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DARSHANFLOW: AN INTEGRATED WEB-BASED FRAMEWORK FOR REAL-TIME TEMPLE CROWD MANAGEMENT AND DIGITAL QUEUEING

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Abstract: Managing large crowds at religious places is a major challenge, especially during festivals, weekends, and special occasions when thousands of devotees visit temples within a short period of time. In many temples, visitors have to wait in long physical queues for several hours to get darshan. This often leads to overcrowding, confusion in movement, and discomfort for devotees. In extreme situations, poor crowd organization may also create safety concerns. This research focuses on improving temple crowd management by introducing a digital approach to queue handling and visitor flow regulation. The proposed system, DarshanFlow: A Structured Digital Queue Architecture for Temple Visitor Entry, is designed to reduce physical waiting lines and help temple authorities manage large gatherings more efficiently. The system provides a web-based platform where pilgrims can view crowd status, book a virtual queue slot, and receive notifications related to their visit. The system also includes an administrative dashboard that allows temple authorities to monitor visitor bookings, update crowd status, and manage queue limits for different time slots. By distributing visitors across scheduled time periods, the system helps maintain a smoother flow of devotees inside the temple premises. The overall organization of temple visits. By combining real-time updates, scheduled entry slots The study highlights how a simple digital queue management system can improve, and administrative monitoring, the proposed approach aims to reduce congestion, improve visitor convenience, and support safer crowd management in religious environments.

Keywords: framework, Crowd management, digital queueing

I. INTRODUCTION

Religious places attract a large number of devotees every day, and the number increases significantly during festivals, special ceremonies, and weekends. Temples are often visited by thousands of people within a limited time period, which makes crowd management a difficult task for temple authorities. Long waiting queues, overcrowded entrances, and limited movement space are common problems faced by visitors during peak hours. These conditions not only create inconvenience for devotees but may also raise safety concerns when large numbers of people gather in confined areas.

Traditionally, temples manage crowds using manual supervision, barricades, and security personnel to guide visitors. While these methods are helpful to some extent, they become less effective when the number of pilgrims increases rapidly. Devotees may have to wait for several hours in long queues to get darshan, which often leads to frustration and congestion around temple premises. Because of these challenges, there is a growing need for more organized and technology based approaches to handle temple crowds.

With the advancement of digital platforms and web technologies, new solutions are being explored to improve the management of large gatherings.

One such approach is the use of digital queue systems that allow visitors to book entry slots in advance instead of waiting in physical lines. This method helps distribute visitor flow across different time periods and reduces unnecessary crowd buildup at temple entrances.

This research proposes DarshanFlow: A Structured Digital Queue Architecture for Temple Visitor Entry, a web-based platform designed to assist both pilgrims and temple authorities in managing temple visits more effectively. Through this system, pilgrims can check crowd status, register for a virtual queue, and receive updates about their scheduled visit. At the same time, temple administrators can monitor bookings, control entry limits, and manage visitor flow through an administrative dashboard.

The objective of this study is to examine how a digital queue management platform can support safer and more organized temple visits. By reducing physical waiting lines and providing better information to visitors, the system aims to improve overall crowd management and enhance the experience of devotees

during temple visits.

II. LITERATURE REVIEW

With the rapid growth of population and the increasing number of public gatherings, managing large crowds has become an important challenge. Events such as religious festivals, temple visits, concerts, and other public celebrations attract a large number of people within limited spaces. When crowd movement and density are not properly monitored, it can lead to congestion, discomfort, and sometimes serious safety risks. Therefore, proper crowd management and monitoring systems are necessary to ensure the safety and smooth movement of people during such large events.

In recent years, researchers and experts have suggested different technological solutions to address this issue. Various approaches such as surveillance systems, computer vision techniques, and digital queue management platforms have been explored to monitor crowd density and manage the flow of people more efficiently.

In addition to IoT and thermal-based monitoring systems, QR-codebased entry mechanisms are widely used in public sectors such as airports and theme parks for managing large crowds efficiently. These systems allow fast verification and controlled access through digital tickets. Unlike these generalpurpose systems, the proposed DarshanFlow architecture integrates QRbased entry with a templespecific slot scheduling mechanism, making it more suitable for religious environments where crowd flow needs to be both regulated and predictable.

Review of Existing Studies:

Several researchers have proposed systems to monitor and manage large crowds using different technologies.
A crowd monitoring system using thermal cameras was proposed in one study to manage large groups of pilgrims during religious gatherings [1].

The cameras are installed at important locations to observe crowd movement and calculate crowd density in real time. When the density becomes too high, the system generates alerts to help authorities take preventive actions. Another study introduced a low-cost IoT-based system called TempleGuard for monitoring crowd and environmental conditions inside temple premises [2].

