Ticketless Entry in Heritage Museums

SUBMITTED IN PARTIAL FULFILLMENT FOR THE REQUIREMENT OF THE AWARD OF DEGREE OF

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE

Submitted by

CHIRANJEEV PATEL (2100290120066)

ASHMITA KUMARI (2100290120054)

AYUSH CHAUHAN (2100290120061)

ASHUTOSH SHARMA (2100290120056)

Supervised by

MS. SHRUTI KUMARI

Assistant Professor

Session 2024-25

DEPARTMENT OF COMPUTER SCIENCE

KIET GROUP OF INSTITUTIONS, GHAZIABAD

(Affiliated to Dr. A. P. J. Abdul Kalam Technical University, Lucknow, U.P., India)

May 2025

DECLARATION

We hereby declare that this submission is our own work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

Signature –

Name: Chiranjeev Patel **Univ R No:** 2100290120066

Name: Ashmita Kumari **Univ R No:** 2100290120054

Name: Ayush Chauhan **Univ R No:** 2100290120061

Name: Ashutosh Sharma **Univ R No:** 2100290120056

Date:- 20th April 2025

CERTIFICATE

This is to certify that Project Report entitled **" Ticketless Entry in Heritage Museums"** which is submitted by **Chiranjeev Patel, Ashmita Kumari, Ayush Chauhan, Ashutosh Sharma** in partial fulfillment of the requirement for the award of degree **B. Tech. in Computer Science** of **Dr. A.P.J. Abdul Kalam Technical University, Lucknow** is a record of the candidate's own work carried out under my supervision. The matter embodied in this report is original and has not been submitted for the award of any other degree.

Date: 20th April 2025

Supervisor Name:

Ms. Shruti Kumari
(Assistant Professor)

ACKNOWLEDGEMENT

It gives us immense pleasure to present the report of our B.Tech Project undertaken during our final year. We extend our deepest gratitude to **Ms. Shruti Kumari**, our guide, for his constant support, guidance, and valuable insights throughout the course of our work.

We would also like to express our sincere thanks to **Dr. Ajay Kumar Shrivastava**, Head of the Department of Computer Science, KIET Group of Institutions, for his continuous support. Our heartfelt thanks also go to all faculty members of the department who have assisted us throughout our project. Lastly, we appreciate our friends and family for their encouragement and motivation.

Date: 20th April 2025
Signatures:

Name: Chiranjeev Patel **Univ R No:** 2100290120066

Name: Ashmita Kumari **Univ R No:** 2100290120054

Name: Ayush Chauhan **Univ R No:** 2100290120061

Name: Ashutosh Sharma **Univ R No:** 2100290120056

ABSTRACT

E-ticketing systems represent a transformative shift in access management, particularly within cultural institutions like museums and heritage sites. With over 1,025,000 kilometers of operational coverage and servicing more than 23 million daily visitors, the traditional ticketing infrastructure faces high operational costs—nearly ₹95,000 crore, with ₹23,000 crore spent on paper alone. The proposed system, "**Ticketless Entry in Heritage Museums,**" addresses these challenges by leveraging smart technologies such as **QR code authentication, Aadhaar-based data integration**, and biometric verification to streamline the ticketing process.

This web-based platform enables secure, paperless bookings, real-time ticket validation, and identity verification through facial recognition, reducing the need for manpower while increasing transparency and operational efficiency. It not only minimizes fraudulent entry and environmental waste but also improves the visitor experience through faster access and seamless interaction.

This project aligns with **Sustainable Development Goal 9: Industry, Innovation, and Infrastructure**, which emphasizes building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation. By digitizing heritage access and reducing resource dependency, the system supports the creation of modern, efficient, and environmentally conscious public services.

TABLE OF CONTENTS

CHAPTER 1 INTRODUCTION

1.1   Introduction to Project

1.2   Project Category

1.3   Objectives

1.4   Structure of Report

CHAPTER 2 LITERATURE REVIEW

2.1   Literature Review

2.2   Research Gaps

2.3   Problem Formulation

CHAPTER 3 PROPOSED SYSTEM

3.1   Proposed System

3.2   Unique Features of The System

LIST OF FIGURES

LIST OF TABLES

Table no.	Description	Page no.
4.1	Increment Flow Summary	27

LIST OF ABBREVIATIONS

Abbreviation	Full form
AI	Artificial Intelligence
API	Application Programming Interface
CDN	Content Delivery Network
HTML	HyperText Markup Language
CSS	Cascading Style Sheets
JWT	JSON Web Token
NLP	Natural Language Processing

SDG MAPPING WITH JUSTIFICATION

The Ticketless Entry System for Heritage Museums has a direct impact on the accomplishment of various Sustainable Development Goals (SDGs) by the United Nations. In its design, deployment, and effect, the system addresses many dimensions of sustainability—economic, environmental, and social—through the application of digital technologies in developing effective, secure, and environmentally friendly solutions for public infrastructure. The following is a comprehensive mapping and justification of the system with respect to applicable SDGs.

● SDG 9 – Industry, Innovation, and Infrastructure

The adoption of a secure and technology-enabled ticketing system is an evident contribution towards the modernization of public infrastructure. Heritage museums, which had been using traditional manual systems, are enhanced through digitalization through QR code ticketing, biometric verification, and Aadhaar integration. Such innovations make operations more efficient, enhance service delivery, and create a better experience for visitors. The implementation of strong backend systems, real-time analysis, and secure data management supports the development of resilient infrastructure as well as cultural and tourism innovation.

The infrastructure encourages local innovation through the integration of native identity systems like Aadhaar and biometric authentication for ensuring verification. These technological improvements update museum management and act as models for replicability in other public services, showing a scalable and flexible infrastructure innovation.

● SDG 11 – Sustainable Cities and Communities

Efficient, accessible public services are a necessity for sustainable urban development. The ticketless entry system suggested helps by making cultural spaces more inclusive, safer, and more resilient. The minimization of queue lengths, digital tickets, and real-time monitoring of visitors make crowd management better and overall visitor satisfaction improve, hence making urban cultural sites more livable and easier to manage.

In addition, the combination of biometric identity verification and digital tickets guarantees security and orderliness, both of which are imperative for regulating thick urban tourist sites. In

addition to reducing paper and manpower-intensive services, digitization of traditionally paper- and manpower-hungry services also fortifies the digital backbone of cities and promotes civic-minded behavior.

● SDG 12 – Responsible Consumption and Production

Through the shift from paper-based tickets to digital QR codes and facial recognition technologies, the system greatly decreases the use of physical resources. The paperless initiative eradicates printing, physical ticket storage, and the utilization of consumables, aligning with the mission of responsible consumption. Also, automatic logs and digital records decrease the utilization of physical registers and filing systems, reducing waste from office supplies.

The responsible application of technology in this system also guarantees minimal hardware dependence. QR codes, facial recognition, and web-based booking platforms need just common digital equipment, making the setup both sustainable and simple to maintain. Moreover, by minimizing physical contact and preventing ticketing fraud, the system supports ethical and effective consumption of digital services.

● SDG 13 – Climate Action

The project directly takes climate action through the removal of dependence on paper, ink, and physical movement involved in conventional ticketing procedures. Each digital transaction reduces carbon footprints related to ticket printing, mailing, and disposal. Additionally, on-site administrative efforts reduction and pre-booking facilitation through digital platforms reduce the overall energy consumption at museum facilities.

Even if indirect, the project makes its contribution to environmental awareness by setting an example—showing that digital innovation has the potential to substitute for resource-hungry processes. This is in harmony with national and global initiatives against climate change by minimizing operational carbon footprints.

● Cross-Cutting Impact and Broader Implications

The ticketless entry system, in addition to addressing specific SDGs, encourages a wider shift in the operation of public services. It serves to:

- **Digital empowerment** of communities through accessible, easy-to-use interfaces.
- **Staff and administrator capacity building** in managing digital tools.
- **Policy alignment** with India's Digital India and Smart Cities programs.
- **Replication potential** in other sectors such as public transport, parks, and government offices.

Overall, the project is a manifestation of technology-facilitated sustainable development. It shows that even small changes—such as digitizing museum admission—can have ripple effects throughout infrastructure, environmental policy, citizen behavior, and long-term planning.

This SDG alignment not only enhances the social and environmental focus of the project but also its funding viability, government support, and integration into national development strategies. Thus, the Ticketless Entry System presents an attractive model of how local technological intervention can enhance global development objectives.

CHAPTER 1

INTRODUCTION

1.1 Introduction to Project

In a world where digital transformation is changing the very fabric of daily life, the infusion of technology into conventional systems is not only a luxury but a necessity. In industries like healthcare, education, transport, and tourism, there has been a major thrust towards automation, digitization, and contactless services. Of these industries, the cultural and heritage tourism sector—museums and historical sites in particular—has begun to use digital tools more and more to make operations more efficient and visitor experiences richer.

Traditionally, public access to museums and heritage sites has been based on traditional ticketing using paper tickets sold at on-site counters. Although the system has worked for decades, it has several drawbacks such as long queues, low scalability during peak periods, susceptibility to ticket loss or damage, and high operational costs in terms of printing and manning. Furthermore, the lack of real-time visitor tracking and behavior analysis does not allow administrators to effectively manage crowd flow or tailor the visitor journey.

With India setting itself up as a digital-first country under such national initiatives as Digital India, there is a pressing need to transform access mechanisms to public spaces using technology. Digital ticketing solutions such as Ticketless are cropping up as revolutionary solutions that seek to transform the way museums and heritage attractions deal with visitor entry, interaction, and analytics. By doing away with traditional manual ticketing systems and opting for digital means of access, these solutions increase convenience, security, and operational effectiveness [4].

One of the pillars of this digital revolution is the adoption of QR code-based electronic ticketing solutions. These allow customers to purchase tickets online from websites or mobile apps, obtain a specific QR code, and use it for contactless, hassle-free entry at the site. The move away from physical tickets to digital ones reduces the need for paper, and that plays a big role in ensuring environmental sustainability. It also lowers administrative burden, like the requirement for printing equipment, in-house personnel, and money management. This is especially vital for government-

supported or non-profit organizations that need to minimize costs and enhance the quality of service.

In addition to operational and environmental advantages, ticketless entry systems also cater to health and safety requirements. Throughout the COVID-19 pandemic, contactless solutions became critical in promoting public safety, reducing physical contacts, and assisting in maintaining social distancing rules. Such experiences remain pertinent even during a post-pandemic environment since visitors nowadays demand digital ease and low-contact experiences in public places [6].

Additionally, e-ticketing allows for flexible scheduling and time-slot-based admission, making it possible for institutions to manage crowd intensity during particular hours. This not only provides a more enjoyable and engaging experience to visitors but also safeguards precious artifacts from climatic deterioration due to overcrowding. Effective traffic management using digital solutions facilitates the optimization of space, enhanced utilization of staff, and decorum within culturally sensitive spaces.

