International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

ONLINE CHATBOT BASED TICKETING SYSTEM FOR CSMVS

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Abstract— **Museums play a vital role in preserving cultural heritage while providing accessible and engaging experiences for diverse visitors. However, conventional counter-based ticketing often results in long queues, delayed ticket issuance, manual errors, and limited accessibility during peak hours and special exhibitions. This work presents an Online Chatbot Based Ticketing System for Chhatrapati Shivaji Maharaj Vastu Sangrahalaya (CSMVS), integrating a SvelteKit web interface, Google Dialogflow ES, and a Node.js backend to automate conversational ticket booking. The system uses structured booking data comprising visitor details, preferred language, visit dates, ticket categories, show or exhibition information, ticket quantities, availability, pricing, payment status, and booking status. Data preprocessing includes validation of visitor inputs, date verification, quantity constraints, ticket-category standardisation, missing-value handling, and availability consistency checks before transaction processing. The conversational workflow employs intent classification, entity extraction, and slot filling to support gate-entry, exhibition, show bookings, FAQs, and multilingual interactions. The implemented models and components include Dialogflow ES-based conversational processing with Node.js fulfilment and PostgreSQL data management. Evaluation uses response correctness, booking completion, availability handling, multilingual recognition, payment processing, cancellation, duplicate booking prevention, and error resilience. All ten evaluated test cases achieved a pass rate of 100%, demonstrating reliable end-to-end functionality. The proposed solution improves ticketing accessibility, reduces manual effort and waiting time, minimises booking errors, and provides structured data for efficient visitor and capacity management.**

Keywords— ***Chatbot-Based Ticketing, Conversational Artificial Intelligence, Natural Language Understanding, Intent Classification, Museum Management Systems, Online Ticket Booking.***

I. INTRODUCTION

Museums play an important role in preserving cultural heritage, promoting education, and providing public access to art, archaeology, history, and natural heritage. They serve as important centres for cultural learning, historical interpretation, research, and public engagement, enabling visitors to understand the social and cultural development of communities across different periods. As visitor numbers continue to increase, efficient digital services have become essential for improving accessibility and enhancing the overall visitor experience. The Chhatrapati Shivaji Maharaj Vastu Sangrahalaya (CSMVS), Mumbai, is one of India's prominent museums, attracting visitors from diverse backgrounds and hosting regular exhibitions, educational activities, and cultural programmes. The increasing demand for museum visits highlights the need for convenient and reliable ticketing services that can support visitors before and during their museum experience. Digital transformation in cultural institutions has therefore created opportunities to modernise conventional administrative services, simplify visitor interactions, and provide more accessible channels for public engagement [1]. Conversational interfaces have further emerged as an effective means of enabling users to access digital services through natural-language interaction, reducing the complexity associated with conventional menu-driven systems and form-based interfaces [2].

Despite these developments, conventional museum ticketing continues to depend substantially on physical counters and manual administrative procedures. Such approaches can result in long queues, delayed ticket issuance, human errors in record maintenance, and difficulties in handling sudden increases in visitor demand during weekends, holidays, and special exhibitions. Visitors may also face limitations when attempting to plan and book tickets remotely before arriving at the museum. These challenges can negatively affect visitor satisfaction and create additional administrative pressure on museum staff. Furthermore, manual processes may make it difficult to maintain accurate and centralised records of bookings, cancellations, ticket categories, and visitor demand. Existing digital ticketing solutions frequently focus primarily on transactional booking interfaces, while limited attention is given to integrating conversational assistance, visitor information, multilingual interaction, and multiple ticket categories within a unified service environment. This gap creates a need for an intelligent and accessible ticketing channel capable of supporting visitors through the complete booking journey while reducing dependency on physical counter operations [3]. Furthermore, the absence of integrated and structured booking information may restrict administrative capabilities for monitoring visitor

Received: 16-06-2026 | Accepted: 21-07-2026 | Published: 27-07-2026

International Journal of
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ISSN: 3068-272X www.ijdim.com Original Research Paper

demand, evaluating booking trends, managing available capacity, and supporting effective capacity planning [4].

