

MSRTC Lost Ticket Recovery System

Rohit S. Raut¹ · Swati T. Patil¹ · Nikita Nitin Patil¹ · Suyashri Satappa Patil¹ · Dipti Dhananjay Shete¹ · Vrushali Dhondiram Dhure¹

¹Department of Computer Science and Engineering (Data Science),

Dr. D. Y. Patil Pratishthan's College of Engineering, Salokhe Nagar, Kolhapur, Maharashtra, India

rohitraut8680@gmail.com · swatibhosale49@gmail.com · np653700@gmail.com · suyashripatil@gmail.com · diptishete135@gmail.com ·
vrushalidhure3009@gmail.com

Abstract— There is a trend from paper tickets and manual collection of fares to electronic, mobile, and automated fare collection. This trend made ticket purchase and validation quicker but led to emergence of new demands related to usability, security, passenger identification, and easy access to ticket data. Mobile ticketing research included such topics as user adoption, usability, payment acceptance, QR code validation, and alternative technologies like BLE. Meanwhile, the research on automated fare collection revealed that ticketing systems may provide valuable operational data besides fare collection. There is however one practical question that gets rather less coverage in the discussed literature – what to do when a passenger lost his ticket, forgot its ID or cannot use a mobile application? This review summarizes the literature related to automated fare collection, mobile ticketing, QR ticketing, electronic validation, passenger acceptance, and public transport ticketing services. On this basis, the concept of a solution that uses registered phone number of the passenger for finding their ticket and account and uses authorized conductor for assistance when required is suggested. This review covers route-based fare choice, ticket state handling, QR presentation, access rights, and security/privacy requirements. In contrast to treating mobile ticketing as just another payment issue, this paper looks at the ticket management as an end-to-end passenger service involving ticket creation, validation, retrieval, and help with using it. The literature reviewed confirms the technological feasibility of the proposed solution but also indicates the opportunity to investigate ticket retrieval and conductor access as a part of digital public bus ticketing system.

Keywords -public transportation, electronic ticketing, mobile ticketing, automated fare collection, QR code, ticket recovery, passenger identification, fare management, ticket validation, digital transport services.

1. INTRODUCTION

Paper tickets are becoming less common because of the rise of technologies such as mobile apps and smart cards. Still paper tickets remain useful in situations. At the time digital systems help reduce manual work and make it easier to collect transaction data. Bieler and colleagues looked at automated fare collection technologies. Described how these systems can improve customer experience create new transport services and make better use of ticketing data [1]. Earlier studies on automated fare collection show that switching from ticket types involves both technical implementation and customer acceptance challenges [15]. Mobile ticketing has become a focus in this shift. Cheng and Huang studied how high-speed rail passengers adopt ticketing. They looked at how QR codes are used for payments and access and also studied factors that influence technology acceptance [5]. Mallat and others did work on mobile ticketing in public transport and found that compatibility with how users behave is a key factor [6]. Recent studies have looked at how to roll out ticketing systems. These studies include usability tests. Staged evaluations before full deployment [2].

In bus systems the usefulness of a ticketing system goes beyond just buying a ticket. A passenger might lose a paper ticket delete an one forget their ticket number, switch devices or need help because they are not comfortable using smartphones. These problems become more important when the conductor is still responsible for checking tickets. That means a digital ticketing system must consider not how tickets are issued but also how they can be recovered. This project, described in this review aims to solve this real-world issue by using phone numbers for ticket recovery. The mobile phone number will not act as the ticket number. That's the ticket identifier. But instead, as a convenient way to find a passenger's ticket. The phone number will be linked to the passenger's account. Can be used to retrieve tickets. An authorized conductor will help passengers recover their tickets when the passenger cannot do it themselves. This paper reviews the literature on topics: automated fare collection, mobile ticketing, QR code ticketing, mobile payment, passenger acceptance, ticket validation, route and fare management and ticket service efficiency.