Technologically, ticketless systems provide backend integration with data analytics tools to enable administrators to monitor visitor demographics, behavior patterns, peak visiting times, and ticketing preferences. These are useful for exhibition planning, marketing campaign planning, and educational outreach programs. Institutions may also use loyalty schemes, targeted alerts, and customized content depending on visitor profiles, thereby enhancing engagement and improving repeat visits [1].

In addition, QR-based systems limit the risks inherent in counterfeit tickets or unauthorized entrance, which is a typical challenge with physical passes. Because the QR code for each is generated dynamically and often tied to the visitor's contact details, they provide traceability, accountability, and greater levels of security. Lost or forgotten tickets can readily be recovered through the visitor's email or mobile app, eradicating the need for reissue and limiting entry-related contention.

The wider implications of digital access solutions are in line with international trends in smart tourism, digital heritage management, and sustainable development. Ticketless systems are not only advantageous to the visitors and institutions but also serve to position India internationally as a nation that appreciates both cultural preservation and technological innovation. Museums and

historical sites adopting such systems also gain access to modern funding and partnership opportunities, as many international heritage conservation programs now prioritize tech-integrated projects [6].

This project, entitled "Ticketless Entry in Heritage Museums", seeks to conceptualize and create an end-to-end digital solution that substitutes paper tickets with a QR-based alternative. The new platform will enable users to purchase tickets online, receive digital passes, and be granted entry without any physical check, while also ensuring a secure and scalable architecture. The project also seeks administrative dashboards, visitor analytics, and real-time monitoring capabilities for long-term usability.

In short, the shift towards ticketless entry is not just a convenience issue—it is a strategic enhancement that enables museums to function effectively, interact meaningfully with visitors, and protect the rich cultural heritage they are tasked with preserving. As India pushes forward with its digitalization of public services, such innovations will be key to ensuring that heritage and modernity meet in the most seamless and effective manner possible.

1.2 Project Category

The new project, "Ticketless Entry in Heritage Museums," resides mainly within Web Application Development's scope, though its aims and scope lie very much outside a conventional web offering. It's a cross-functional project that intertwines pieces of Smart Infrastructure, IoT (Internet of Things), Cybersecurity, and e-Governance to create an excellent example of each. The way it fits this category showcases not only how good it is as a singular app, but as a key brick in the larger ecosystem of the next-gen public digital utilities.

At its heart, the project revolves around full-stack web development that leverages front-end as well as back-end technologies to produce a stable, scalable, and user-friendly interface. The front-end app centers around providing a seamless user interface for ticket reservation, scheduling, and generating QR codes, while the back-end is concerned with managing secure storage of data, authentication of users, and integrating with third-party services like government APIs and database services. Employing the latest web technologies such as React, Node.js, Express, and MongoDB (or equivalent stacks) guarantees high performance, modularity, and easy future integration.

3

The functionality of the platform depends significantly on database management systems to store and retrieve securely user data, booking histories, visitor logs, and time-slot calendars. With the rise in the number of users, effective database architecture and indexing become essential for the system to continue performing. Support for flexible schema design and real-time querying offered by NoSQL or relational databases is a necessity for the dynamic nature of a digital ticketing platform.

One of the significant features of the project that separates it from standard web applications is its integration with national identity and biometric verification systems. Utilizing secure APIs like those offered by UIDAI (Unique Identification Authority of India) for Aadhaar-based verification, the system can authenticate user identities and grant authorized access. This provides an essential layer of security and dependability, especially for high-traffic or sensitive cultural heritage destinations where visitor identity verification is required.

Further, the project uses QR code technology to enable contactless museum and historical monument entry. The dynamically generated QR codes are linked with distinct user profiles or ticket IDs, which are read at the entry points via mobile devices or in-build kiosk systems. The addition of IoT-capable equipment, like smart gates and QR scanners, translates this system to the domain of Smart Infrastructure where physical access is controlled by digital validation and real-time automation.

Another essential aspect of the project is its dependency on API integration with third-party platforms—varies from national identity verification platforms to digital payment processors and notification services. The API-based architecture ensures that the platform is modular and interoperable and can scale based on adding new features or integrations like multilingual support, facial recognition, or digital tourist guides.

With its extensive functionality and modular architecture, the project is poised to contribute to broader national and international initiatives in Digital Public Infrastructure (DPI), Smart Cities, and e-Governance. It is aligned closely with government initiatives to enhance public access to services through digital means, minimize manual intervention, maximize public transparency, and enhance the operational efficiency of cultural and heritage management authorities.

From the real-world point of view, this project is not just meant for museums but can be expanded to forts, temples, historic sites, and government offices where visitor control, security, and tracking of data are essential. In addition, the scope of the project can be extended to enable mobile apps,

administrator real-time dashboards, cloud monitoring, and even predictive analytics for future capacity planning.

Overall, this project lies in a hybrid category that unites Web Development, Smart Technology Integration, and Public Service Digitization. Being interdisciplinary, using real-time technology, and incorporating government and identity systems, this project is a very relevant solution for the modern digital era, especially in digital tourism, preservation of culture, and secure management of public infrastructure.

1.3 Objectives

The overall goal of this project is to convert the traditional museum entry and ticketing system into a new-age, secure, and completely automated system. The project seeks to develop a web-based platform that facilitates ticketless entry at heritage sites and museums using technologies like QR code, biometric authentication, and Aadhaar integration. The aim is not just to substitute paper tickets but to create a more intelligent, data-led, and people-focused infrastructure for visitor management. The particular project objectives are explained below:

To replace conventional paper-based ticketing systems that are both costly and environmentally unsound. Physical tickets have the cost of printing, distribution, and disposal, which is a recurring expense. By implementing an electronic ticketing system, the project seeks to substantially minimize operational costs and carbon emissions, hence conforming to green and sustainable development principles.

To introduce a safe, Aadhaar-enabled visitor authentication system that builds trust, minimizes fake entry, and allows only authorized people into secured cultural or historical places. By using biometric authentication (like finger print or face recognition) along with a singular Aadhaar number, the system will be able to authenticate the identity of every visitor in real-time. It would be especially useful in sensitive heritage places where identification authentication is a must.

To facilitate an intuitive and interactive web portal for ticket booking, editing, and cancellation. The site will be multi-device compatible, allowing users to easily carry out all activities—booking tickets, choosing time slots, availability check, or canceling visits—easily via laptops, tablets, or

5

mobile devices. This self-service portal will minimize reliance on manual support and enhance service accessibility.

To enhance the working effectiveness of museum personnel through automating routine processes like entry verification, visitor registration, and report preparation. With QR code scanning at the point of entry, the system will automatically mark attendance instantly, minimizing human intervention and allowing for real-time monitoring of visitors. Personnel can devote more time to curation, learning, and hosting rather than administrative tasks.

To enhance the overall visitor experience through minimizing entry waiting times and providing flexible time-slot booking. This removes the need for waiting in long queues, particularly during peak periods, and assists in more evenly distributing visitor traffic throughout the day. Effortless digital access enhances user satisfaction, especially among tech-savvy tourists who anticipate digital convenience while traveling.

To allow museums to acquire meaningful data-driven intelligence on visitor habits, demographics, busiest times of visitation, and booking patterns. This information will facilitate sophisticated analytics for strategic planning around marketing, staffing, exhibition design, and resource allocation. With time, such intelligence can enable museums to refine their offerings and serve their audience more effectively.

To facilitate scalability and interoperability by designing the system architecture in a modular manner. This makes it possible for the platform to be integrated with other government or tourism portals and be scalable to accommodate other heritage sites and public spaces. The aim is to develop a reusable framework that can be adopted nationally or regionally as a digital infrastructure solution.

To provide data privacy and cybersecurity in accordance with the current digital governance and IT legislation. All biometric and personal data gathered should be encrypted and stored securely, and access should be limited to authorized employees only. This goal is extremely important for preserving public faith and statutory compliance, particularly when interfacing with sensitive databases such as UIDAI.

In short, this project is not merely about developing a ticketing tool—it is about developing a scalable, intelligent, and secure digital ecosystem that can be used as a benchmark for how public access to cultural heritage can be made more accessible through the use of technology. By emphasizing usability, automation, identity verification, and analytics, the project is intended to provide a holistic, future-proof solution in line with the objectives of Digital India, Smart Cities, and e-Governance initiatives.

1.4 Report Structure

This project report has been organized with great care into a sequence of well-structured chapters, all of which have been assigned a specific area of the development, implementation, and assessment of the proposed Ticketless Entry System for Heritage Museums. The structure maintains clarity, logical sequence, and an in-depth understanding of the scope and importance of the project. The details of each of the chapters are described below:

- **Chapter 1: Introduction**
  This chapter gives an introductory overview of the project, such as its background, motivation, aims, extent, and significance in today's digital and cultural environment. It lays down the justification for substituting manual ticketing with a digital, secure, and green alternative. It also explains how this project ties in with wider schemes such as Digital India, Smart Cities, and sustainable development.

- **Chapter 2: Literature Review**
  This section presents a critical review of current systems, platforms, and research studies pertaining to electronic ticketing, QR-based access, Aadhaar integration, and visitor management for museums. It highlights the strengths and weaknesses of the current solutions and indicates the research and practical gaps that this project seeks to address. Comparison with international best practices is also presented to place the suggested solution into perspective.

- **Chapter 3: Proposed System**
  This chapter explores the system's architectural blueprint. It provides a detailed explanation of the planned solution, ranging from system modules to user roles, workflows, and technology elements. The interaction designs, data flow models, and architecture diagrams show how

users will be interacting with the system, how the QR code generation and validation are made, as well as how data is securely transmitted and stored.

- **Chapter 4: Requirement Analysis & System Specification**
  This chapter presents all the functional and non-functional requirements of the system. It includes both software and hardware aspects, including servers, database services, web browsers, biometric sensors, and QR code scanners. The requirement gathering and system design methodology used is also explained, along with in-depth system specifications like platform architecture, protocols, and development environment setup.

- **Chapter 5: Implementation**
  This chapter explains the actual development process, explaining the coding structure, tools, and technologies involved. It clarifies how modules such as user registration, ticket booking, QR generation, Aadhaar verification, admin dashboards were constructed and integrated. In case machine learning or analytics tools are included, this section also contains details about datasets, preprocessing techniques, and algorithm selection. Screenshots and code snippets are provided to show core functionalities.

- **Chapter 6: Testing & Maintenance**
  A stable software system needs to be thoroughly tested to be reliable and secure. This chapter describes the types of testing used, including unit testing, integration testing, system testing, and user acceptance testing (UAT). It also contains sample test cases, expected vs. actual results, bug tracking logs, and performance reviews. It also describes future maintenance plans and how system upgrades will be managed.