The objective of this study is to develop an online chatbot-based ticketing system tailored to the operational requirements of CSMVS. The proposed solution provides a public-facing digital platform through which visitors can obtain museum-related information and interact with a conversational assistant for ticket booking. The chatbot enables users to communicate their requirements using natural language and guides them through the necessary booking process. It supports bookings associated with museum entry, exhibitions, and shows while collecting essential information such as visit dates, ticket quantities, ticket categories, and relevant show selections. The system is designed to validate the information provided by visitors, check availability, identify duplicate booking requests, and maintain appropriate transaction states. It also aims to provide multilingual accessibility, reduce manual intervention in booking activities, and maintain structured booking information for administrative use. In addition, the proposed framework demonstrates an integrated approach that connects visitor interaction, booking management, availability handling, payment confirmation, and communication within a single digital environment [5], [6], [7].

The conversational nature of the proposed system represents an important aspect of its design. Instead of requiring visitors to navigate through multiple webpages or manually complete lengthy forms, the chatbot allows users to express their requirements through simple conversational messages. Natural Language Understanding (NLU), intent classification, entity recognition, and slot-filling mechanisms enable the system to interpret user requests and identify the information required for successful ticket processing. For example, a visitor can initiate a booking request and provide only partial information, after which the chatbot can interactively request the remaining details. This conversational workflow makes the booking process more flexible and accessible while reducing the possibility of incomplete requests. Multilingual interaction further supports users from diverse linguistic backgrounds by enabling communication in supported languages, thereby reducing language-related barriers to accessing museum services.

The significance of the proposed solution lies in its potential to improve both visitor convenience and museum administration. By providing an always-available online booking channel, the system can reduce dependence on physical counters, minimise waiting times, and improve access to ticketing services regardless of visitor location. Conversational interaction can also make digital booking more approachable for users who may find conventional forms less intuitive, while multilingual support can improve inclusivity for a diverse visitor population [8]. Structured booking records can support better understanding of visitor patterns, capacity management, operational monitoring, and future exhibition planning [9]. In addition, the integration of booking information and transaction status can assist administrators in maintaining reliable records and improving the overall efficiency of ticket management.

Although the current implementation is intended as a prototype and does not include live payment gateway integration or direct synchronisation with an existing production ticketing system, its architecture provides a foundation for broader adoption across museums and cultural heritage institutions. Future implementations can extend the framework through real-time payment processing, mobile applications, advanced analytics, cloud deployment, dynamic capacity management, and integration with existing museum management platforms. The system can also be enhanced with additional regional languages, voice-based interaction, personalised visitor recommendations, and intelligent analytics for understanding visitor behaviour. The proposed approach consequently demonstrates how conversational digital services can contribute to more efficient, accessible, inclusive, and visitor-centred museum operations while supporting the broader digital transformation of cultural heritage institutions [10].

II. Related Work

The adoption of chatbot technologies has expanded across online commerce, education, healthcare, travel, and customer-service environments, demonstrating their potential to improve accessibility, responsiveness, personalisation, and user engagement. Illescas-Manzano et al. investigated chatbot implementation in online commerce and open innovation, highlighting the role of conversational technologies in improving digital customer interaction and supporting innovative service models [11]. Wu et al. designed and evaluated a digital learning-based English chatbot, demonstrating that conversational systems can facilitate self-directed online learning and provide users with flexible access to interactive support [12]. Similarly, Chen et al. examined the usability and responsiveness of artificial intelligence chatbots in online retailing and reported their relevance to improving customer experience and facilitating digital interactions [13]. However, these studies primarily focus on commercial and educational contexts, leaving opportunities to investigate conversational systems for specialised cultural and heritage services where visitor assistance and transactional requirements must be combined within a single platform.