2. RESEARCH METHODOLOGY

This paper adopts a narrative review methodology. The literature reviewed was categorized on the basis of the functionalities which are relevant to the bus ticket management system under consideration. These categories include automated fare collection, mobile ticketing, QR code based validation, mobile payment, passenger acceptance, ticket service evaluation, smart card data, and electronic ticket validation. The literature has been chosen since they contain information about one or more of the components of the proposed bus ticket management system and not just transportation. Bieler et al., for example, have

done a detailed study about the automated fare collection systems [1]. Mesoraca and Brakewood, on the other hand, compare various mobile ticketing applications used by commuter railroads and their validation and QR barcode process [3]. Ferreira et al. have explored the possibility of using Bluetooth Low Energy for mobile ticketing in urban passengers transport [4]. This literature provides the basis for understanding various approaches to the deployment of digital tickets technically and operationally.

The review addresses user-oriented problems. Bartin et al. suggest an evaluation methodology comprising four stages of testing mobile ticketing applications, namely alpha, beta, pilot, and system-wide tests [2]. Di Pietro et al. study the adoption of mobile payment in public transport and determine that such aspects as usefulness, ease of use, and security affect it significantly [12]. Srivastava and Purohit investigate the efficiency of ticketing services in relation to commuter satisfaction [14].

Finally, the literature review analyzes these results in terms of the features of the proposed system and shows how the literature may be used in both direct and indirect ways in this project. It must be noted that the review does not claim that the mobile-number recovery process suggested by the system is innovative; it is just a combination of well-known digital ticketing elements.

3. EVOLUTION OF PUBLIC TRANSPORT TICKETING

There have been a number of evolutionary phases of fare collection in public transport. Cash, tokens, paper tickets, magnetic storage devices, contactless cards, and applications are all examples of ways of fulfilling the same fundamental need – ensuring that the passenger has paid for their ride. Foote et al. examined the acceptance of the automated fare collection system implemented by the Chicago Transit Authority and examined the customer response and technical issues involved [15].

An automated fare collection system can not only collect payments. It is capable of storing transaction details and generating information which could help in transport planning and analysis. Pelletier, Tre'panier, and Morency looked at the usage of smart card data in public transport and explained how information derived from transaction data can be helpful outside of the revenue collecting context [13]. This point is especially important in the case of digital bus ticket management since the ticket itself is rich in information.

Gusev and Sergeev studied the design of public transportation automated fare collection systems, which includes the collection of fares, passenger accounting, and routing control [9]. This research provides a good example of the relationship between ticketing and overall management of a public transportation system. The mobile ticketing system was developed by Deka et al. for automated fare collection due to the time consumption and efforts involved in ticketing processes [10].

The emergence of such systems implies that a modern ticketing system needs to be treated as an integrated system of transactions, passengers' interaction, validation, and operations management.

4. MOBILE TICKETING IN PUBLIC TRANSPORT

Mobile ticketing allows a passenger to use a smartphone as a ticketing interface. The passenger may purchase, store, display, and validate a ticket without carrying a conventional paper ticket or physical fare medium.

Mesoraca and Brakewood synthesized mobile ticketing applications used by major commuter railroads in the United States and compared ticket validation, ticket types, additional application features, and transfers between transport modes [3]. Their review found that visual inspection was used for validation in the applications examined, while many systems also used QR barcodes. This is relevant to a bus environment in which a conductor may visually inspect or verify a digital ticket.

Cheng and Huang investigated passenger adoption of mobile ticketing using a framework that combined the Technology Acceptance Model with mental accounting theory [5]. Their study also considered QR codes for payment and gate entrance. Mallat et al. examined mobile ticketing adoption in public transportation and reported that compatibility with consumer behaviour was an important determinant [6].

Ferreira et al. investigated whether Bluetooth Low Energy could be used for mobile ticketing in urban passenger transport [4]. Their prototype was tested in the Metropolitan Area of Porto and used BLE beacons as part of a check-in/be-out model. The study demonstrates that mobile ticketing can be implemented using multiple technical approaches, and that practical deployment requires both technical evaluation and passenger feedback.