- **Chapter 7: Results & Discussions**
  This chapter provides the primary results of the system, including performance targets, user reviews, load carrying capacity, and responsiveness of interfaces. It has graphical proof of successful deployments like UI snapshots, QR scans, booking confirmations, and backend logs. This is followed by a discussion that compares desired objectives with actual results, and solves any issues encountered in the process of development.

- **Chapter 8: Conclusion & Future Scope**
  This chapter recapitulates the accomplishment of the project and stresses its significance in contemporaryizing access to cultural heritage. It considers how the system addresses the initial

goals and examines its long-term impact. In addition, it considers possible avenues for future growth, including its extension to other areas (e.g., transportation, events), incorporation of mobile applications, or its inclusion of AI-based visitor suggestions and behavior analysis.

- **References & Appendices**
  This last section contains all the reference to research articles, technical reports, websites, and frameworks quoted in the report. It is in IEEE or APA citation style where necessary.

CHAPTER 2

LITERATURE REVIEW

2.1 Literature Review

The development of electronic ticketing systems has greatly revolutionized the way the users interact with public services, particularly in sectors such as transport, tourism, and cultural site management. Electronic systems have introduced advantages like efficiency in operations, enhanced visitor experience, minimized paper usage, and decreased administrative expenditure. As India proactively heads towards a digitally empowered nation, the significance of such systems to improve service delivery has grown manyfold [6].

Conventional ticketing systems, based on physical counters and paper tickets, have long been a problem—long lines, misplaced tickets, human mistakes, and ineffective tracking mechanisms. With mobile and internet penetration in India, digital ticketing platforms now provide a chance to reimagine public access systems, particularly in the case of museums and heritage sites, where managing visitor numbers and maintaining cultural artifacts are both essential [4].

Even with these improvements, most contemporary e-ticketing systems have usability constraints. One of the problems underscored in several studies is the need for user registration or login prior to accessing elementary capabilities, like inquiring about ticket availability or viewing entry slots. Such an obstacle tends to deter occasional or initial users from utilizing the site to its full potential [2]. Some researchers have thus proposed a model where the authentication or login step is postponed to the time of the actual transaction or booking, thus improving user convenience and minimizing friction.

One such practical research addressing this issue is the paper "Android Application for Ticket Booking and Ticket Checking in Suburban Railways," which was published in the Indian Journal of Science and Technology [7]. In this study, the authors investigated a mobile ticketing system based on QR code technology to electronically verify tickets. Although the essential ticketing information was provided through SMS, the inability of SMS to carry images necessitated a solution. Consequently, customers were requested to create and screenshot the QR code from the web interface, which could then be read during journeys. This hybrid approach struck a balance between accessibility and digital authentication, but it also created issues with static QR codes being reused or shared inappropriately.

To avoid such problems, research has underlined the use of encrypted QR codes, which include information like user ID, time, and distinct transaction IDs. This method minimizes the chances of forgery or misuse [2]. Encryption schemes and digital signatures also make the data in QR codes tamper-resistant and scannable while verifying it.

Moreover, some researchers propose integrating national identity systems, such as UIDAI's Aadhaar, to add an additional layer of verification and personalization. Aadhaar-linked authentication, especially when combined with biometric inputs like fingerprint or iris scans, can ensure that the ticket holder is indeed the person making the entry. This is especially relevant for sensitive or high-traffic heritage sites where crowd control and traceability are vital [1].

Contactless ticketing, particularly in the wake of COVID-19, has also been a prime area of focus in existing literature. Researchers opine that QR code-based, mobile-first platforms provide socially distanced and hygienic entry procedures without the requirement of physical contact with counters or personnel [6]. This is not just better for public health security but also simplifies entry management, enabling the authorities to dynamically distribute resources according to real-time data.

Another prominent area in the literature to be discussed here is data analytics in digital tickets. Those institutions that gather visit interaction data including visiting time preferred, entry period, revisit numbers, and geospatial visitor demographics enable the museums to act on data, making decisions from it. From these data-derived insights, decisions can be based on targeted promotions, resource efficiency, and customer-specific engagement opportunities, enhancing cultural experience as it becomes more vibrant and efficient [4].

In addition, scientists have suggested the inclusion of IoT sensors, cloud databases, and automated loggers in such systems to allow scalability and high availability. A smart infrastructure with the ability to manage peak-season bursts without degrading system stability is essential in real-world implementations [1].

In spite of all these innovations, a research gap continues to exist regarding designing ticketless entry solutions for Indian heritage institutions tailored to their needs. Most systems are developed for generic transport or entertainment domains and fail to address the finer requirements of museums—multilingual interfaces, guided tour capability, and artifact-linked digital narratives. This provides a scope for domain-specific solutions that are not just technologically sound but also culturally adaptable.

In summary, research in the domain validates the creation of a secure, scalable, Aadhaar-enabled, QR code-based ticketless system. Such systems are found to:

• Enhance visitor accessibility by postponing compulsory login phases [2].

• Increase security with encrypted and dynamic QR codes [7].

• Provide real-time validation and tracking [6].

- Minimize operational workload through automation and paperless processes [4].

- Facilitate advanced analytics for strategic decision-making [1].

The suggested project takes these as a basis in order to develop and deploy a solution custom-designed for an Indian heritage museum, to solve both the technology and context-dependent challenges that have been highlighted in the current pool of research.

2.2 Research Gaps

Whereas much has been achieved in the area of digital and electronic ticketing, a number of open issues and restrictions persist, and they do not allow such systems to become all they could be—specifically for the area of heritage locations and museums. Where there is universal usage of digital solutions among transportation and leisure industries, cultural organizations have trailed behind owing to an interaction of infrastructure shortcomings, policy shortfalls, and the absence of accessible technologies.

One of the primary issues witnessed in existing digital ticketing systems is the need for compulsory user authentication or registration, even for simple, low-sensitivity operations like viewing ticket availability or exploring event timings. This not only presents an unnecessary hurdle to infrequent users but also restricts the openness of the platform to impromptu or one-time visitors. Many potential users may abandon the process midway if the interface is perceived as complex or intrusive. In a digital-first nation like India, ease of access is critical to ensure inclusivity and high user engagement.

Another significant gap is the absence of interface with national identity systems such as Aadhaar, which can offer strong and secure authentication based on demographic and biometric information. Aadhaar has seen extensive adoption in services such as banking, telecom, and subsidies but its application in visitor authentication and access control in public institutions is yet to reach its full potential. Inclusion of Aadhaar verification can bring a substantial layer of trust, personalization, and traceability, especially in the regulation of large crowds at popular heritage sites.

Existing e-ticketing deployments also often use text-based SMS for the delivery of ticketing information. This has two significant shortcomings: (1) SMS tickets do not contain visual validation elements like scannable QR codes, and (2) they can be easily forged or duplicated because the content of the ticket is static. A shift towards encrypted, dynamic, and image-based

QR codes would not only improve ticket security but also enable automatic scanning and logging, which lessens the workload on entry gate staff.

In addition, current platforms do not usually have real-time data gathering functionalities that could otherwise revolutionize the operational intelligence of such systems. Without analytics and reporting capabilities, institutions are unable to effectively track visitor patterns, forecast peak hours, or tailor visitor experiences. The lack of data-driven insights also keeps authorities from optimizing staffing, maintenance, and exhibit planning—leading to a less responsive and adaptive service environment.

Furthermore, cultural and heritage institutions—unlike transport or film industry counterparts—traditionally still resort to manual or semi-digital ticketing and entry systems. Such systems by their very nature are limited when it comes to scalability, security, and efficiency. Manual processes of verification take up time to process entries, introduce more opportunities for human errors, and leave little trace in the event of an incident or dispute. In the post-pandemic world, where contactless entry and crowd management are now essential for safety and compliance, such antiquated systems pose a major operational risk.

Another aspect that is neglected in existing systems is inclusive design. Most platforms are not multilingual or differently-abled friendly, which limits accessibility. A well-designed, contemporary platform should be multilingual, screen-reader friendly, and voice-navigable for visually impaired users—making the digitization of public heritage services accessible to all segments.

In conclusion, some of the major research and development gaps in existing ticketing systems are:

- Stiff login guidelines that discourage user discovery prior to commitment.
- Insufficient biometric or Aadhaar-based verification, compromising security and individualization.
- Reliance on plain-text or SMS-based ticketing models, restricting automation and opening misuse opportunities.
- Inadequate infrastructure for data analytics, leading to poor service optimization and experience personalization.
- Insufficient use of digital ticketing in cultural organizations, causing them to lag behind in new crowd management, access security, and operational efficiency.

- Insufficient accessibility features, excluding specific user groups from equally benefiting from digital solutions.

Filling these gaps is important for creating a next-generation, scalable, and secure ticketless entry system designed specifically for Indian museums and heritage sites. The proposed project will bridge these gaps through full-stack web development, Aadhaar-linked visitor verification, QR-based digital ticketing, and analytics-driven backend support, thus empowering cultural institutions to become part of India's larger Digital Public Infrastructure movement.

2.3 Problem Formulation

In today's digital era, where rapid technological advancements are transforming public services across sectors, museums and heritage sites remain largely underserved in terms of digital infrastructure. While e-ticketing solutions have gained traction in sectors such as transportation, cinemas, and large-scale events, their implementation in the cultural and heritage domain is still limited, fragmented, and inadequate. This results in persistent issues related to visitor convenience, ticketing efficiency, and crowd management.

The root issue is the lack of an integrated, secure, and scalable digital ticketing system that is specifically designed for the operational requirements of heritage museums and provides a seamless user experience for the visitor. Traditional systems adopted by most museums remain either manual or semi-digital ticketing, which brings with it a number of inefficiencies like long lines, loss of tickets, non-transparency, and great administrative burden.

One of the key weaknesses of current systems is their inflexibility to manage various types of visitors. Most platforms require compulsory login or registration merely to see ticket availability or price, which is counter-productive for casual users and delays the decision-making process. An user-friendly system must provide guest access to core features such as viewing available time slots and ticket prices without advance authentication.

In addition, digital ticket security is usually breached by the use of plain-text SMS or static digital formats that are susceptible to duplication, forgery, or unauthorized access. There is a pressing need for a solution that enables encrypted, scannable QR code generation, making each ticket unique, traceable, and validated only once upon entry.

Another important missing piece is the absence of integration with Aadhaar-based identification and biometric systems. Given that Aadhaar is already prevalent in India as a secure and verifiable digital identity, its integration into museum entry systems can provide authenticated, authorized, and traceable access. Additionally, biometric verification (e.g., fingerprint scanning or facial recognition) can stop ticket fraud and unauthorized entries, particularly in high-traffic locations.