Research in online travel and customer service further demonstrates the importance of chatbot quality, reliability, perceived usefulness, and continuous user engagement. Li et al. examined continued chatbot usage in Chinese online travel agencies and identified factors influencing users' willingness to repeatedly interact with chatbot services, highlighting the importance of reliability and perceived usefulness in sustained adoption [14]. Han and Lee explored FAQ chatbots in massive open online courses and showed their potential to support inclusive learning by providing accessible responses to frequently asked questions [15]. Chen et al. compared chatbot-based and human-based online customer service and investigated their effects on consumer purchase intentions, emphasising that the choice between automated and human interaction can influence user decision-making [16]. Although these studies establish the value of conversational assistance, they generally address information retrieval, customer engagement, or purchasing behaviour rather than end-to-end

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booking services involving availability verification, ticket categories, visitor information collection, payment processing, and transaction confirmation.

The application of chatbots in educational environments also illustrates their potential to support interactive communication and user assistance. Goda et al. investigated conversations with a chatbot before online English group discussions and reported positive implications for learner interaction and critical thinking, demonstrating that conversational systems can prepare users for subsequent activities [17]. In contrast, Ifelebuegu examined the challenges associated with AI chatbot intervention in online assessment and highlighted concerns regarding authenticity and the appropriate role of automated systems in digital environments [18]. These findings indicate that chatbot effectiveness depends not only on conversational capability but also on the context in which automation is deployed. Sharma et al. reviewed chatbot integration in online shopping through a bibliometric analysis and identified emerging research directions, reinforcing the growing importance of conversational technologies while also indicating the need for further investigation into domain-specific applications and practical service integration [19].

Sarosa et al. demonstrated the implementation of a chatbot in online classes using Google Classroom, showing how conversational interfaces can be integrated with existing digital platforms to improve communication and support users within a defined service environment [20]. This work demonstrates that chatbots can operate as an intermediary layer between users and existing digital services, simplifying access to information while reducing the complexity of conventional interaction methods. Such an approach is relevant to museum environments, where visitors may require information about exhibitions, shows, ticket categories, schedules, and booking procedures before making a reservation. Integrating conversational assistance with structured backend services can therefore provide a more unified and accessible experience than isolated information pages or conventional ticketing forms.

Collectively, the reviewed studies demonstrate significant progress in chatbot-based customer interaction, education, online commerce, travel services, and information support. The existing literature confirms that conversational systems can improve user engagement by providing immediate responses, simplifying information access, and supporting interactive communication. However, the reviewed research also reveals several limitations when considered from the perspective of cultural heritage and museum services. Most existing systems are designed for general information retrieval, learning assistance, commercial customer support, or purchasing activities. Comparatively limited attention has been given to specialised museum environments where conversational assistance must operate alongside ticket reservation, availability checking, multiple ticket categories, cancellation handling, and transaction status management.

Another important research gap concerns the integration of multilingual conversational interaction within museum ticketing services. Museums frequently serve visitors with diverse linguistic backgrounds, yet existing chatbot studies provide comparatively limited emphasis on supporting multilingual communication within complete booking workflows. Similarly, peak-demand management remains an important area requiring further consideration, particularly for museums that experience increased visitor numbers during weekends, holidays, exhibitions, and cultural programmes. A conversational system capable of checking availability before confirmation can help minimise overbooking and provide suitable alternatives when requested slots are unavailable. Furthermore, structured booking information can support administrators in monitoring visitor demand and improving capacity planning.

Therefore, the current study addresses these identified gaps by introducing an online chatbot-based ticketing solution for CSMVS that combines conversational visitor assistance with unified ticket booking and administrative support. The proposed system integrates natural-language interaction, intent classification, entity recognition, slot-filling, multilingual communication, input validation, availability checking, duplicate booking detection, and transaction state management. This integrated approach extends existing chatbot applications beyond simple information retrieval or customer interaction by supporting a complete museum ticketing workflow. The study consequently contributes to the development of accessible, efficient, and visitor-centred conversational services for cultural heritage institutions while providing a foundation for future integration with advanced payment systems, real-time capacity management, analytics, and broader multilingual support.