The proposed bus ticket system uses a simpler account-based approach. It does not require BLE-based automatic trip tracking. Instead, the passenger is associated with a registered mobile number and ticket records are stored in a database. The approach is therefore closer to an account-oriented ticket management system in which passenger records remain available after ticket creation.

5. QR-BASED TICKETING AND VALIDATION

I see that QR codes are widely used to show ticket information in a small easy format. QR codes can appear on a smartphone. Can be checked or scanned by a transport worker or a validation device. Upendra Reddy and others suggested a bus ticket system that uses QR codes and a mobile app showing how useful QR representation is for bus tickets. Ong and Abdullah showed a ferry e-ticketing system that uses QR codes and IoT giving another example of QR codes, in transport ticket processes. Mesoraca and Brakewood's review is very useful because it shows that QR-based validation is already used in mobile ticketing apps. Borges and Sebe' recently presented a public transport electronic ticket system that validates quickly and follows a privacy-by-design approach. This work shows that electronic ticketing can be built to meet both performance and privacy needs. In the proposed project QR generation is treated as a copy of an existing ticket. The ticket number stays the identifier while the QR code gives a handy digital copy. This difference matters because making a QR image and putting in full QR scanning and cryptographic validation are levels of work. Therefore a prototype should only report the QR features that have really been built and checked.

6. PASSENGER IDENTIFICATION AND LOST-TICKET RECOVERY

From the literature reviewed above there is progress in mobile ticket purchase, digital ticketing, QR validation and automatic fare collection systems.. The situation where a traveller forgets a ticket or a ticket number receives less attention in the papers we looked at.

Traditionally a ticketing process means creating a ticket and showing proof of that ticket while travelling. If a traveller loses a ticket the original ticket number disappears. Likewise if a digital ticket is saved on a device that's no longer available the traveller must find another way to locate that ticket.

This proposal tackles the issue by separating two ideas:

- Ticket identity: the ticket number uniquely identifies each ticket.
- Passenger lookup: the mobile number identifies the passenger's account and the tickets linked to that account.

Mobile Number → Passenger Account → Ticket Records → Ticket Recovery

This means that a traveller does not need to remember a forgotten ticket number. It also means that the mobile number is not used as a ticket number.

The recovery process still requires authorization and checks, on ticket status. A ticket that is cancelled must not become valid just because it can be retrieved. Likewise a ticket that is already used must stay used. Ticket retrieval and ticket validity are operations.

7. CONDUCTOR-ASSISTED TICKETING

One such feature that sets apart the proposed system from others is conductor assistance. In many instances in the public transport bus setting, the conductor still plays a role in the ticketing process despite the introduction of automated systems.

According to Deka et al., the rationale behind using automated systems for fare collection is the reduction of effort and time spent on manual processes of public transport ticketing [10]. Gusev and Sergeev also note the link between automated fare collection and accounting and route control of passengers [9]. Foote et al. cover customer assistance in relation to the automated fare collection system [15].

In the context of the proposed system, this feature is utilized in the process of recovering lost tickets. A passenger without a smartphone or unable to use the application can share the registered mobile phone number with the conductor.

Passenger → Lost Ticket → Mobile Number → Conductor Dashboard → Passenger Verification → Ticket Records → Status Check

The intention of the approach is to enhance passengers' capability in using the application and not replace it. Passengers are still able to use the application when possible.

Since a conductor has access to passenger data, it is critical that role-based access protection is introduced. A conductor should not have unlimited powers. The following division is proposed:

- Passenger: personal account and ticket access.
- Conductor: ticket creation, verification, recovery, and ticket-use operations for an assigned trip.
- Administrator: bus, route, fare, trip, and authorized-user management.

8. ROUTE AND FARE MANAGEMENT

Various passengers on the same bus might be headed to different destinations, thus requiring a ticketing system to associate tickets with their corresponding routes or trips and also calculate the relevant fees.