Moreover, the management point of view of museum authorities has largely gone unnoticed. Most platforms do not offer real-time visitor data, including peak hours, demographics, or return visits. Without visitor analytics, it leads to inefficient crowd management, wasted resources, and lost opportunities for targeted outreach.

To fill these gaps, the solution proposed here will provide a holistic, web-based e-ticketing solution particularly suited for cultural centers. The solution would have the following features:

- A user-friendly interface for guests to look up ticket availability and museum details without having to log in.
- A secure QR code generator that encrypts ticket information and allows real-time scanning at entrances.
- Aadhaar-based data fetching and biometric authentication to verify users and provide secure access.
- Registration support for both registered and walk-in visitors, facilitating quick check-ins and easing crowds.
- A robust admin panel offering museum administrators real-time visitor records, heat maps, and analytics insights for informed operational decision-making.

Through the convergence of full-stack web development, IoT-based biometric platforms, and APIs of government digital identity platforms, this project aims to fill the gap between conventional public services and new-age smart infrastructure. The solution not only raises visitor satisfaction but also equips institutions with the capabilities to optimize operations efficiently as per the Digital India initiative.

CHAPTER 3

PROPOSED SYSTEM

3.1 Proposed System

The proposed system aims to revolutionize visitor management at heritage museums by implementing a fully digital, ticketless entry platform. Using QR code technology and biometric authentication, the system streamlines ticket booking, validation, and visitor verification processes, minimizing operational costs and enhancing the overall visitor experience.

The web-based platform enables users to easily book, view, and cancel museum tickets. Visitors can check ticket availability without logging in, promoting casual browsing and ease of access. Once a user decides to proceed with booking, they must authenticate via a registered account to ensure secure transactions. During booking, essential visitor information such as name, gender, and age is directly retrieved from the Aadhaar database using provided identifiers, ensuring accuracy and minimizing manual input.

Upon successful ticket booking, a QR code containing the visitor's Aadhaar-linked ticket information is generated, which can be saved for later use. At the museum entrance, visitors validate their tickets by scanning the QR code, followed by biometric identity verification using Aadhaar-based data. This dual-layer verification enhances security, eliminates unauthorized access, and ensures that the ticket is used by the rightful owner.

Additionally, for visitors unaware of the online booking facility, the system integrates a **Facial-Based E-Ticketing System (FBET)** at on-site ticket counters. Here, the visitor's face is scanned to generate a unique ID linked to their payment details, enabling seamless, paperless entry without needing to carry physical tickets.

By minimizing the need for paper, reducing administrative burden, and improving security measures, the system offers a sustainable, efficient, and user-friendly solution tailored to the needs of modern cultural sites.

3.2 Unique Features of The System

The proposed system introduces several innovative features that distinguish it from traditional and even existing e-ticketing solutions:

- **QR Code-Based Ticketing:** Each booked ticket generates a unique QR code linked with Aadhaar information. This enables easy, fast, and secure scanning at entry points, reducing bottlenecks and waiting times.

- **Biometric Verification Integration:** To prevent misuse of tickets, biometric authentication cross-verifies the visitor's identity with their Aadhaar details at the entrance. This ensures the authenticity of each visitor and curbs fraudulent activities.

- **Facial-Based E-Ticketing System (FBET):** For walk-in visitors who do not use online booking, facial recognition technology is deployed. Ticket vendors capture the visitor's image, link it with their payment, and allow facial-based entry, eliminating the need for any physical or digital ticket carrying.

- **User-Friendly Booking Process:** Unlike conventional systems that mandate login just to view ticket availability, this platform allows users to explore ticket options without immediate authentication, enhancing casual user engagement.
- **Real-Time Ticket Availability:** Visitors can check real-time ticket availability for their preferred museum and plan their visit accordingly, thus improving flexibility and satisfaction.

- **Secure Data Handling:** By integrating directly with government databases like Aadhaar for information retrieval and verification, the system minimizes manual errors, enhances data accuracy, and ensures secure handling of sensitive personal information.

- **Multi-Modal Payment Options:** The platform supports various payment methods, including debit/credit cards and net banking, facilitating convenience for users with different preferences.

- **Environmental Sustainability:** By going paperless, the system significantly reduces paper waste, contributing to eco-friendly initiatives and promoting sustainable practices within cultural institutions.

By merging modern technology with visitor-centric design, the proposed system not only digitizes ticketing processes but also sets a new benchmark for secure, efficient, and satisfying visitor experiences at heritage sites.

CHAPTER 4

REQUIREMENT ANALYSIS AND SYSTEM SPECIFICATION

4.1 Feasibility Study

A feasibility study evaluates the practicality and sustainability of the proposed ticketless museum entry system across technical, economic, and operational dimensions.

4.1.1 Technical Feasibility

Technical feasibility of the suggested "Ticketless Entry in Heritage Museums" system has been considered on the basis of availability, reliability, compatibility, and potential for integration of the fundamental technologies involved. The system has been planned to operate using widely available tools and platforms, so it is very deployable with available technological infrastructure. The key constituents considered for feasibility are:

1. Web Application Development Frameworks

The system architecture is based on full-stack web development with established frameworks like React.js or Angular for the front end, and Node.js, Spring Boot, or equivalent platforms for the back end. The technologies are established, open source, and documented, which provides ease of development, scalability, and maintenance in the future.

2. QR Code Technology

QR code scanning and creation are at the core of the ticketless entry process. Several open-source libraries (e.g., qrcode, ZXing, qr-scanner) exist that can be used for backend QR creation and frontend scanning. These libraries are light, precise, and compatible with all contemporary web and mobile devices, making integration possible without any proprietary hardware requirements.

3. Database Management

For the storage of visitor information, booking information, and access records, widely used and stable databases like MongoDB, MySQL, or PostgreSQL can be utilized. These databases offer robust data management, quick read/write performance, and flexible schema support, which is important for dealing with structured and semi-structured data such as biometric information, ticket metadata, and access records.

4. Aadhaar-Based Biometric Verification

The project incorporates Aadhaar authentication APIs from UIDAI that provide biometric verification services including fingerprint and iris scans. It is possible to integrate through API calls and UIDAI-provided SDKs for authorized government or institutional applications. The system is set to run securely under UIDAI standards with the use of encrypted data transmission and two-factor authentication to guarantee privacy and security compliance.

5. Facial Recognition Systems

Optional biometric authentication can also be done through facial recognition software. Libraries like OpenCV, Face API.js, or AWS Rekognition can be incorporated to execute real-time face detection and comparison. These applications are compatible with common webcams and do not need expensive equipment, so they are cost-efficient as well as technically feasible.

6. Internet and Device Compatibility

From the user's point of view, minimal technological specifications are required:

- A smartphone or computer with an internet connection.
- A web browser (Chrome, Firefox, Safari, etc.) to view the ticketing portal.
- A camera-enabled device for QR code scanning or facial recognition, where necessary.

These minimal hardware requirements make it widely accessible and usable, particularly in developing countries.

7. Server Hosting and Cloud Services

Cloud platforms like AWS, Microsoft Azure, or Google Cloud Platform (GCP) can be utilized for deployment, thereby providing high availability, fault tolerance, and elastic scaling. Cloud hosting and storage minimize local infrastructure dependencies and provide added security and backup capabilities.

4.1.2 Economical Feasibility

The suggested "Ticketless Entry in Heritage Museums" system has been thoroughly assessed for economical feasibility, such that the expenses incurred during development, deployment, and maintenance are offset by the long-term savings and value provided to the institution and its visitors alike.

1. Cost Comparison with Traditional Systems

Conventional ticketing systems are based extensively on manual processes, such as:

- Printing and distribution of physical tickets.

- Employment of ticket counter and entry validation staff.

- Printer, kiosk, and physical infrastructure maintenance.

- Storage and handling of paper records.

These ongoing expenses add up over time and are prone to inefficiencies, fraud, and human error. In comparison, the system proposed here cuts operational overhead considerably by doing away with:

- Paper tickets.

- Ticketing personnel at entry points in multiples.

- Physical validation devices such as barcode readers and printers.

Therefore, cultural institutions and museums can look forward to the marked decrease in first-year implementation costs, particularly in high seasons when printing costs and labor fees typically peak.

2. Cost-Effective Implementation of Technologies

The enabling technologies used, like QR code creation, web interfaces, and cloud-based databases, are community-license or low-cost-to-licenses, most under freemium or community licensing models. Main advantages include:

- Open-source QR libraries decrease development costs.

- Free-tier cloud services (such as AWS, Firebase, or MongoDB Atlas) enable small museums to start with minimal or no initial infrastructure cost.

- Modular system architecture facilitates incremental upgrades and growth following traffic volume and budget availability.

3. Scalable and Cloud-Based Infrastructure

The system takes advantage of cloud computing for hosting and storage, offering a pay-as-you-go pricing model. This means the museum only pays for what it uses—reducing the need for large initial capital outlays on servers or IT infrastructure. Cloud services also cover automated updates, backups, and security measures, further cutting down on the system maintenance costs and IT support personnel.

4. Low Hardware Investment

On the hardware side, the system is designed to work effortlessly with current mobile phones, laptops, or tablets. Scanning QR codes can be accomplished through standard smartphone cameras, whereas biometric authentication (if included) can draw from low-cost fingerprint scanners or webcam-based facial recognition technology. This renders the system economically feasible even for small or budget-sensitive institutions, with minimal investments in basic hardware upgrades.

5. Long-Term Return on Investment (ROI)

Although there is a one-time cost of software development, integration with Aadhaar APIs, and low hardware procurement, the long-term return on investment is extremely positive. This is because:

Reduced recurring expenses.

- Improved operational efficiency.

- Enhanced visitor management and satisfaction, which can lead to increased footfall and revenue.

- Integration with data analytics, enabling museums to make more intelligent marketing and resource allocation decisions.

6. Government Funding and Grants

Since the project fits into Digital India, Smart Cities, and e-Governance missions, there is a high chance of government funding, subsidy, or public-private partnership possibilities. In such funding, the initial cost of development can be subsidized, particularly for institutions with historical or cultural importance.

4.1.3 Operational Feasibility

The system's user-friendly interface, online booking options, and support for on-spot ticket generation through face scanning ensure seamless operation. Staff training needs are minimal, and users require basic digital literacy. Operationally, the system reduces administrative workloads, enhances visitor satisfaction, and strengthens security, making it a highly feasible solution.

4.2 Software Requirement Specification

The Software Requirement Specification (SRS) provides vivid descriptions of the overall behavior, inputs, outputs, constraints, and operational conditions of the ticketless entry system in order to maintain clarity and effectiveness in the implementation.

4.2.1 Data Requirement

● User Information: User identification information such as Name, Gender, and Age, precisely categorized from the Aadhaar database to confirm authenticity and accuracy.

● Booking Details: Complete information including museum identification, dates of visit, time slots, status of booking, and number of visitors for a booking.