III. Materials And Methods

The proposed system is an online chatbot-based ticketing platform designed for Chhatrapati Shivaji Maharaj Vastu Sangrahalaya (CSMVS) to automate visitor information access and ticket booking through a conversational interface. The system uses structured booking data containing visitor details, preferred language, visit date, ticket category, show or exhibition information, ticket quantity, availability, pricing, payment status, and booking status. The workflow integrates a SvelteKit-based web interface with Google Dialogflow ES for natural-language intent recognition, entity extraction, and slot filling, while a Node.js backend manages booking fulfilment and communicates with a PostgreSQL database. Specialised conversational techniques enable the system to distinguish between informational queries and booking requests, collect incomplete booking parameters interactively, validate availability, and provide alternative dates when requested slots are unavailable. Multilingual interaction improves accessibility for diverse visitors, while simulated payment confirmation and Brevo transactional email services complete the booking communication flow. The proposed architecture reduces manual intervention, waiting time, and ticketing errors while providing structured booking records that support visitor management and future capacity planning.

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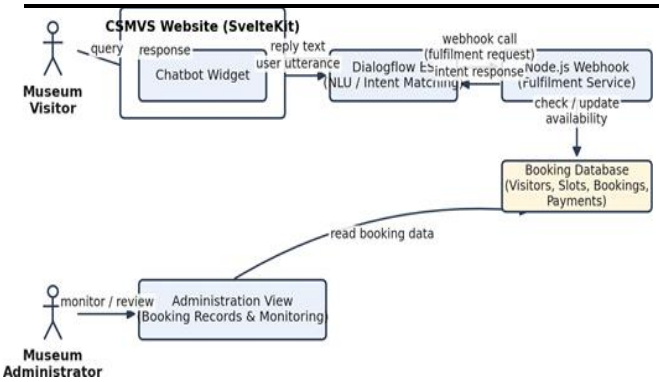

Fig. 1. System Architecture

B) Modules:

1. Natural-Language Input Preparation: Natural-language input preparation is the initial stage in which visitor queries are collected through conversational language and transformed into a suitable format for further processing. The system is designed to handle different forms of visitor communication, including ticket booking requests, show reservations, frequently asked questions, greetings, cancellations, and museum-related enquiries. Training data contains multiple variations of similar requests, short conversational phrases, spelling errors, informal expressions, and code-mixed English-Hindi inputs. This preparation improves the robustness of the conversational agent by reducing dependency on predefined commands. Consequently, visitors can communicate naturally with the system, improving usability, flexibility, accessibility, and overall interaction quality.

2. Intent Classification: Intent classification is a crucial preprocessing stage that determines the underlying purpose of each visitor query. The conversational system categorises inputs into predefined intent classes such as ticket booking, show booking, museum information, cancellation requests, greetings, and unsupported queries. This classification enables the system to distinguish between transactional and informational interactions before initiating subsequent processing activities. Each identified intent is associated with an appropriate conversational workflow, ensuring that visitors receive relevant responses according to their requirements. Accurate intent classification prevents unnecessary booking operations from being triggered by general enquiries and enables the system to efficiently manage different visitor requests while maintaining a consistent conversational experience.

3. Entity and Slot Extraction: Entity and slot extraction processes visitor messages to identify essential information required for completing a museum ticket or show booking. The system extracts relevant parameters such as the intended visit date, number of tickets, ticket category, and selected show or exhibition when applicable. These extracted values are converted from unstructured conversational input into structured booking information that can be processed by subsequent validation and transaction components. If any mandatory information is missing, the conversational agent automatically requests the required details through guided prompts. This incremental information collection approach reduces visitor effort, eliminates the need for lengthy forms, and supports accurate and efficient booking fulfilment.

4. Multilingual Query Handling: Multilingual query handling enables the conversational ticketing system to process visitor requests expressed in multiple supported languages. In the demonstrated implementation, the conversational agent supports English and Hindi, allowing visitors to communicate booking requirements and general enquiries using their preferred language. Equivalent requests expressed in different languages are mapped to the corresponding intents and conversational workflows while preserving the meaning of the original query. This preprocessing capability is particularly valuable for museums that attract visitors from diverse linguistic backgrounds. By reducing language-related communication barriers, multilingual processing improves accessibility, inclusiveness, and user convenience, allowing visitors to interact naturally with the digital ticketing service.