As can be concluded from Gusev and Sergeev, fare collection, passenger accounting and route control are interrelated components of public automated transport systems. Similarly, Bieler et al. affirm that automated fare collection actually serves as a more sophisticated structure rather than merely a payment processing system.

The system under consideration maintains route information and fare information independently from the conductor's ticket input. The system administrator provides the capability to create or amend the routes and the fares in the database. The conductor has to select an appropriate destination when generating the tickets, while the system automatically retrieves the necessary fare instead of allowing for manual fare input.

This separation can reduce inconsistent fare entry and provides a clear responsibility boundary between system administration and onboard ticket operations.

9. MOBILE PAYMENT AND USER ACCEPTANCE

The development of digital ticketing relies not just on the technology available but also on how users accept the new technology. Di Pietro et al. formulated the Integrated Model of Mobile Payment Acceptance and applied this model to the public transport domain. They focused on ease of use, usefulness, compatibility, attitude toward mobile services, and security as factors influencing mobile payment and ticketing acceptance.

Mallat et al. also looked at mobile ticketing adoption and placed lots of emphasis on compatibility in terms of consumer behaviour that consumers have [6]. This means that even if the mobile ticketing application works properly from the technology point of view, it may still be adopted by users since it is difficult to use and is not compatible with their travelling habits.

That is why the proposed system includes the Assisted Path system. This way, the users of the system have the opportunity to use the help of the conductor to solve various problems. If the passenger cannot find the mobile ticket or has problems with using the mobile application, the conductor will perform the recovery procedure using the special authorized interface.

10. USABILITY AND TICKET-SERVICE EFFECTIVENESS

Usability is regarded as a vital aspect for ticketing in public transportation systems since ticket purchase and validation processes are often time-bound. Bartin et al. suggested a four-point evaluation framework for mobile ticketing systems: Alpha testing, beta testing, pilot testing, and system-wide testing [2]. The authors call for the detection of usability issues before large-scale implementation.

The authors Srivastava and Purohit have carried out an investigation regarding the efficiency of ticket acquisition systems in relation to customer satisfaction [14]. The paper supports the notion that ticketing quality is determined not only by the success of a transaction.

In this regard, the usability testing of the envisaged bus ticketing application should include at least the following process scenarios:

1. passenger registration and login;
2. viewing a digital ticket;
3. creating a ticket through the conductor dashboard;
4. selecting a destination;
5. retrieving a passenger using a registered mobile number;
6. recovering a lost ticket;
7. checking ticket status;
8. generating and displaying a QR representation;
9. marking a valid ticket as used.

A future evaluation can measure task completion time, failed attempts, user errors, passenger satisfaction, and conductor workload. Such testing would allow the project to move from a functional prototype toward a more evidence-based evaluation.

11. SECURITY AND PRIVACY CONSIDERATIONS

It has become clear that there are certain requirements for security and privacy in digital ticketing because the system collects the information regarding the passenger as well as transactions. Therefore, a passenger's mobile phone number becomes personally identifiable information and must not be used as a public key. The literature has shown that the issues of security

and privacy are relevant to electronic ticketing. According to Pelletier et al., there are a number of privacy and legal issues related to storing the information regarding smart cards, including encryption [13]. Borges and Sebe' mention the importance of privacy-by-design concept in their project and the distinction between proving or verifying that the traveller has a ticket and constantly disclosing the identity of the traveller [11].

The mobile number retrieval mechanism in the considered system should now comply with the process of verification and authorization.

- authenticated conductor access;
- role-based authorization;
- restricted access to passenger records;
- secure password handling;
- protected API communication;
- validation of ticket status before use;
- audit records for ticket creation, recovery, and status changes; • avoidance of unnecessary exposure of passenger information.

The system should also distinguish between finding a ticket and authorizing its use. A passenger record being found by mobile number does not by itself prove that a particular ticket is valid for travel. The ticket status, trip information, payment status, and other required conditions must be checked.

