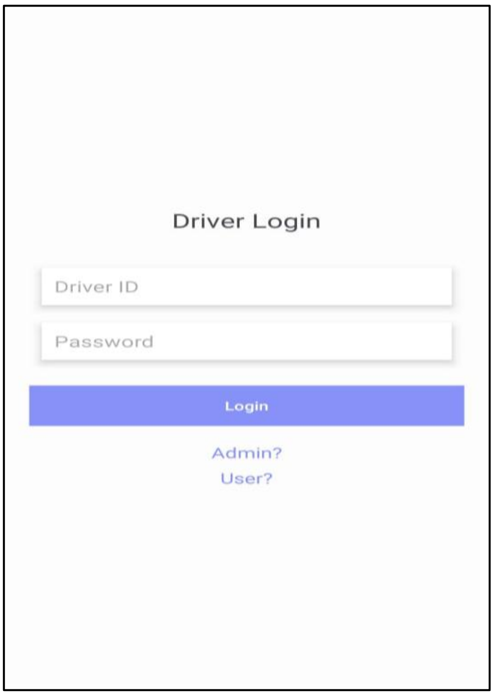


Figure 2.2.1 Driver Login

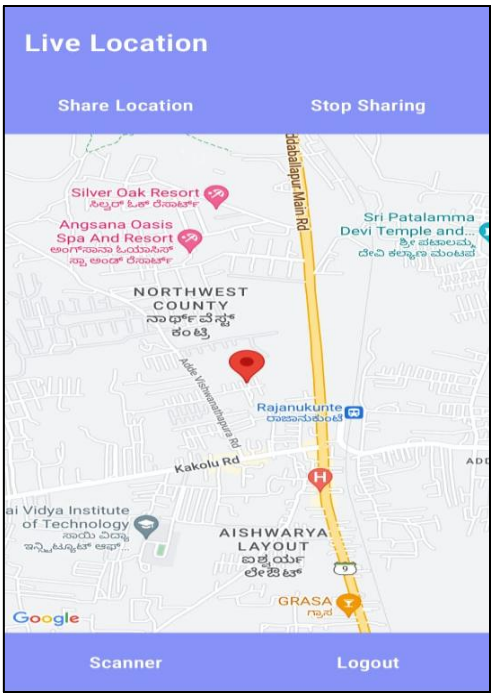


Figure 2.2.2 Live Location and Ticket Scanner

2.3 Admin Interface

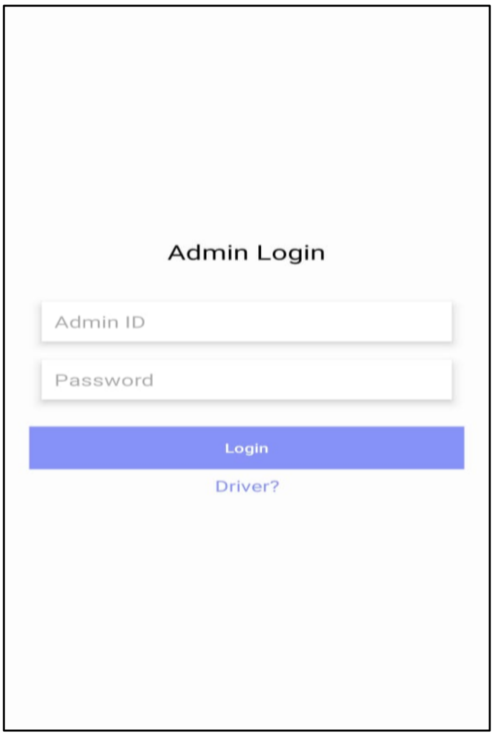


Figure 2.3.1 Admin Login

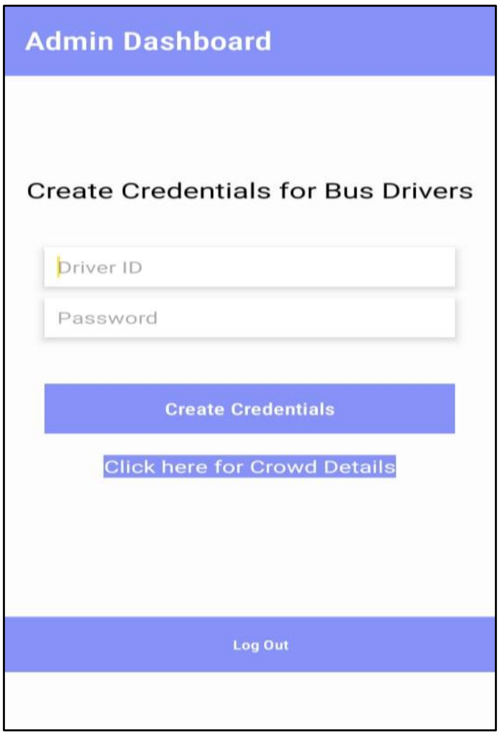


Figure 2.3.2 Admin Dashboard

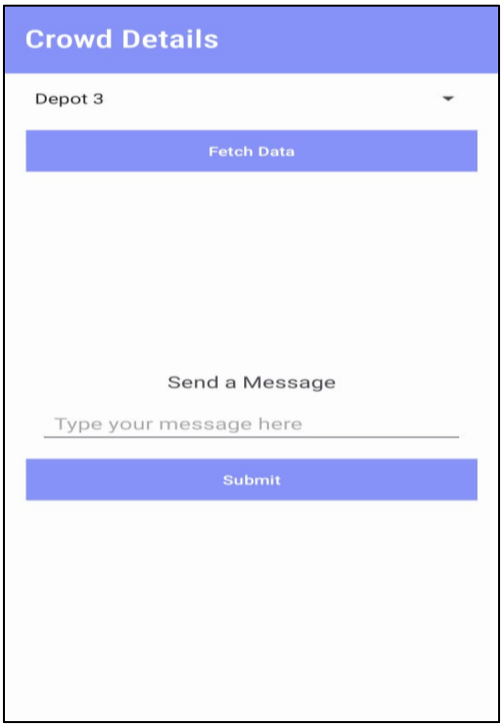


Figure 2.3.3 Crowd Details

APPENDIX-C

ENCLOSURES

Details of mapping the project with the Sustainable Development Goals (SDGs).

1. SDG 8: Decent Work and Economic Growth

Relevance:

- Modernization of transport systems provide new avenues for jobs and economic growth in the cities.

Contribution:

- Enhances productivity in public transportation operations.
- This provides great opportunities for IT professionals, app developers, and system administrators to develop and enhance digital solutions.

2. SDG 9: Industry, Innovation and Infrastructure

Relevance:

- The project enhances public transportation infrastructure to be smarter and more efficient through the integration of digital technologies like e-ticketing, real-time tracking, and crowd management.

Contribution:

- Improves operational efficiency, reduces manual intervention, and computerizes the transportation system, thus bringing novelty in public service delivery.

3. SDG 11: Sustainable Cities and Communities

Relevance:

- Public transportation can play a vital role in building more sustainable cities by reducing congestion, decreasing emissions, and increasing the accessibility of various areas.

Contribution:

- It also encourages the use of public transport to make it more convenient and efficient.
- Reduces overcrowding at bus stands, improving safety and accessibility for all, including vulnerable groups like children, elderly, and disabled individuals.

4. SDG 12: Responsible Consumption and Production

Relevance:

- The shift away from paper-based ticketing towards fully digital tickets means a decrease in waste, thus entailing sustainable consumption.

Contribution:

- E-ticketing minimizes paper usage.
- It encourages resource efficiency with regard to transportation systems.

Digitalizing the tickets and Crowd Management at Public Bus Stands

Parinitha M[1*], Chandana S[2], Nethra K[3], Yukthi V[4], Dr. Ramesh Sengodan[5]