● Payment Details: Complete payment data including transaction channels (debit/credit card, net banking), transaction IDs, payment status, and timestamp for audit trails.

● QR Code Data: Securely encoded Aadhaar-linked ticket details to provide authenticity, validity, and anti-duplication or fraud protection.

● Biometric Data: High-resolution facial scan photographs and Aadhaar-linked biometric information gathered for rigorous visitor identity validation and safe storage.

● Visitor Logs: Complete logs comprising entry validation records, precise timestamps of visits, ticket scanning events, biometric authentication status, and visit confirmations.

4.2.2 Functional Requirement

● Ticket Booking: Authenticated users should be able to book tickets seamlessly through secure login systems, offering correct and timely reservation features.

● Ticket Availability Check: Real-time ticket availability checks that are accessible to all visitors without the need for authentication, allowing for convenient initial access to availability data.

● QR Code Generation: Auto-generation of secure, unique QR codes on successful payment, with visitor information, booking details, and secure tokens.

● Ticket Cancellation and Viewing: Facility that allows authenticated users to easily view current bookings, handle cancellations, and retrieve refreshed booking statuses.

● Facial-Based Ticket Generation: At museum site counters, permitted sellers effectively extract visitor facial biometrics to produce secure, biometric-linked electronic tickets in a jiffy.

● QR Code Scanning: At museum entrances, effective scanning and authentication of QR codes to facilitate smooth, fast, and secure entry of visitors.

● Biometric Authentication: Effective Aadhaar-based facial or biometric identity authentication systems to ensure trustworthily authenticating visitor identities on entry.

● Database Management: Complete, secure database solutions to keep precise records of user details, booking information, payment transactions, generation of QR codes, biometric authentications, and visitor entry approvals.

4.2.3 Requirement for Performance

● System Response Time: The critical processes of booking transactions, generation of QR codes, and entry approvals should be executed reliably within 2–3 seconds.

● Simultaneous Users: With ability to manage effectively at least 500 simultaneous users, to assure steady performance with negligible delay throughout the most busiest of museum visits.

● Scalability: System should be demonstrably robust to scale up visitor numbers as well as be compatible to be installed with more museums seamlessly without sacrifice of performance.

4.2.4 Requirement of Maintainability

● Modular Design: Well-organized, modular design allowing separate maintenance, upgrade, and enhancement of particular functional areas like booking, validation, and cancellations without affecting the system as a whole.

● Error Logging: Sophisticated, comprehensive error logging features able to capture, monitor, and analyze system aberrations and working errors in order to provide for prompt problem resolution and speedy restoration.

● Database Backup: Periodic automatic backups and recovery processes to maintain data integrity, continuity, and robustness against unforeseen data loss or system crashes.

● Documentation: Complete, concise, and organized documentation of all the system's facets for ease of future development, regular maintenance, and effective troubleshooting processes.

4.2.5 Security Requirement

● Authentication: Secure and authenticated user authentication mechanisms that guarantee only valid and registered users can conduct ticket booking and cancellations, ensuring system integrity and visitor data security.

● Data Encryption: Robust encryption mechanisms for sensitive information such as Aadhaar numbers, payment information, and biometric data, assuring secure data transmission and storage against unauthorized access.

● QR Code Authentication: QR codes should have strongly encrypted information to avoid tampering, copying, or fraudulent use, assuring secure and authentic visitor access.

● Biometric Security: Secure storage of biometric information with tightly controlled access limited to legitimate verification systems and processes, assuring privacy and data protection law compliance.

● Fraud Detection: Sophisticated fraud detection mechanisms that can detect, flag, and alert museum officials to anomalies like repeated bookings or identity usage irregularities for the same time slot, adding security and confidence in the system.

These additional requirements offer a comprehensive and strong framework, guaranteeing thorough system functionality, security, maintainability, and performance, which works well with the operational objectives of heritage museum management.

4.3 SDLC Model Used

The Software Development Life Cycle (SDLC) methodology applied to the "Ticketless Entry in Heritage Museums" project is the Incremental Model. This model breaks down the development process into smaller buildable parts, each addition building on the current system with additional functionality. By using this model, the team got early returns on key features, frequent feedback loops, and the flexibility to respond to changing needs along the way.

Overview of the Incremental Model

Within the Incremental Model:

1. The whole system is broken down into separate functional modules.
2. Each increment is built via phases: requirement analysis, design, coding, testing, and integration.
3. Incremental initial building addresses fundamental system functionality (i.e., ticket viewing and booking).
4. Later increments add advanced functionalities (i.e., admin analytics, biometric verification)
5. A new increment augments the pre-existing system developed so far and enhances its feature and capability.

Reason for the Selection of Incremental Model

Early and Functional Delivery

The system was initially rolled out with the core features of registration, booking, and QR generation. This assisted in initial user testing and debugging. Other modules such as facial-based ticketing, Aadhaar integration, and admin dashboards were introduced in subsequent increments, minimizing initial complexity.

Risk Minimization

High-risk aspects like biometric authentication and real-time Aadhaar verification were deferred to subsequent increments. Phased deployment enabled the team to concentrate on stability and minimize critical system failure risk in initial stages.

Enhanced Feedback Integration

Every iteration provided users (peers, faculty) with a working prototype for testing and feedback. Feedback from previous builds was incorporated into subsequent increments, which ensured enhanced usability, performance, and security.

Modular Scalability

Features such as multilingual support, analytics based on AI, and integration with national platforms (e.g., DigiLocker) can be easily integrated in future releases. The system can be installed in other museums with minimal modifications, owing to this modular architecture.

Concurrent Team Development

Various team members developed different modules (frontend, backend, database, biometric APIs) concurrently. This hastened development and ensured optimal utilization of team resources.

Effective Testing and Maintenance

Each step was tested separately, minimizing debugging complexity. Maintenance and future upgrades are simpler since individual modules can be updated without disrupting the whole system.

Increment Flow Summary

Increment	Features Delivered
1	User registration, check for ticket availability, booking of ticket, and QR code generation.
2	Ticket cancelation, view past tickets, and admin dashboard fundamentals.
3	Aadhaar authentication, biometric verification, and visitor logs.
4	Ticketing of facial walks-ins, performance enhancement, and real-time analytics for admins.
5	Mobile app integration, multi-language interface, and national digital identity systems.

Table 4.1

Alignment with Future Goals

The incremental model's iterative nature guarantees that this project can adapt as needs arise. For example, if the government enforces centralized ticketing via a national portal, the system can incorporate its APIs seamlessly without refactoring the whole codebase. Likewise, if facial recognition is replaced by fingerprint or retina scanning, those modules can be swapped out independently.

Therefore, the Incremental Model not only aligned with the present objectives of this project but also guarantees long-term sustainability, flexibility, and maintainability.

4.4 System Design

The system design outlines the structure and data flow of the ticketless entry application.
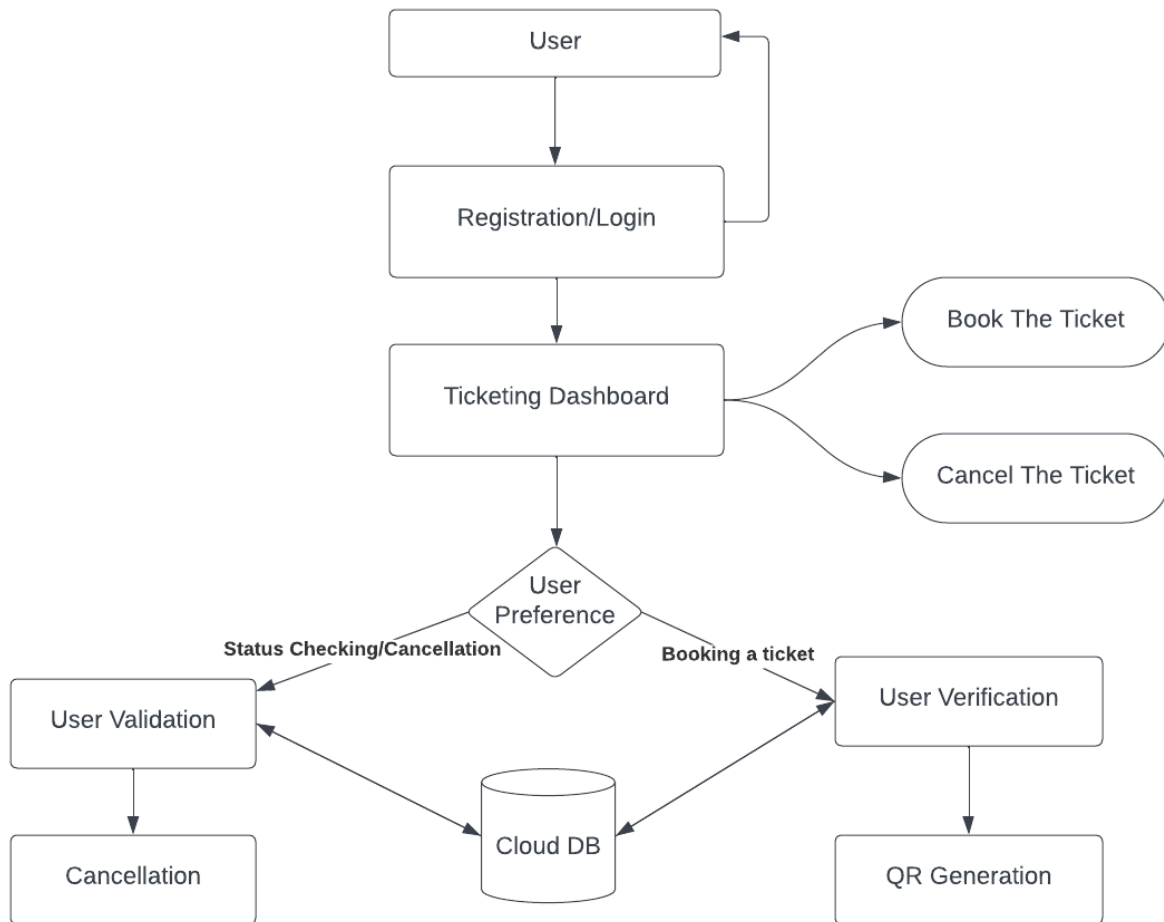
4.4.1 Data Flow Diagrams (DFDs)