5. Booking Parameter Validation: Booking parameter validation ensures that the information extracted from visitor conversations is accurate, complete, and suitable for transaction processing. Before any booking operation is performed, the system validates essential parameters such as visit date, ticket quantity, and ticket category. The visit date is checked to ensure that it is correctly formatted and does not represent a past date. The requested ticket quantity is verified as a valid whole number within the permitted booking limit, while the selected ticket category is compared against predefined accepted options. This independent validation layer improves data integrity, prevents invalid transactions, reduces processing errors, and protects database operations from incorrect input values.

6. Availability Validation: Availability validation determines whether sufficient capacity exists to fulfil a visitor's requested booking before the transaction is confirmed. The system evaluates the selected visit date, ticket category, exhibition, gate-entry allocation, or show slot against the corresponding availability records. The requested number of visitors is compared with the remaining capacity to ensure that the booking does not exceed the permitted limit. If the selected date or slot is unavailable, the system can identify and recommend an alternative available date where applicable. This preprocessing stage prevents overbooking, supports effective capacity management, and provides visitors with practical alternatives, thereby improving booking reliability and overall customer satisfaction.

7. Duplicate Booking Validation: Duplicate booking validation is performed to identify repeated booking requests that may result in unintended multiple transactions for the same visitor and visit date. In conversational environments, users may accidentally submit identical requests due to repeated messages, delayed responses, or uncertainty regarding transaction completion. The system therefore examines relevant booking information to determine whether an existing booking already satisfies the requested transaction. When a duplicate request is detected, the existing booking reference can be reused instead of creating another

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booking record. This validation improves database consistency, prevents unnecessary capacity allocation, avoids duplicate transactions, and ensures more reliable management of visitor ticket bookings.

8. Transaction Status Validation: Transaction status validation maintains the consistency and accuracy of booking and payment states throughout the ticketing process. The system uses predefined status values to differentiate between pending and completed payments and between confirmed and cancelled bookings. These states ensure that incomplete transactions are not incorrectly represented as successful bookings. The validation process maintains a reliable representation of each transaction across the conversational interface, database, and administrative components. It also supports important operations such as booking confirmation, cancellation processing, capacity release, and transaction tracking. By maintaining consistent status information, the system improves transactional integrity and ensures that visitors and administrators receive accurate booking information.

D) Algorithms

Intent Classification: Intent classification determines the primary objective of each visitor message by categorising requests into ticket booking, show booking, museum information, cancellation, greetings, or unsupported queries. It directs each input toward the appropriate conversational workflow and ensures that responses match visitor requirements. This approach reduces incorrect routing, prevents irrelevant operations, improves response accuracy, and enables efficient automation of museum services through structured conversational decision-making.

Entity Recognition: Entity recognition identifies and extracts important information from natural-language visitor queries, including visit dates, ticket quantities, ticket categories, and show names. It transforms unstructured conversational expressions into meaningful structured parameters required for booking operations. This method improves information extraction accuracy, supports consistent processing of reservation details, reduces manual data collection, and enables the conversational agent to handle diverse visitor requests expressed using different linguistic patterns.

Slot-Filling: Slot-filling collects all mandatory information required to complete a ticket or show reservation. When a visitor provides incomplete information, the conversational agent identifies missing parameters and interactively requests details such as visit date, visitor quantity, ticket category, or show selection. This method ensures that all required booking fields are completed before processing, reducing incomplete transactions, improving conversational continuity, and supporting accurate fulfilment of visitor requests.

Natural Language Understanding (NLU): Natural Language Understanding interprets the meaning of visitor messages and associates them with appropriate intents and entities. It enables the conversational agent to process alternative expressions, abbreviated queries, spelling variations, informal language, and code-mixed English-Hindi communication. This capability improves the system's robustness when handling diverse linguistic patterns and enables more natural interaction. Consequently, visitors can communicate using flexible conversational expressions without relying on rigid predefined commands.