School of Computer Science and Engineering, Presidency University, Bangalore,

Karnataka - 560064, India

[1*]parinitha1911@gmail.com, [2]chandanashivashankara21@gmail.com,

[3]nethrak452@gmail.com, [4]yukthiv12@gmail.com, [5]raameshs@gmail.com

***Abstract* — This initiative focuses on the improvement of efficiency in public transport by developing an Android application to digitalizing the ticketing system and crowd management at bus stands. In the system design, user, driver, and admin maintain separate interfaces that will make for seamless interaction, and its operation is seamless. The user can book a ticket, track a bus in real time using Firebase, and upload pictures to be used in the analysis of crowd density. The driver's panel provides the facility of location sharing in real time as well as scanning tickets to board quickly and safely. The admin panel provides options to admins to manage driver credentials and monitor the inside crowd level by sending a message to users in case of overpopulation. A central point for this application is the embedded "Crowd Detection System" using Flask and YOLOv8 for object detection. The system processes images uploaded by users to estimate crowd density and sends data to admin. It offers a modular way to monitor crowd levels to ensure public safety and resource allocation. By streamlining ticketing, providing real-time bus tracking, and offering proactive crowd management, this app presents a scalable solution to modernize public transportation. The aim is toward minimalizing the complexities with respect to the ticket-buying process, smooth operations flow, and public safety for humans.**

Keywords: Public Transportation · Digital Ticketing· Crowd Management · Real-time Tracking· Firebase · YOLOv8 · Public Safety

1. Introduction

Digitization in ticketing and efficient crowd-managing systems are a few of the steps needed to improve the ecosystem of public transportation. There is a need for innovations that take convenience to passengers, address overcrowding challenges, avoid fraudulent ticket sales, and smooth operations. Digital solutions offer an opportunity to the authorities to ensure a safe, swift, and efficient commute without wastage of resources. Such technology is important in building smart cities and ensuring seamless urban mobility.

1.1 Digital Ticketing Systems

Digital ticketing has transformed the way passengers interact with public transportation companies, moving from traditional paper tickets to more streamlined, efficient, and greener digital solutions. With increasingly available mobile and online ticketing platforms, passengers can now book tickets with so much convenience from any location using their smartphones or computers. Some of the key features are: real-time bus tracking to help travelers track the exact location of buses and, therefore, minimize waiting time to plan their journey well. Integrated payment gateways boast a variety of options, including UPI and digital wallets for seamless and smooth transactions. Besides, the system generates digital tickets with QR codes for fast and quick validation at entry points without any need for human intervention.

1.2 Smart Technology for Crowd Management

Smart technologies could be employed to note and inform how many people are around especially during peak hours of day or during festivals. Additionally, this helps ensure the undisturbed and smooth movement of passengers in front of the bus stand. For identifying the crowd at each single moment in real-time at the bus stand, that model uses a predefined YOLOv8 Python-based model. To start, YOLOv8 analyses images provided by the user before counting the number of present people. A single excessive crowd automatically sends an immediate message to the administrators who take necessary action. Including flask combined with YOLOv8 advances in this process, whereby FLASK serves as the API that handles the backend, serving user-uploaded images' processing through YOLOv8 for overcrowded detection and sending timely notification alerts to administrators for apt handling of the situation on time.

2. Related Work

Keller, Christine, et al. proceed to analyze adaptive systems in public transportation means, which adapt the content of real-time information to suit passenger demands. They observe how those kinds of adaptation features can ensure great enhancement of the overall journey, comfortable and even more efficient for the passengers, such as personalized trip updates. The paper enumerates that passengers are more bound to accept such systems when the information provided is relevant in their view and timely, too. The authors also discuss technical challenges in such systems, especially on infrastructure requirements and integration of adaptive technologies into existing transport networks. They also mention information, as passengers may feel overwhelmed if the system adapts too frequently or provides too much detail. [7]

M. Bieler, A. Skretting, P. Büdinger and T. -M. Grønli, provide deep information about AFC systems within public transport, accentuating the enrichment by machine learning in developing better decisions and improving customer insight. This paper covers automation of fare collection to reduce gross inefficiencies, smooth operations, and serve passengers much better. They warn, however, that sophisticated AFC systems have a very high implementation cost that might challenge the adoption of such technologies in many cities. The dependence on robust infrastructures, again, in terms of high costs for high-tech components and perennial maintenance burdens, is another challenge proposed. Despite these challenges, the long-term benefits that result from operational efficiency and customer satisfaction by the automated fare collection are worth the initial investments. [1]

Kočárková, Dagmar, Vojtěch Novotný, and Jana Jíšová pointed out that accessibility, mobility, and sustainability in cities can be significantly improved by an appropriately designed public transport stop/station. The paper positions the public transport stop/station within the wider development of urban areas and the general quality of life. It also increases social contact to make public spaces active with the people traveling by stops and stations that are well-planned and well-designed. They state, however, that developing these spaces can be one of the biggest challenges especially when it comes to populous urban areas with less land availability. In highly-used locations, constant upkeep is an ongoing concern, especially concerning maintenance and safety-safeguard measures of cities and towns. [10]