12. COMPARISON OF LITERATURE THEMES AND PROPOSED SYSTEM

TABLE 1 Comparison of Literature Themes and Proposed System

Area	Evidence in Reviewed Work	Role in Proposed System
Automated fare collection	AFC design, customer acceptance and system-level surveys [1], [9], [15]	Digital ticket creation, fare recording and operational management.
Mobile ticketing	Adoption, evaluation and deployed application studies [2], [3], [5], [6]	Passenger-facing digital ticket access and conductor ticket operations.
QR validation	QR-based transport ticketing and validation [3], [7], [8]	QR representation of generated tickets and future validation support.
Mobile payment	Public transport mobile-payment acceptance [12]	Payment-method recording and future digitalpayment integration.
Electronic validation	Fast electronic ticket validation and privacy-aware designs [11]	Ticket status checking and validation workflow.
Passenger data	Smart-card and automated fare transaction data [13]	Account and ticket records stored for operational use.
Ticket-service quality	Ticketing effectiveness and customer acceptance [14], [15]	Future usability and service-quality evaluation.
Lost-ticket recovery	Limited direct treatment in the selected literature	Registered-mobile-number-based lookup of existing ticket records.
Conductor assistance	Operational support and manual/automated fare collection contexts [9], [10], [15]	Staff-assisted ticket creation, verification and recovery.

13. COMPARATIVE REVIEW OF EXISTING APPROACHES

Table 1 summarizes the main capabilities represented by the reviewed literature and the corresponding role in the proposed project. The comparison shows that most individual components of the proposed system already have research or practical precedents. Mobile ticketing, QR validation, automated fare collection, electronic validation, and passenger acceptance are established research areas. The proposed contribution is therefore not the invention of these technologies individually. Instead, the project combines them around a specific passenger-service problem: recovering a lost ticket through an account-linked mobile number and providing conductor-assisted access.

14. RESEARCH GAP

The reviewed literature supports several conclusions. First, electronic and automated fare collection systems are established areas of transportation technology [1], [9], [15]. Second, mobile ticketing has been investigated from both technical and behavioural perspectives [2], [5], [6]. Third, QR codes are already used as digital ticket representations and validation

mechanisms [3], [7], [8]. Fourth, mobile payment acceptance and ticket-service effectiveness depend on usability, usefulness, security, and passenger expectations [12], [14].

However, the selected references provide less direct coverage of a complete workflow that starts with a passenger's registered mobile number and ends with recovery of an existing lost ticket, particularly when the passenger is assisted by a bus conductor.

This observation should be expressed carefully. The review does not establish that no previous system has ever used mobile-number based ticket recovery. Instead, within the literature selected for this review, the main focus is generally on ticket purchase, ticket validation, payment acceptance, automated fare collection, or system usability. The proposed project brings these established elements together with a recovery workflow.

The resulting research gap can therefore be stated as follows:

Existing public transport ticketing research provides substantial work on electronic fare collection, mobile ticketing, QR-based validation, payment acceptance, and ticket-service usability. Comparatively less attention is given in the selected literature to the practical recovery of a lost passenger ticket through an account-linked identifier, especially when the recovery is assisted by an authorized bus conductor. This creates an opportunity to investigate ticket recovery as an integrated part of public bus ticket management rather than treating ticket generation and ticket recovery as separate concerns.

15. PROPOSED CONCEPTUAL SYSTEM

A. Conceptual System Architecture

The system outlined in this report clearly distinguishes passenger services, operations related to the conductor, and the management of administrative duties while maintaining ticket records in a centralized backend method. This segregation simplifies every phase of the ticketing cycle and gives rise to a standard approach when it comes to implementing authorization rules.

According to the insights derived from the reviewed literature, the system touched upon in this report can be described in terms of its three roles.