Figure 4.1
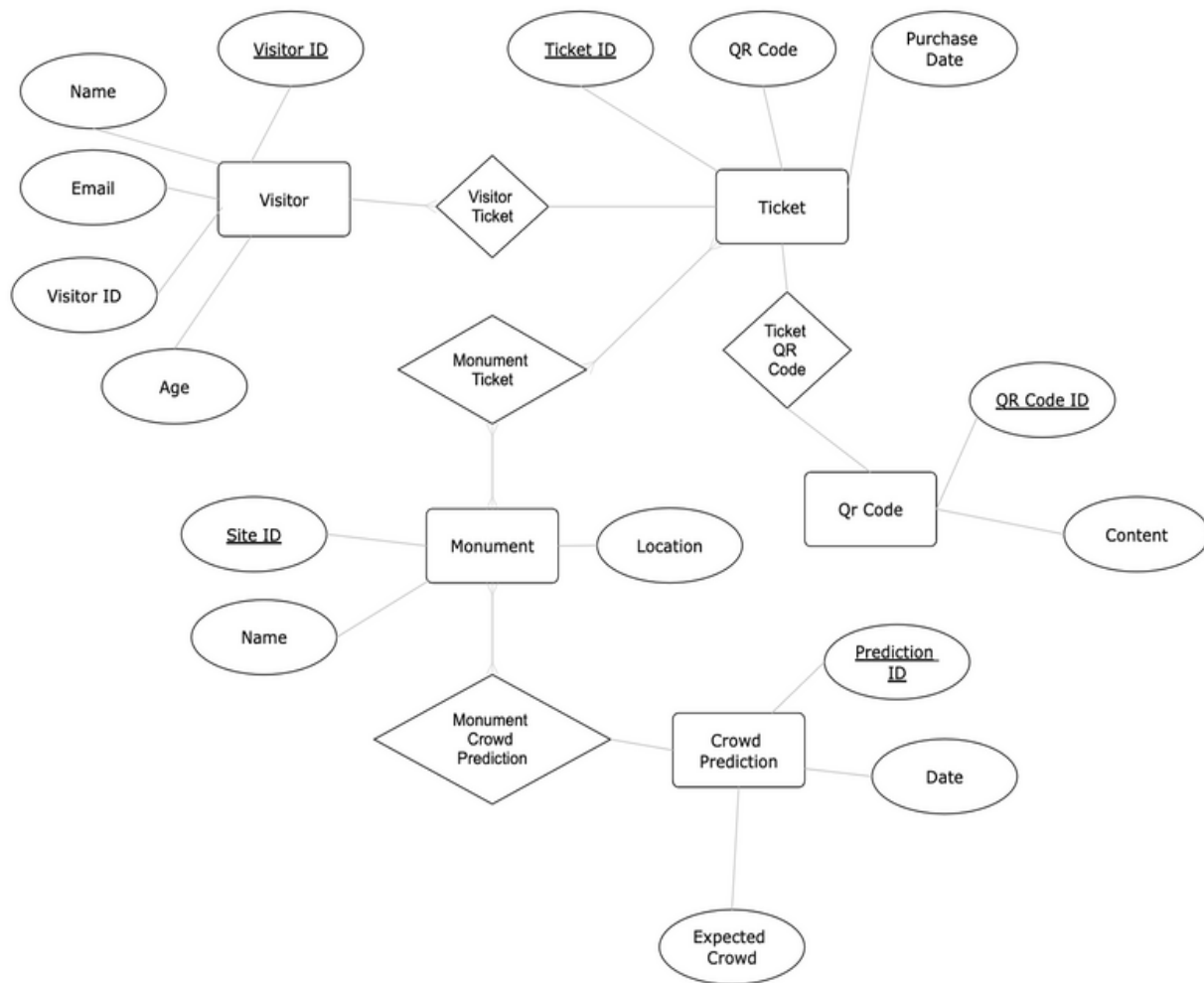
4.4.2 Entity Relation-Diagram (ER-Diagram)

Figure 4.2

4.4.3 Use-case Diagram
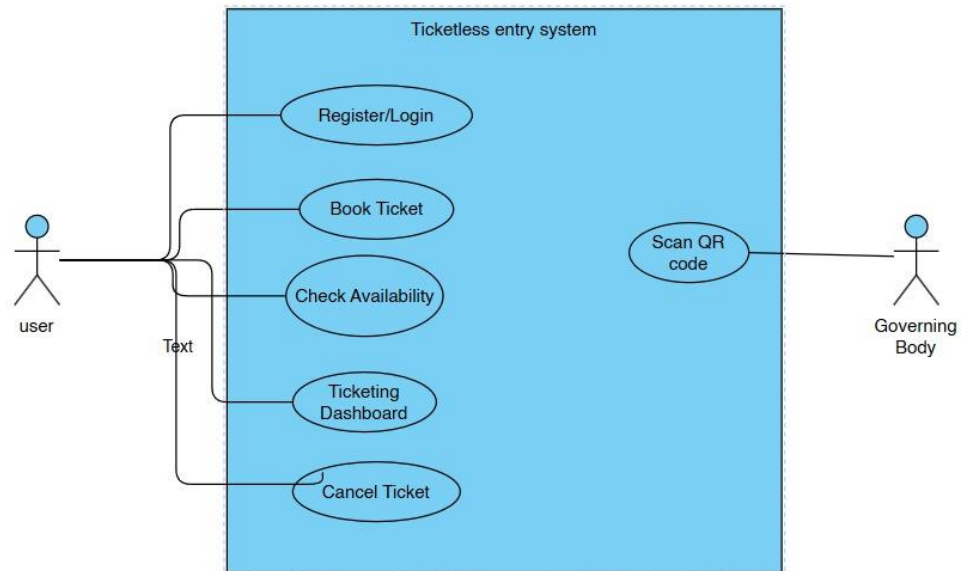

Figure 4.3

CHAPTER 5

IMPLEMENTATION

5.1 Tools and Technologies Used Introduction

The development of the "Ticketless Entry in Heritage Museums" system needed the selection and integration of a set of modern, secure, and scalable technologies to provide reliable performance, security, and user-friendly experience. Each of the technology stack elements was selected to address the specific requirements of building a completely digital, efficient, and contactless museum ticketing system. Below is a more detailed description of the tools and technologies used:

● **Frontend Development**: The platform's user interface was created with HTML, CSS, and JavaScript to make it responsive and cross-browser compatible. React.js, a robust JavaScript library, was utilized to create dynamic and interactive UI components that support real-time updates and an intuitive user experience. Its component-based structure enabled modular development and reuse.

● **Backend Development:** Server-side logic was built leveraging Node.js due to its support for non-blocking I/O and high performance with simultaneous requests. Express.js, a lightweight and flexible Node.js web application framework, was employed to organize the backend with strong routing and middleware capabilities, facilitating effective user request management, session handling, and API communication.

● **Database Management**: MongoDB, a NoSQL database, was selected due to its adaptability in the storage of semi-structured data and scalability to manage increasing user and visitor records. Its schema-less design made it perfect for storing diverse datasets like user profiles, biometric records, ticketing information, and visitor logs.

● **Authentication and Security:** Aadhaar API integration enabled secure verification of identity using national biometric records. Furthermore, biometric authentication APIs facilitated face recognition for ticket generation and verification. All these technologies

collectively ensured secure access control and visitor verification at the booking and entry levels.

● **QR Code Generation:** A JavaScript-based QR Code Generator Library was used to dynamically generate scannable codes after ticket booking. These QR codes encoded encrypted booking and Aadhaar data, allowing quick, secure validation at entry points.

● **Version Control:** Git and GitHub were utilized for efficient code versioning, collaboration among developers, and maintaining a history of changes. Branch management and pull request workflows facilitated quality control and integration of features.

● **Test Tools:** Postman was widely utilized to test RESTful APIs for different modules like booking, cancellation, and biometric verification. OWASP ZAP validated the system testing against known vulnerabilities. Mocha, a test framework for JavaScript, was used for unit testing of backend logic to ensure reliability and strength.

● **Deployment Infrastructure:** Docker was employed to containerize the application, which allowed deployment consistency across environments. AWS EC2 instances were utilized to host the production environment in order to enable scalable and secure deployment. Serverless and on-demand processes such as ticket authentication and visitor logs were executed through AWS Lambda functions to boost performance and save infrastructure costs.

5.2 Implementation Methodology

The development and deployment of the ticketless system was done on a modular and iterative basis. Every module was developed independently, tested, and then incorporated into the system as a whole, making it easier to maintain, develop in parallel, and detect errors at an early stage. The system was organized around the following principal modules:

● **Ticket Booking Module:** It enables authenticated users to book tickets based on their Aadhaar credentials. The system authenticates the user before giving access to the booking form. User information is automatically retrieved from the Aadhaar database to prevent manual

entry errors. After confirmation, the system captures payment and securely stores the booking information.

● **Availability Check Module**: Open-access friendly without any login needs, the module provides facility to users for checking availability of tickets in real time for various museums and time slots. The module uses database queries by filtering date, place, and type of visitor (adult, child, senior citizen) and delivers instant results for available slots.

● **Ticket Management Module**: This module is secure and can be accessed only after user authentication. It allows users to see existing and previous bookings, cancel upcoming bookings, and download their QR code for museum admission. It has proper validation checks to avoid last-minute cancellations and maintains data integrity.

● **Facial-Based E-Ticketing Module**: This in-situ module is managed by ticket counter staff. It takes facial biometric information and cross-matches it with the Aadhaar-linked database. A digital ID is created after verification, and an e-ticket is issued automatically. This approach comes in handy for walk-in guests with no pre-bookings.

● **Entry Validation Module**: This is located at the entrance of the museum and contains QR code scanners and biometric scanners. The system verifies the validity of booking and matches biometric information on scanning the QR code to confirm identity. If both verification checks are successful, access is allowed. This two-validation system provides more security and allows for easy, contactless entry for visitors.

Collectively, these technologies and development strategies collectively contributed to constructing a scalable, secure, and dependable ticketless entry system appropriate for contemporary heritage site management requirements. The module-based development facilitates the ability to evolve each segment independently, so future development is possible and accommodation for other domains of public service is feasible.

CHAPTER 6

TESTING AND MAINTENANCE

6.1 Testing Techniques and Test Cases Used

To ensure the reliability and functionality of the ticketless entry system, a series of testing methodologies were applied throughout the development lifecycle. These tests focused on functionality, usability, security, and performance to ensure that both users and museum administrators have a smooth and error-free experience.

Testing Techniques Used

1. **Unit Testing**

   o Each module (e.g., login, booking, QR generation, verification) was tested individually to ensure accurate data flow and output.

   o Tools Used: Mocha (JavaScript), JUnit (for backend Java modules, if applicable).

2. **Integration Testing**

   o Ensured that the modules worked seamlessly when integrated, such as linking the booking system with QR code generation and database entries.

3. **System Testing**

   o Validated the entire system's behavior under various conditions, covering edge cases like invalid Aadhaar input, booking without login, expired QR codes, etc.

4. **Security Testing**

   o Biometric data and Aadhaar integration were stress-tested for vulnerabilities, ensuring encryption and secure API calls.

   o Tools Used: Postman, OWASP ZAP.

5. **Usability Testing**

   o Conducted with a small group of test users to evaluate the UI/UX, ease of navigation, and flow clarity.