Jevinger, Åse, and Jan A. Persson. discuss challenges and opportunities for managing disruptions with real-time information systems in public transport. Their paper underlines, further, the fact that good communication development and effective information sharing between various means of transport can minimize the delay for the passengers, thus improving their total time of travel. According to them, this is true in the event of any intermodal disruption that coordination among modes of transport will minimize the impact on passengers. They admit, however, that operational troubles-such as the "complexity of multiple transport modes being managed in parallel" leads to cascading effects that worsen delay. Information gaps in giving and receiving between transport providers and passengers increase uncertainty at the cost of travelers keeping themselves informed during disruptions. [6]

Kaushik, Varun, and P. Suhas. introduces modern ticketing systems that are purely based on the RFID mechanism for fare collection and comprehensive elimination of ticketless traveling. This paper discussed some benefits of two-way authentication mechanisms to verify tickets and consequently reduce revenue losses. This system is relatively cost-effective, easy to implement, and reliable, hence can be implemented by many cities. However, it also contemplates the possible drawbacks that include delay in passenger authentication, which might bring inefficiency in the system. Furthermore, infrastructural upgrade requirements are very high to incorporate these systems on a large scale, and this might be a burden on passengers and operators, as per the authors. [9]

3. Proposed System

3.1 User Interface

Users can book tickets through it by selecting the source, destination, and number of passengers. A QR code is generated for easy verification at the time of boarding. Real-time tracking of buses is provided through Firebase, whereby the location of drivers is shared, and based on that, the position gets updated on the interactive map. Apart from this, users can upload images of bus stands to monitor crowds. These images are processed at the backend by Flask to compute crowd density. In case of a detection of overcrowding, an alert is sent to the admin for timely intervention.

3.2 Driver Interface

Drivers share real-time location through the app, thus improving route efficiency and enabling tracking, which reduces waiting and improves the passenger experience. The ticket scanning feature also allows drivers to check passengers for a smooth boarding and fare collection process and flags invalid or expired tickets instantly for accurate enforcement.

3.3 Admin Interface

Administrator has the ability to manage driver credentials and performance metrics in order to assign personnel quickly and efficiently to buses. This in-app crowd monitoring system sends instant messages to admins about the occupancy of a bus, which enables them to take quick response actions: deploying more buses, adjusting the schedules to balance out the passenger demand, or sending out warnings in advance to prevent overcrowding.

4. Methodology

4.1 Mobile Client (Android Application)

The application will be developed on Android Studio, the IDE for native Android applications, focusing on e-ticketing, bus tracking, and crowd management. The app integrates Google Maps for real-time tracking of buses on an interactive map to let users know the exact position of buses for effective journey planning. Firebase provides the real-time storage and communication backbone, thereby allowing the application to interact with the backend in real-time. It will manage vital data, such as user profiles, bookings, bus schedules, and people count analysis for efficient handling of data-smooth functionality of the app.

4.2 Back-End: Firebase Database and Cloud Functions

It leverages Firebase Realtime Database to store and handle such information as users' profiles, details of tickets, and crowd density in real time, together with efficient and smooth retrievals and updates. Firebase Authentication is integrated for safe user registration and login for safe and reliable access to the application. Firebase Cloud Functions handle server-side logic, such as the processing of ticket bookings, maintenance of crowd-related data, and sending automated alerts in case of congestion in certain areas. In sum, these Firebase services work together to provide a seamless, secure experience for users and administrators alike.

4.3 External APIs

It provides an online secured payment gateway via the use of Stripe, PayPal, or any custom solutions in order to make e-ticket payment processing smooth and secure for ticket reservations. Besides this, the application integrates the Google Maps API to enable real-time tracking of the location of buses, thus allowing passengers to track the exact position of the buses at any given moment. This therefore increases convenience for users by efficiently merging the facilitation of easy payment solutions with effective journey planning tools.