Availability Checking: Availability checking determines whether sufficient ticket capacity exists for a requested visit date, show, exhibition, or ticket category. The mechanism compares the requested visitor quantity with the remaining capacity before allowing confirmation. When the requested option is unavailable, suitable alternative dates can be identified where applicable. This approach prevents overbooking, supports effective capacity utilisation, improves reservation reliability, and provides visitors with practical alternatives instead of simply rejecting unavailable booking requests.

Input Validation: Input validation examines visitor-provided booking parameters before they proceed to transaction processing. The mechanism verifies whether dates are correctly formatted and valid, ticket quantities are acceptable whole numbers within defined limits, and selected ticket categories belong to supported options. This process prevents malformed, incomplete, or inconsistent information from entering subsequent workflows. It strengthens data integrity, reduces processing failures, improves operational reliability, and ensures safer handling of conversational inputs.

Duplicate Booking Detection: Duplicate booking detection identifies repeated reservation requests that correspond to an existing booking for the same visitor and visit date. The mechanism examines relevant booking information to determine whether an equivalent transaction has already been recorded. When duplication is detected, the existing booking reference is reused instead of creating another reservation. This prevents redundant transactions, avoids unnecessary capacity allocation, maintains database consistency, and improves reliability during accidental or repeated submissions.

Transaction State Management: Transaction state management maintains accurate booking progress through predefined payment and reservation states, including pending, completed, confirmed, and cancelled conditions. It ensures that each transaction reflects its current lifecycle stage and prevents incomplete payments from being treated as successfully confirmed reservations. This mechanism coordinates payment status, booking confirmation, cancellation processing, and capacity release. It also supports consistent administrative monitoring, transaction tracking, auditing, and reliable maintenance of reservation records.

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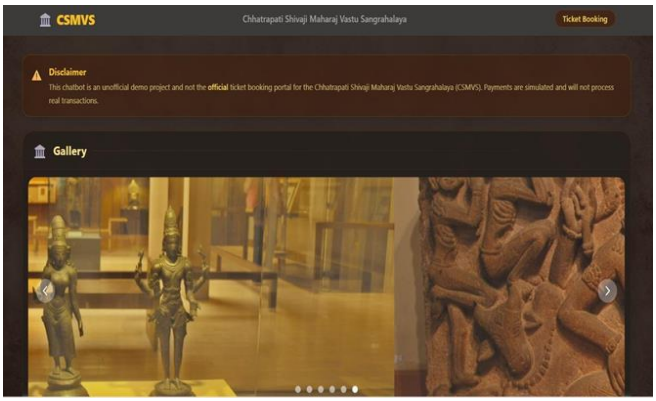
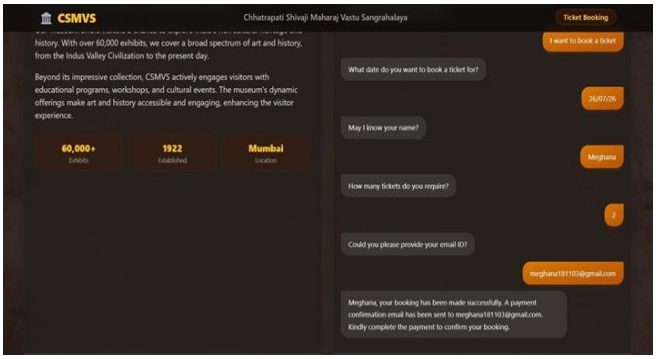
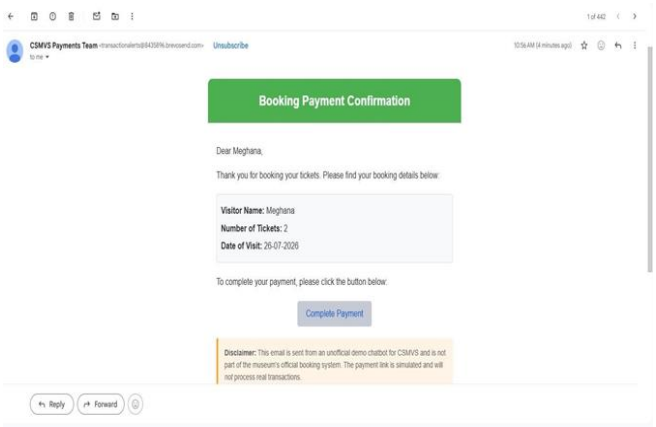
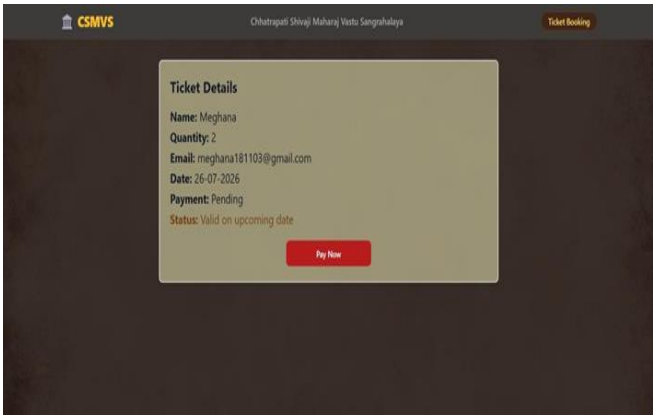
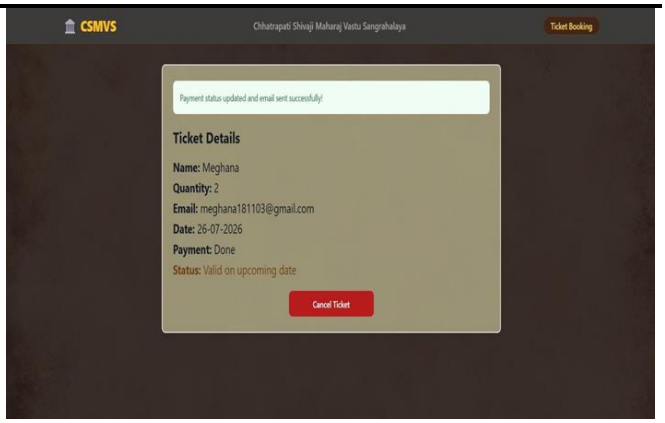
IV. Experimental Results