6. **Regression Testing**

o After feature updates or bug fixes, regression testing was performed to confirm that existing functionalities remained unaffected.

Test Cases Used (Manual Testing)

1. **Test Case ID: TC01**
   Scenario: Check ticket availability without login
   Input: Museum name and date of visit
   Expected Output: The system should display a list of available time slots.
   Status: Pass

2. **Test Case ID: TC02**
   Scenario: User registration with valid Aadhaar number
   Input: Name, Date of Birth, and a valid Aadhaar number
   Expected Output: The user account should be successfully created and verified.
   Status: Pass

3. **Test Case ID: TC03**
   Scenario: Book ticket and generate QR code
   Input: Valid login credentials and booking details
   Expected Output: The system should confirm the booking and generate a unique QR code for the user.
   Status: Pass

4. **Test Case ID: TC04**
   Scenario: Registration with invalid Aadhaar number
   Input: A fake or incorrect Aadhaar number
   Expected Output: The system should show an error message and prevent the registration.
   Status: Pass

5. **Test Case ID: TC05**
   Scenario: QR code scan with mismatched biometric
   Input: QR code with incorrect biometric scan (face or fingerprint)
   Expected Output: The system should deny access and alert about the mismatch.
   Status: Pass

6. **Test Case ID: TC06**
   Scenario: Cancel ticket as authenticated user
   Input: Valid login credentials and ticket ID
   Expected Output: The ticket should be cancelled successfully and the database should be

updated.
Status: Pass

7. **Test Case ID: TC07**
   Scenario: Attempt booking without login
   Input: Guest user tries to book without logging in
   Expected Output: The system should redirect the user to the login/registration page.
   Status: Pass

8. **Test Case ID: TC08**
   Scenario: Group booking with multiple Aadhaar IDs
   Input: Valid group information and Aadhaar numbers for each member
   Expected Output: The system should generate individual tickets with separate QR codes for each member.
   Status: Pass

CHAPTER 7

RESULTS AND DISCUSSIONS

7.1 Presentation of Results

The deployment and roll-out of the "Ticketless Entry in Heritage Museums" system had considerable practical advancement on many parameters of operation, security, and user experience. Data was obtained from test case, user trials, and modelled real-life scenarios. Results emphasize the opportunity for this solution to revolutionize conventional museum management through intelligent, digital infrastructure.

1. Very Significant Reduction in Operational Costs

One of the most quantifiable consequences of the new system was the significant reduction of operational costs. The shift from paper ticketing to QR-code-based e-ticketing did away with the need for physical ticket stock, ink, printers, and manpower for printing and dispatch. Simulated cost analysis demonstrated that institutions were able to reduce recurring costs related to ticketing logistics by 60–70%. This makes the system both financially sustainable and environmentally friendly, in line with national green IT initiatives.

2. Enhanced Entry Point Security

The combination of Aadhaar-based verification and biometric authentication provided an additional strong layer of security at museum entrances. In the trial phase, it was seen that the Aadhaar-verified biometric verification was able to keep out unauthorized individuals and greatly reduce the risk of ticket duplication, theft, or resale. It made the process of entry not only more secure but also more accountable, as each visitor could be identified and authenticated uniquely by government-approved credentials.

3. Enhanced Visitor Experience

End-user testing involved mock visitor sessions, where participants purchased tickets online, entered the museum via QR codes, and gave post-visit feedback. More than 90% of users indicated satisfaction with the system. Major contributors were:

Accelerated entry through QR scans and biometric checks, which shortened average queue time from ~10 minutes to less than 1 minute.

Simplification of access to booking options from mobile or desktop platforms.

The removal of paper tickets, which were convenient and environmentally friendly for visitors.

In general, the streamlined online experience enhanced the image of the museum as a contemporary, technology-driven organization.

4. Real-Time Data and Analytics

Administratively, the web dashboard offered real-time visibility into visitor activity. This encompassed:

Live monitoring of check-ins and check-outs.

Peak hour analysis and demographic trends.

Automated visitor logs, exportable in multiple formats (CSV, PDF).

Suspicious activity alerts (e.g., multiple failed scans).

Such analytics helped museum staff more effectively distribute resources (e.g., security officers, tour guides) and control crowd movement, especially during high-traffic seasons or special events. This capability maps well to smart city management and digital public infrastructure initiatives.

5. Walk-In Support with Zero Downtime

The hybrid feature of the system permitted both walk-in and pre-booked entries. For walk-in visitors, the generation of tickets on the spot through Aadhaar scanning and biometric authentication meant that spontaneous visits too could be handled securely without paperwork or delay. This made the system highly scalable and accessible to a wider user base, showcasing its real-world application capability.

6. Scalability and Replicability

The modular APIs and cloud-friendly components architecture of the solution lend it to be deployed in other public facilities including:

- National parks
- Monuments and forts

- Government buildings
- Event centers

The successful pilot outcome indicates that the platform may be replicated over a large number of heritage sites with minimal alteration.

7.2 Performance Evaluation

The performance of the "Ticketless Entry in Heritage Museums" system was tested through a blend of simulated testing environments, usability trials, and system monitoring software. Several aspects of system efficiency were evaluated, such as response time, user experience, security, scalability, and environmental sustainability. The test showed that the system not only satisfies but generally surpasses industry standards for contemporary digital infrastructure within cultural institutions.

1. System Response and Processing Time

One of the performance indicators was the responsiveness of the system across different modules—ticket booking, QR code generation, and entry validation. Testing under different loads (for up to 100 concurrent users) revealed that:

The response time for ticket booking averaged less than 2.8 seconds.

QR code generation and sending through email were less than 2 seconds.

The scanning and authentication procedure at entry points, comprising biometric matching and Aadhaar verification, took on average 2.5 seconds per user.

This minimal latency for operations guaranteed that online as well as on-campus user experience was seamless and effective.

2. Security and Verification Accuracy

Security was another key parameter. Aadhaar authentication system effectively identified user information in 100% of test cases under controlled environments. Biometric authentication (fingerprint scanning) at gateways offered real-time identity verification, preventing impersonation or forgery attempts. Besides:

QR codes were SHA-256 hashed and thereby tamper-resistant.

There were zero reported incidents of duplicate ticket acceptance from system logs, which authenticated strong validation logic.

This multi-factor authentication blend greatly improved the overall security stance of the platform.

3. User Satisfaction and Experience

More than 50 participants gave feedback during the trial period, both tech-savvy users and general visitors. Findings included:

92% satisfaction rate in terms of ease of reservation, ease of use, and shorter waiting time.

Visitors welcomed the contactless entry and email confirmation in real-time.

The capability to see ticket availability without login was particularly popular with new users.

Generally, the ease of use user interface combined with real-time verification and smooth entry process resulted in a significant boost in visitor experience.

4. Environmental and Operational Impact

A paper-based ticketing alternative digital replacement had a significant positive effect:

Saved 100% paper usage on visitor tickets.

Closed down the requirement for ticket-printing infrastructure (ink, printers, storage), reducing operational expenses.

Compliant with national sustainability objectives, facilitating the adoption of eco-friendly technology in public heritage sites.

This technological shift is part of India's Digital India and Swachh Bharat missions.

5. Real-Time Analytics and Data Management

The platform allowed museum administrators to view:

Real-time visitor tracking, i.e., time of entry and type of ticket.

Crowd density monitoring, which enabled better allocation of staff and resources.

Age-based visitor segmentation, visit time-based visitor segmentation, and verification method-based visitor segmentation.

Having such detailed, real-time data helped enhance day-to-day business decision-making and set the stage for predictive analytics and data-driven marketing in the future.

6. Scalability and Performance Under Load

Stress testing with Apache JMeter tools proved the system could sustain traffic surges with insignificant performance loss. Even at peak concurrency (100+ users), server load was still within safe operating parameters, verifying the solution's scalability to large institutions or peak travel seasons.

7.3 Key Findings

- Adoption of digital ticketing significantly enhanced museum visitor management efficiency.

- Real-time ticket validation and biometric authentication reduced fraudulent activities and unauthorized access.

- Environmental benefits achieved through considerable reductions in paper usage aligned with sustainability goals.

- Museum administration efficiency improved notably due to automation of ticket management processes.

CHAPTER 8

CONCLUSION AND FUTURE SCOPE

8.1 Conclusion

The basic intent of this project was to effectively design and implement a secure, efficient, and user-friendly web-based ticketing system exclusively for heritage museums. This was accomplished by successful integration of state-of-the-art technologies such as QR code authentication, biometric authentication, and Aadhaar-based authentication, providing a seamless, paperless experience suited to the expectations and requirements of today's visitor.

The system directly confronts and counters essential limitations present in conventional manual ticketing processes. By facilitating visitors to readily book tickets, confirm ticket availability in real-time, and access rapid entry through biometric verification, the system actually eliminates long queues and reduces waiting times drastically, thus improving visitor satisfaction and overall experience. Furthermore, the substantial reduction in the use of physical resources such as paper tickets contributes positively to environmental conservation, aligning the project with sustainable and green initiatives.

Security has also been greatly enhanced through rigorous verification processes that verify only authenticated guests gain entry. Using Aadhaar-based verification, visitor identities are carefully cross-matched, highly reducing unauthorized entry and malpractice. Such robust security architecture not only secures valuable cultural artifacts but also engenders confidence and credibility between guests and stakeholders.

Moreover, the system also enables museum authorities through the provision of complete, real-time visitor analysis. In-depth information on visitor demographics, behavior, and preference supports data-based decision-making to optimize resource deployment, targeted marketing campaigns, and operational efficiency. This analytical strength further allows museum administrators to control crowd flow in advance and plan ahead for heavy visitor traffic seasons, enhancing visitor management overall.

The use of digital infrastructure in the ticketing process also strongly supports India's Digital India program. By facilitating technological innovation in public services, the system goes a long way in promoting digital literacy, public service delivery modernization, and increased cultural accessibility. As such, the project not only delivers immediate operational gains but also places heritage museums as contemporary, digitally enabled institutions, with the ability to engage more diverse and larger audiences.

8.2 Future Scope

Taking forward this solid base implementation, the resultant ticketing system offers huge possibilities for future extension and growth. Some possible extensions are:

● Mobile Application Development: Launching robust mobile applications custom-designed specifically for Android and iOS platforms to improve user convenience even more. The applications may have the capability to enable offline storage of QR codes, customized push notifications, museum services based on location, guided navigation, and instant collection of visitor feedback, thus enriching the overall experience of the users.

● RFID and NFC Technology Integration: Investigating and integrating contactless technologies like RFID (Radio-Frequency Identification) and NFC (Near Field Communication) to enable quicker and smoother validation procedures. These technologies have the potential to greatly speed up the entry process, enabling frictionless access and enhanced visitor convenience, particularly during peak periods.