4.4 UI/UX Design

The design of the application's interface is user-friendly, with intuitive navigation to make it easy to use. The user can sign up with their phone number for ease of onboarding. The home screen acts like a dashboard, showing available buses, schedules, and booking options in an easy-to-understand layout. Using the feature of booking tickets through this app, customers can choose any schedule of a bus, number of passengers, and make a payment for their tickets securely. Live Bus Tracking via Google Maps The application will allow viewing the real-time location of buses using Google Maps. Besides, its feature for crowd management presents real-time information on crowd density at bus stops, waiting time estimates, and bus capacities for the customer to avoid crowds. The confirmation screen after booking shows the details of the ticket, followed by a QR code to ensure smooth embarkation.

4.4 Core Features & Modules

It consists of three phases in total: Phase 1 concerns the user's registration and authentication, where Firebase Authentication enables sign-in and sign-up securely; similarly, Firebase Database provides facility for user profile and authenticating information storage. Token management will ensure secure communication/session management. Phase 2 concerns e-ticketing and payment processing that are reservations of tickets, selection of schedules, and payments made through embedded platforms like Stripe or PayPal. Code generation will provide a unique QR code for the ticket on validation, and information about the tickets is to be stored in the Firebase Realtime Database, linked with user profiles. Phase 3: tracking of buses and crowd management- the buses, which periodically send location updates to Firebase, enabling real-time tracking through the app; it will analyze crowd density by considering the images uploaded by the users, which are previously processed using YOLOv8, flagging conditions that potentially lead to any overcrowding issues that may require administrative action.

4.5 Firebase for Back-End Development

Cloud Functions are key in automating and managing processes that are very central in the system. The backend will house the logic for booking, which would go about the reservation of the tickets upon validation of the payment, generation of tickets, and storage of relevant data into the Firebase database. Regarding updating bus locations, Firebase Cloud Functions can be employed to process periodic location updates sent by buses and push the same to the app in real time, thus positioning buses accurately. Cloud functions are also used to manage the analytics of crowds, whereby the crowd data is processed from images uploaded by the users. These perform computation of crowd density in bus stands and send alerts automatically in case of over-crowding to admins, which thus enables quick intervention for congestion management.

4.5 Testing and deployment

The testing phase may regard unit testing for every block implemented, such as authentication, buying tickets; integration in establishing that Firebase, Payment integration, and Google maps ensure a smooth interaction without false errors; UAT tests by the user to implement functionalities in real-life scenario development. Stress testing finds which amount of load application a system can bear due to increased traffic. The admin panel will be deployed on Firebase Hosting; this allows for efficient administration of bus schedules and crowd data. Later, the Android application will be published on the Google Play Store after testing so that users can download it easily.

5. Results and Analysis:

5.1 User Interface

The user interface is planned to be seamless and friendly, beginning with a safe login page. After login, the main page is designed to be quite easy to navigate, including buttons to access the various features. Users can track their driver's real-time location, book tickets easily, and upload images for crowd management to analyze bus stand density. There is an easy logout option to handle accounts securely. Visual representations of the implementation, including the login screen, main page layout, and the functionality of each feature, are provided in the images (Figures 5.1.1 to 5.1.8), offering a clear view of the system's practical design and usability.

Figure 5.1.1 Splash Activity

Figure 5.1.2 Enter Mobile No.

Figure 5.1.5 User Dashboard

Figure 5.1.6 Bus Tracker

Figure 5.1.3 Enter OTP

Figure 5.1.4 Enter Username

Figure 5.1.7 Ticket Booking

Figure 5.1.8 Crowd Report

5.2 Driver Interface

A safe log-in page introduces the easy-to-use interface with optimal operational efficiency for the driver. The home page delivers basic functions in the shape of buttons: 'share' and 'stop' sharing real-time location that automatically reflects at the user's side tracking the bus using the Firebase database. Ticket scanning, another convenient function, facilitates smooth verification by the drivers on their account while providing the logout feature. Below the interface, visuals of the implementation (Figure 5.2.1 and 5.2.2) will be shown, including the driver login screen, main dashboard layout, and functionalities like location sharing and ticket scanning, which will highlight the practical design and effectiveness of the interface.