V. Conclusion

In conclusion, the proposed Online Chatbot Based Ticketing System for Chhatrapati Shivaji Maharaj Vastu Sangrahalaya (CSMVS) was developed to overcome the limitations of conventional manual ticketing by providing an accessible, automated, and conversational booking platform. The system integrates structured booking data containing visitor details, visit dates, ticket categories, quantities, availability, payment status, and booking information with SvelteKit, Google Dialogflow ES, Node.js, and PostgreSQL technologies. The methodology combines natural-language intent recognition, entity extraction, slot filling, server-side validation, availability verification, and multilingual conversational interaction to support gate-entry, exhibition, and show bookings. The developed system successfully achieved a 100% pass rate across 10 functional test cases, confirming reliable performance across booking, multilingual interaction, payment confirmation, cancellation, duplicate booking prevention, and error-handling scenarios. The system is further enhanced through simulated payment processing, automated transactional email confirmation using Brevo, and structured booking records for administrative monitoring. Overall, the developed solution demonstrates a reliable and practical approach to automating museum ticketing, reducing visitor waiting time and manual errors, improving accessibility, and enabling efficient booking management. Its conversational interface and integrated architecture provide meaningful real-world value for modernising visitor services and supporting data-driven museum operations.

Future enhancements can integrate a secure live payment gateway, real-time synchronisation with the museum's production database, and voice-based chatbot interaction. Additional regional languages can improve accessibility for diverse visitors. An intelligent analytics dashboard can visualise visitor trends, booking patterns, and exhibition demand to support capacity planning. Integration with mobile applications, QR-based digital tickets, and personalised recommendations can further enhance visitor convenience. Cloud deployment, stronger security mechanisms, and scalable infrastructure can improve reliability and support

International Journal of
DATA SCIENCE AND IOT MANAGEMENT SYSTEM
Peer Reviewed, Referred & Indexed Journal
ISSN: 3068-272X www.ijdim.com Original Research Paper

large-scale adoption across museums and cultural heritage institutions.

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