B. Passenger Layer

At the beginning, the passenger generates his/her profile and logs in to the system. If the passenger has registered a mobile number, it is linked to the account. When ticket orders are placed, ticket information is connected to the passenger's account. Passenger flow is as follows

The normal passenger flow is:

Register/Login → Passenger Dashboard → My Tickets → Digital Ticket

If the ticket is lost:

Lost Ticket → Registered Mobile Number → Passenger Lookup → Ticket Record

C. Conductor Layer

The conductor works using an authorized dashboard. Before generating a ticket. The conductor inputs the passenger's registered mobile number. The back end checks whether the passenger exists or not. In case the passenger does not have a record, the ticket cannot be made according to the process.

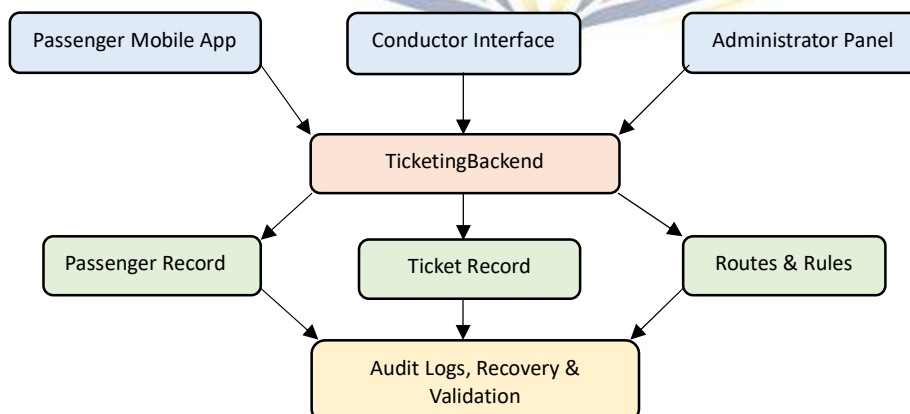


Fig. 1. Conceptual architecture of the proposed digital bus ticket management system.

After successful passenger identification, the conductor selects the destination. The system retrieves the stored route and fare information, records the payment method, and creates the ticket. The conductor workflow is:

Conductor Login → Active Trip → Passenger Mobile → Passenger Check → Destination → Fare → Payment → Ticket

The same interface can support ticket verification and recovery.

D. Administrator Layer

The administrator manages system-level information such as buses, routes, fares, trips, and authorized conductors. This separation prevents ordinary conductor operations from modifying core route or fare configuration.

The administrative workflow is:

Admin → Bus / Route / Fare / Trip Management → Operational Database

E. Ticket Lifecycle

A ticket record should retain its own status. A simple lifecycle is:

CREATED → VALID → USED

with a separate cancellation path:

VALID → CANCELLED

Recovery does not change the ticket state. It only retrieves the existing record. This prevents a recovered ticket from automatically becoming a new ticket.

16. EXPECTED BENEFITS

This technique presents a variety of practical advantages. First of all, it makes it unnecessary to remember the ticket number received from the system. It creates a guided route for passengers who have difficulties accessing the app. Furthermore, it provides separation between the management of routes and fares on the administrative side and the ticketing procedures performed by conductors. In addition, while the ticket number remains a unique identifier, the use of a mobile number makes it easier to search for a passenger. Lastly, it lays the groundwork for future possibilities of QR validation and integration of digital payment systems. The advantages must be tested empirically rather than assumed. Specifically, the application must be tested with passengers and conductors to see if mobile number lookup reduces the time required to retrieve the ticket and if the process is comprehended in realistic bus conditions.

17. LIMITATIONS

There are limitations concerning the reviewed literature and offered concept as well.

Firstly, the suggested mobile-number retrieval mechanism is account-based and, therefore, needs accuracy and safety in relation to the data of passengers. Secondly, the fact that mobile numbers need to be stored implies certain privacy obligations. Thirdly, conductor-driven retrieval means that a trustworthy human being gets involved in the process; therefore, strong role-based authorization and auditing should be involved as well.