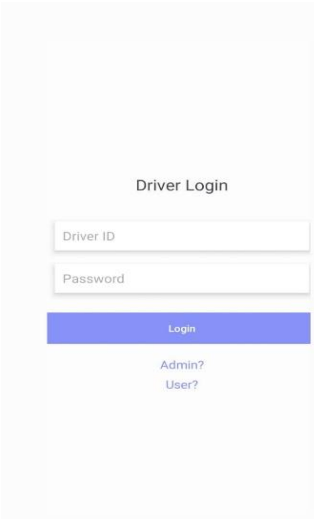


Figure 5.2.1 Driver Login

Figure 5.2.2 Live Location and Ticket Scanner

5.3 Admin Interface

The admin interface is designed to manage and control efficiently. It starts with a secure login page, and then the main dashboard unfolds. There, administrators can create driver credentials to allow smooth operations and fetch the details of images uploaded by users for crowd management. This feature enables admins to analyze the situation and send messages or alerts to users if needed, thereby ensuring that communication and action are prompt. A logout option is there to ensure secure access control. Below the interface, some visuals of the implementation (Figures 5.3.1 and 5.3.2) will illustrate the admin login process, admin dashboard layout, and functionalities such as managing crowd details and creating credentials for bus drivers, demonstrating the system's practicality and effectiveness.

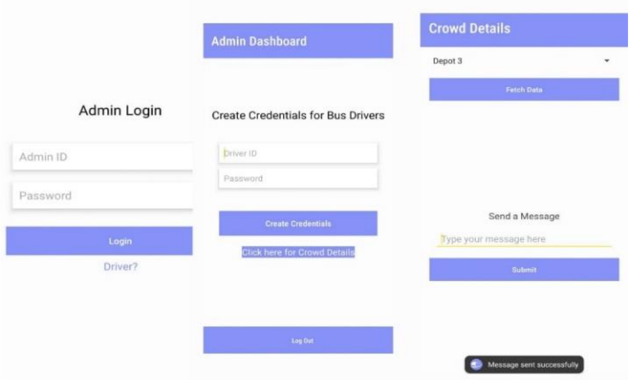


Figure 5.3.1 Admin Login Figure 5.3.2 Admin Dashboard Figure 5.2.3 Crowd Details

6. Conclusion and future scope:

In conclusion, this project makes use of modern technology to transform public transportation systems with digital ticketing, real-time tracking of buses, and efficient crowd management. It uses Android Studio, Firebase, and YOLOv8 for advanced object detection in overcoming key challenges such as overcrowding, inefficiency, and lack of real-time data. The system makes passenger travel more convenient through paperless ticketing, along with giving real-time updates, thereby reducing waiting time and uncertainty. It provides timely alerts on issues of crowd density, along with better resource allocation and issues of public safety. By being scalable, this particular solution can be applied and used across various modes of transport, thereby contributing significantly to smart city initiatives, ultimately streamlining urban mobility, reducing environmental impact and improving safety.

Future Works:

This project can be further improved by integrating TensorFlow for advanced detection, applying machine learning for crowd prediction, and adding Augmented Reality for passenger navigation. Dynamic route optimization, multimodal transport integration, sustainability features, and voice assistance for accessibility would enhance efficiency.

Furthermore, linking with smart city infrastructure could further improve urban mobility and sustainability.

7. References

[1] M. Bieler, A. Skretting, P. Büdinger and T. -M. Grønli, "Survey of Automated Fare Collection Solutions in Public Transportation," in IEEE Transactions on Intelligent Transportation Systems, vol. 23, no. 9, pp. 14248-14266, Sept. 2022, doi: 10.1109/TITS.2022.3161606.

[2] S. Sankarananrayanan and P. Hamilton, "Mobile enabled bus tracking and ticketing system," *2014 2nd International Conference on Information and Communication Technology (ICoICT)*, Bandung, Indonesia, 2014, pp. 475-480, doi: 10.1109/ICoICT.2014.6914108.

[3] Sundaramoorthy, Revathy, Yamuna Ilango, and Ananth Kumar Tamilarasan. "Smart bus passengers information and safety management system." *International Journal of Pure and Applied Mathematics* 119.14 (2018): 795-800

[4] Fantin Irudaya Raj, E., and M. Appadurai. "Internet of things-based smart transportation system for smart cities." *Intelligent Systems for Social Good: Theory and Practice*. Singapore: Springer Nature Singapore, 2022. 39-50.