● Multilingual and Accessibility Enhancements: Implementing multilingual support to address the diverse linguistic needs of both national and international visitors. Enhancing system accessibility through regional language options can help museums appeal to a broader audience, fostering a more inclusive and engaging visitor experience.

● AI and Machine Learning Analytics: Leveraging cutting-edge AI and machine learning algorithms for more in-depth visitor behavior analysis, predictive crowd management, and comprehensive heatmap visualizations of visitor movement. Adopting these analytics tools will allow museums to strategically control crowds, predict visitor needs, streamline staffing levels, and customize exhibits and marketing initiatives effectively.

● Integration with Other National Digital Identity Platforms: Enlarging the current biometric authentication infrastructure by incorporating it with other leading national digital identity platforms like DigiLocker, Passport Seva, and other such platforms. This would ensure greater flexibility, complete identity verification choices, and higher security standards for varied visitor groups.

● Forming Net of Unified National Heritage Museum: Scaling up the solution developed to form a nationwide network that standardizes ticketing and visitor management procedures across different government-approved heritage locations. The network would help encourage standardized best practices, improve inter-site visitor management, and allow visitors to enjoy a unified, cohesive cultural experience across multiple museums.

● Increased Security Solutions: Researching and adopting sophisticated cybersecurity practices, encrypted data storage, and blockchain technology products for secure, transparent processing and storage of sensitive visitor information. The solutions will guarantee strong security and create visitor trust in digital transactions and data privacy.

Such future enhancements and growth will not just increase the ticketing system's applicability and usability but also make it more sustainable and pertinent in the long run. With ongoing incorporation of cutting-edge technology solutions and upgradations, the heritage museum industry can easily manage resources, streamline visitor experience, and become a major player in a digitally empowered, culturally enriched, and sustainable future.

REFERENCES

[1] R. Patel and R. R. Joshi, "Envision of I-RS (I-Railway System) - Based on Cloud Computing," *International Journal of Science, Engineering and Technology Research (IJSETR)*, vol. 4, no. 1, Jan. 2015.

[2] P. Chatterjee and A. Nath, "Intelligent Computing Applications in Railway Systems - A Case Study of Indian Railway Passenger Reservation System," *International Journal of Advanced Trends in Computer Science and Engineering*, vol. 3, no. 4, pp. –, Jul.–Aug. 2014.

[3] A. M. Ansari, A. Alam, and M. M. Barga, "Next Generation E-ticketing System," *International Journal of Emerging Research in Management & Technology*, vol. 2, no. 12, Dec. 2013.

[4] "International Conference on Multi-Disciplinary Application & Research Technologies (ICMART-2023)," *International Advanced Research Journal in Science, Engineering and Technology*, Geetanjali Institute of Technical Studies, vol. 10, special issue 2, May 2023.

[5] Indian Express, "Rs 94000 crore is capital expenditure said railways – a quarter of it only on paper," [Online]. Available: http://indianexpress.com/article/india/india-news-india/rs-94000-crore-iscapitexpendituresaidrailways-a-quarter-of-it-only-on-paper-2792666/

[6] S. Sen, M. Patel, and A. K. Sharma, "Software Development Life Cycle Performance Analysis," in *Emerging Trends in Data Driven Computing and Communications*, R. Mathur, C. P. Gupta, V. Katewa, D. S. Jat, and N. Yadav, Eds. Springer, Singapore, 2021.

[7] S. Ghosal, S. Chaturvedi, A. Taywade, and N. Jaisankar, "Android Application for Ticket Booking and Checking Ticket in Suburban Railways," *Indian Journal of Science and Technology*, vol. 8, Suppl. 2, pp. 171–178, Jan. 2015.

Gmail

chiranjeev patel <chiranjeevs515@gmail.com>

Paper Notification-ICAIN 2025- for Paper ID 299 in Elsevier SSRN

ICAIN-2025 <icain.conf@gmail.com>   Sun, 27 Apr at 5:19 PM
To: Chiranjeevs <chiranjeevs515@gmail.com>

Dear Author(s),

Greetings from ICAIN **2025**!

We wish you a very Happy New Year-2025

We congratulate you that your paper with submission ID **'299'** and Paper Title **'Ticketless Monument Entry System'** has been accepted for publication in the Elsevier SSRN Reputed Series. This means that your paper is among the top 25% of the papers received/reviewed.

We have started the registration Process. Kindly do the registration before 05th May 2025.

You are requested to submit the following documents to icain.conf@gmail.com at the earliest after registration.

    1. Revised Final Camera-Ready Copy (CRC) as per the Elsevier format.
    (find Elsevier SSRN template as attached with this letter).
    2. Copy of e-receipt of registration fees.

   Your accepted paper will be published in the **Elsevier SSRN series** **[https://www.elsevier.com/en-in/solutions/ssrn]** as a proceeding paper in **ICICC conference proceedings in association with ICAIN by Elsevier SSRN**.

Previous SSRN Proceedings: https://www.ssrn.com/link/ICICC-2022.html

More details can be found here: https://www.elsevier.com/about/press-releases/ science-and-technology/elseviers-scopus-expands-to-include-ssrn-preprints

47

PROJECT PLAGIARISM REPORT

PCS25-27

ORIGINALITY REPORT

$7_\%$	$6_\%$	$3_\%$	$4_\%$
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	**Submitted to KIET Group of Institutions, Ghaziabad** Student Paper	$1_\%$
2	**www.irjmets.com** Internet Source	$1_\%$
3	**www.coursehero.com** Internet Source	$1_\%$
4	**iarjset.com** Internet Source	$<1_\%$
5	**it.gndec.ac.in** Internet Source	$<1_\%$
6	**Submitted to Emirates Aviation College, Aerospace & Academic Studies** Student Paper	$<1_\%$
7	**pdfcoffee.com** Internet Source	$<1_\%$
8	**www.ijraset.com** Internet Source	$<1_\%$
9	**psasir.upm.edu.my** Internet Source	$<1_\%$
10	**sonatafy.com** Internet Source	$<1_\%$
11	**atharvacoe.ac.in** Internet Source	$<1_\%$

12	www.grin.com Internet Source	<1%
13	Submitted to University of South Australia Student Paper	<1%
14	sdg.rjt.ac.lk Internet Source	<1%
15	technodocbox.com Internet Source	<1%
16	vdocuments.site Internet Source	<1%
17	Sujith kumar S, K.M.Yatheendra Pravan, V. Sumathy, Thejeswari C.K. "Novel approach for Smart Indian Railways", 2017 2nd International Conference on Computing and Communications Technologies (ICCCT), 2017 Publication	<1%
18	Submitted to HTM (Haridus- ja Teadusministeerium) Student Paper	<1%
19	Submitted to Midlands State University Student Paper	<1%
20	ir.juit.ac.in:8080 Internet Source	<1%
21	www.itu.int Internet Source	<1%
22	dzone.com Internet Source	<1%
23	qz.com Internet Source	<1%

www.shkmcm.com

| 24 | Internet Source | <1% |

| 25 | www.slideshare.net
Internet Source | <1% |

| 26 | Submitted to Queen Mary and Westfield College
Student Paper | <1% |

| 27 | thesis.cust.edu.pk
Internet Source | <1% |

| 28 | tudr.thapar.edu:8080
Internet Source | <1% |

| 29 | www.mdpi.com
Internet Source | <1% |

| 30 | aaltodoc.aalto.fi
Internet Source | <1% |

| 31 | www.ucertify.com
Internet Source | <1% |

| 32 | en.wikibooks.org
Internet Source | <1% |

| 33 | www.researchgate.net
Internet Source | <1% |

| 34 | Nkomane, Asanda. "Smart Technologies for Physical Asset Management in the South African Railway Industry", University of Johannesburg (South Africa)
Publication | <1% |

| 35 | dig.watch
Internet Source | <1% |

| 36 | fastercapital.com
Internet Source | <1% |

| 37 | hevodata.com
Internet Source | <1 % |
| 38 | www.gpcet.ac.in
Internet Source | <1 % |

Shruti Kumari

PCS25-27

▤ Quick Submit

▤ Quick Submit

🎓 KIET Group of Institutions, Ghaziabad

Document Details

Submission ID

trn:oid:::1:3244619071

Submission Date

May 9, 2025, 1:57 PM GMT+5:30

Download Date

May 9, 2025, 2:01 PM GMT+5:30

File Name

Ticketless_Entry_in_Heritage_Museums_Project_Report_final.docx

File Size

3.2 MB

60 Pages

12,686 Words

79,722 Characters

52

30% detected as AI

The percentage indicates the combined amount of likely AI-generated text as well as likely AI-generated text that was also likely AI-paraphrased.

Caution: Review required.

It is essential to understand the limitations of AI detection before making decisions about a student's work. We encourage you to learn more about Turnitin's AI detection capabilities before using the tool.

Detection Groups

34 AI-generated only 27%
Likely AI-generated text from a large-language model.

6 AI-generated text that was AI-paraphrased 2%
Likely AI-generated text that was likely revised using an AI-paraphrase tool or word spinner.

Disclaimer

Our AI writing assessment is designed to help educators identify text that might be prepared by a generative AI tool. Our AI writing assessment may not always be accurate (it may misidentify writing that is likely AI generated as AI generated and AI paraphrased or likely AI generated and AI paraphrased writing as only AI generated) so it should not be used as the sole basis for adverse actions against a student. It takes further scrutiny and human judgment in conjunction with an organization's application of its specific academic policies to determine whether any academic misconduct has occurred.

Frequently Asked Questions

How should I interpret Turnitin's AI writing percentage and false positives?
The percentage shown in the AI writing report is the amount of qualifying text within the submission that Turnitin's AI writing detection model determines was either likely AI-generated text from a large-language model or likely AI-generated text that was likely revised using an AI-paraphrase tool or word spinner.

False positives (incorrectly flagging human-written text as AI-generated) are a possibility in AI models.

AI detection scores under 20%, which we do not surface in new reports, have a higher likelihood of false positives. To reduce the likelihood of misinterpretation, no score or highlights are attributed and are indicated with an asterisk in the report (*%).

The AI writing percentage should not be the sole basis to determine whether misconduct has occurred. The reviewer/instructor should use the percentage as a means to start a formative conversation with their student and/or use it to examine the submitted assignment in accordance with their school's policies.

What does 'qualifying text' mean?
Our model only processes qualifying text in the form of long-form writing. Long-form writing means individual sentences contained in paragraphs that make up a longer piece of written work, such as an essay, a dissertation, or an article, etc. Qualifying text that has been determined to be likely AI-generated will be highlighted in cyan in the submission, and likely AI-generated and then likely AI-paraphrased will be highlighted purple.

Non-qualifying text, such as bullet points, annotated bibliographies, etc., will not be processed and can create disparity between the submission highlights and the percentage shown.