Fourthly, QR generation should not be confused with QR scanning which is wholly responsible for carrying out the whole verification process technologically. Failing to implement QR scanning should be presented in sections of future work. Fifthly, it is worth noting that the offered concept is only a prototype-level system and, therefore, cannot be regarded as a production deployment for a real transport authority.

Finally, assessment of large-scale performance, in-field usability, passenger acceptance, and fraud resistance is needed. These points correspond with the findings of the literature which suggests carrying out the evaluation before system-wide deployment [2].

18. FUTURE SCOPE

There are several possibilities for improvement of the suggested system in future projects. The initial approach would be to carry out usability testing with passengers and conductors. Moreover, the evaluation process can be based on the conceptual stages outlined by Bartin et al. [2].

QR code functionality can be improved by transforming it from being just a generator and display into a valuable tool for secure scanning and validation processes. Furthermore, mobile payment can be introduced by documenting the acceptance and security issues mentioned in the work of Di Pietro et al. [12].

Another possible future task relates to low-connectivity operation mode. Most of the modern public transportation works in places where the availability of the network is unstable. Hence, a future version of the system can include secure off-line caching of tickets.

Also, the system can be extended by introducing multilingual interface, SMS notifications, improved audit logs, privacy-sensitive data retention features, and analysis of the performed tasks carried out by administrative staff. An additional experiment can utilize several techniques for the ticket recovery process and compare them in terms of speed of processes, number of mistakes made, and satisfaction level of users.

19. LOST-TICKET RECOVERY WORKFLOW

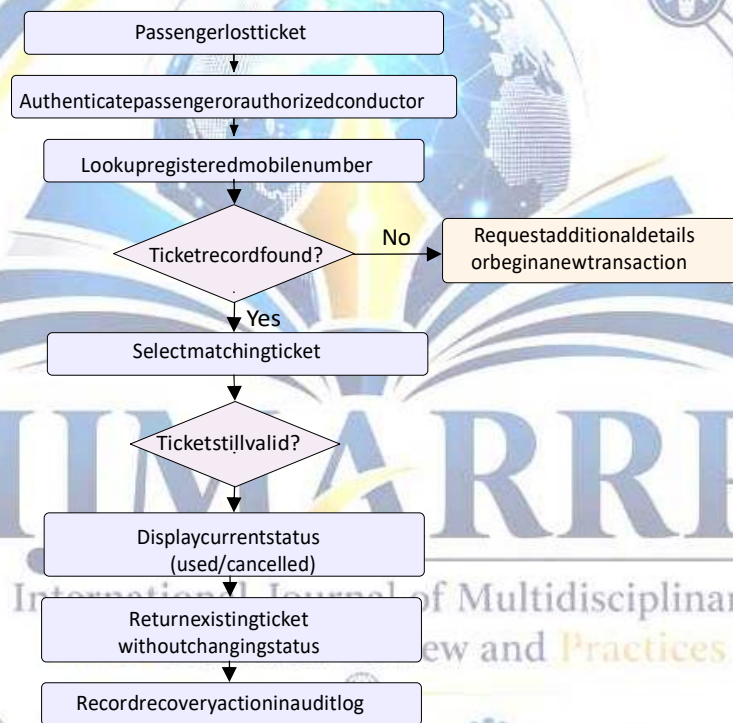


Fig.2. Proposedlost-ticketrecoveryworkflow.

20. CONCLUSION

The ticketing process has evolved from the manual, paper-based systems into automatic systems, using mobile systems, electronic validation, QR codes, and mobile payments. The literature reviewed indicates that these technologies would revolutionize public transport systems in terms of convenience and functionality, but they also impose new requirements in terms of usability, security, privacy, and end-user acceptance.

The literature presents sufficient support regarding each element comprising the digital bus ticketing system. Automated fare collection was studied at the system and customer level [1], [9], [15]; mobile ticketing was researched via adoption studies [2], [5], [6]; QR codes were implemented in the transport ticketing sector along with validation processes [3], [7], [8]; electronic tickets focused on quick validation and privacy [11].