[5] Nguyen, Nguyen Phong, and Emmanuel Mogaji. "Information technology for enhancing transportation in developing countries." *Management and information technology in the digital era: Challenges and perspectives*. Emerald Publishing Limited, 2022. 81-94.

[6] Jevinger, Åse, and Jan A. Persson. "Information-based disturbance management for public transport." *Project report* 1 (2016).

[7] Keller, Christine, et al. "Understanding the usefulness and acceptance of adaptivity in smart public transport." *HCI in Mobility, Transport, and Automotive Systems: First International Conference, MobiTAS 2019, Held as Part of the 21st HCI International Conference, HCII 2019, -31, 2019, Proceedings 21*. Springer International Publishing, 2019.

[8] Baldauf, Matthias, and Martin Tomitsch. "Pervasive displays for public transport: an overview of ubiquitous interactive passenger services." *Proceedings of the 9TH ACM international symposium on pervasive displays*. 2020.

[9] Kaushik, Varun, and P. Suhas. "Fool Proof ticketing System for public transport." *2018 3rd International Conference on Communication and Electronics Systems (ICCES)*. IEEE, 2018.

[10] Kočárková, Dagmar, Vojtěch Novotný, and Jana Jíšová. "Design of public transport stops and stations and its contribution to attractive and accessible public transport." *2019 Smart City Symposium Prague (SCSP)*. IEEE, 2019.

Acceptance Notification - ERCICAM 2025 Inbox ×

ERCICAM 2025 NMIT Bengaluru <ercicam2025@nmit.ac.in>
to me

Jan 9, 2025, 8:49 PM (12 hours ago)

Dear Author,

Congratulations and Greetings from ERCICAM-2025!!!

We thank you for submitting your paper to our Second International Conference on "Emerging Research in Computing, Information, Communication, Artificial Intelligence and Machine Learning" (ERCICAM-2025).

We are pleased to inform you that your paper:

Titled:Digitalizing the tickets and Crowd Management at Public Bus Stands

having Paper id: 226

is 'ACCEPTED' for Oral Presentation & Publication at ERCICAM-2025 to be held during 07-08, March 2025 at Nitte Meenakshi Institute of Technology (NMIT), Yelahanka, Bangalore, India.

The accepted papers will be published in Springer – LNEE series (Lecture Notes in Electrical Engineering). The books of LNEE series are submitted to EI-Compendex, SCOPUS, Google Scholar, Springer links.

Every accepted paper must be registered by any one of the authors of the paper. Only registered papers will be submitted to Springer for publication in LNEE Series. Certificates will be given to all the authors of the paper. Also, a presentation Certificate will be given to the presenter of the paper during the conference.

Digitalizing the tickets and Crowd Management at Public Bus Stands Report_ plagarism

ORIGINALITY REPORT

11%	8%	10%	9%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Presidency University Student Paper	5%
2	Submitted to Ashesi University Student Paper	1%
3	dblp.dagstuhl.de Internet Source	1%
4	www.irjet.net Internet Source	1%
5	www.ijisae.org Internet Source	1%
6	"Emerging Cutting-Edge Applied Research and Development in Intelligent Traffic and Transportation Systems", IOS Press, 2024 Publication	1%
7	dspace.library.uu.nl Internet Source	1%
8	Emmanuel Mogaji, Nguyen Phong Nguyen. "Evaluating the emergence of contactless	<1%

digital payment technology for transportation", Technological Forecasting and Social Change, 2024
Publication

9	www.ijirmf.com Internet Source	<1 %
10	journals.stmjournals.com Internet Source	<1 %
11	www.k2centrum.se Internet Source	<1 %
12	S. Vaishnavi, G. Renish, T. Surendra, J. Ram Kumar, V. Srinivasan. "Advancements in Public Transport: Design and Implementation of an Android-Based Real-Time Bus Tracking System", 2023 IEEE 5th International Conference on Cybernetics, Cognition and Machine Learning Applications (ICCCMLA), 2023 Publication	<1 %
13	Zenong Cheng, Yun Bai, Xinzheng Yang, Xujie Feng, Nan Zhang. "Dynamic Factor of Suburban Railway Bridge Considering Random Vibration", International Journal of Structural Stability and Dynamics, 2023 Publication	<1 %
14	kipdf.com Internet Source	<1 %

15	link.springer.com Internet Source	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	On		