The most important aspect of the suggested project is about alterations occurred to the ticket when it is lost and not easy to recover. The connection of ticket stored on the database with the telephone number of the registered passenger allows having an alternative way of the ticket search without needing to give up using the ticket number as a unique identifier. Also, the

process of recovering through the help of the conductor broadens the possibilities of the application for those passengers unable to use it independently.

Based on the literature reviewed, it is difficult to claim that the proposed solutions are completely new. From one point of view, as a combination of the existing functionality of digital ticketing mechanisms and of the lost ticket recovery and conductor assistance use case, the proposed methods are worthy of prototyping and empirical studies. Hence, the research to be carried out in future should include testing usability, validation of security and privacy, performance testing, QR checking, and testing in real-world settings.

REFERENCES

- [1] M Bieler, A Skretting, P Buding and T-M Gronli "Survey of Automated Fare Collection Solutions in Public Transportation " IEEE Transactions on Intelligent Transportation Systems vol. 23 No. 9 Pages 14248 to 14266 2022
- [2] B Bartin, K Ozbay and H Yang "Evaluation framework for ticketing applications in public transit: a case study," IET Intelligent Transport Systems, vol. 12 No. 9 Pages 1166 to 1173, 2018
- [3] J Mesoraca and C Brakewood "A Synthesis of Mobile Ticketing Applications Used by Commuter Railroads in the United States " Journal of Public Transportation vol. 21, No. 2 Pages 86 to 100 2018
- [4] M Ferreira et al, "Is Bluetooth Low Energy feasible for ticketing in urban passenger transport?" Transportation Research Interdisciplinary Perspectives, vol. 5 Page 100120 2020
- [5] Y -H Cheng and T-Y Huang, "High speed rail passengers mobile ticketing adoption " Transportation Research Part C: Emerging Technologies, vol. 30 Pages 143 to 160 2013
- [6] N Mallat, M Rossi, V Tuunainen and A Oorni "An investigation of mobile ticketing service adoption in public transportation " Personal and Ubiquitous Computing, vol. 12 No. 1 Pages 57 to 65 2008
- [7] C Upendra Reddy et al, "Bus Ticket System for Public Transport Using QR Code " IOP Conference Series: Materials Science and Engineering vol. 590, Page 012036 2019
- [8] C Ong and M Abdullah "Design and Development of Ferry ETicketing System with QR Code based on IoT Technology " Applied Information Technology and Computer Science, vol. 4, No. 1 2023
- [9] A V Gusev and V V Sergeev "Public Transportation Automated Fare Collection Systems Design," Indian Journal of Science and Technology vol. 9 No. 47 Pages 1 to 7 2016
- [10] C Deka et al, "Mobile Ticketing System for Automatic Fare Collection Model for Public Transport " in 2013 5th International Conference on Communication and Information Networking (CICN) 2013
- [11] J Borges and M Sebe "A public transport electronic ticket system with fast validation " Public Transport, vol. 17 Pages 929 to 953 2025
- [12] L Di Pietro, R Guglielmetti Mugion, G Mattia M F Renzi and M Toni "The Integrated Model on Mobile Payment Acceptance (IMMPA): An empirical application to public transport " Transportation Research Part C: Emerging Technologies, vol. 56 Pages 463 to 479 2015
- [13] M-P Pelletier, M Trepanier and C Morency "Smart card data use in transit: A literature review," Transportation Research Part C: Emerging Technologies, vol. 19 No. 4 Pages 557 to 568 2011
- [14] G N Srivastava and H Purohit "Measuring effectiveness of ticketing services of transportation " International Journal of Services and Operations Management, 2021 pages 23 to 46
- [15] P J Foote, R T Patronskey and D G Stuart "Transit Customer Acceptance of Automated Fare Collection Systems " Journal of Public Transportation vol. 2, No. 3 Pages 1, to 20 1999