The system uses sensors to count visitors and also monitors parameters such as temperature, humidity, and air quality. When predefined limits are exceeded, alerts are generated and automated actions such as activating fans or alarms are triggered. An Integrated Intelligent Crowd Control and Management (IICCM) framework was also proposed for monitoring large crowds using artificial intelligence, IoT devices, and computer vision technologies [3].
The system analyses crowd density and predicts possible risks during large gatherings. It was mainly tested using the Hajj pilgrimage scenario, which involves extremely dense crowds. Some researchers have focused on predicting visitor flow in religious places. A Temple Time Recommendation System was developed using deep learning techniques to estimate visitor footfall and suggest suitable visiting times [4].By recommending less crowded time slots, the system helps distribute visitors more evenly throughout the day and reduce peak congestion. Computer vision techniques have also been widely used for crowd monitoring. One research study proposed a crowd analytics framework that analyzes surveillance camera footage to estimate crowd density and detect congestion in real time [5].
This approach helps security personnel monitor crowd movement and respond quickly to dangerous situations. Another approach used IoT sensors for crowd monitoring inside temple environments [6].

The system uses sensors such as infrared and ultrasonic sensors to estimate the number of people in specific areas. In addition, automated mechanisms such as escalators and servo motors were used to improve the movement of devotees and reduce congestion. Wireless identification technologies have also been explored for crowd management. An RFID-based monitoring system was proposed to track individuals during crowded events [7].

RFID tags attached to participants help authorities track their movement and locate missing persons during large gatherings. Some studies have combined video analysis with mathematical models to analyse crowd behaviour. One such system integrates camera data with a cellular automata model to estimate crowd density, movement speed, and flow patterns [8].

The system can also help identify safe exit routes during emergency situations. Research has also examined the challenges faced in crowd management at religious places. One study discussed problems such as overcrowding, long waiting queues, and difficulties in managing large numbers of pilgrims during temple events [9].

The study emphasizes the need for better planning and organized queue management systems. A survey study reviewed different crowd monitoring and classification techniques used in public environments [10].

It discussed various methods used for analyzing dense crowds and highlighted challenges such as occlusion and complex human movement patterns. Smart queue

management systems have also been proposed to reduce congestion in waiting areas [11].

These systems provide real-time notifications to users through mobile applications so that they can return when their turn approaches instead of waiting in physical queues. Another important study analysed stampede incidents during large religious festivals in India [12].

The research highlighted that poor crowd control, lack of monitoring, and inadequate planning are some of the main causes of accidents in mass gatherings. The study emphasizes the need for better monitoring systems and effective crowd management strategies. Several studies have also focused on understanding crowd behaviour and improving safety during large gatherings. Researchers have reviewed technological advancements in crowd management systems and highlighted the importance of effective planning and monitoring in preventing disasters during mass events and religious gatherings [13] [15].

Research Gap:
Although many studies have proposed systems for crowd monitoring and queue management, most existing solutions focus on a single aspect such as crowd density detection, prediction of visitor flow, or general queue management systems. Many of these approaches are designed for large international events or general public service environments rather than temple specific situations. There is still a need for an integrated system that can provide real-time crowd monitoring along with a digital queue management system specifically designed for temple environments. Therefore, this research proposes a Structured Digital Queue Architecture for Temple Visitor Entry to improve crowd control, reduce waiting time, and enhance the overall experience of pilgrims.

System	Technology Used	Limitation	Advantage
TempleGuard [2]	IoT	No booking	Monitoring
TTRS[4]	Deep Learning	Only Prediction	Time Suggestion
RFID System	RFID	High Cost	Tracking
DarshanFlow	Digital Queue + QR	–	Complete System

III. PROPOSED SOLUTION

The increasing number of pilgrims visiting temples often leads to overcrowding and long waiting queues, especially during peak hours and religious events. These conditions create inconvenience for visitors and make crowd management difficult for temple authorities. To address this problem, this research proposes a Structured Digital Queue Architecture for Temple Visitor Entry that shifts the traditional physical waiting line to a digital platform. The main objective of the application is to manage visitor flow more efficiently while helping pilgrims plan their visit in a more organized manner.

The proposed application combines digital queue booking and crowd estimation within a single platform. Through a mobile or web application, pilgrims can book a specific time slot before arriving at the temple. After completing the booking process, the platform generates a digital queue ticket that includes the assigned time slot and queue number. This approach reduces the need for pilgrims to stand in long physical queues and allows them to arrive closer to their scheduled time.

The platform mainly consists of two parts: the visitors interface and the administrative monitoring application. The visitors interface allows users to create an account, log in, and select an available time slot for temple entry. Once the booking is confirmed, the user receives a digital ticket and may also receive notification updates when their scheduled time is approaching. This feature helps visitors manage their time more effectively and reduces unnecessary waiting at the temple entrance.

The administrative monitoring platform is designed for temple authorities to manage visitor flow. The application estimates the expected crowd level by analyzing the number of digital bookings and check-in records stored in the database. Since every booking contains a specific entry time, the application can determine how many visitors are expected during each time period. If the number of scheduled visitors for a particular time slot reaches the allowed limit, the application can temporarily stop additional bookings for that slot. This helps maintain a controlled flow of pilgrims and prevents overcrowding inside the temple premises without relying on physical monitoring devices.

An administrative dashboard is also included to provide temple management with real-time information about visitor bookings and crowd distribution across different time slots. Through this dashboard, administrators can monitor current crowd trends, adjust the number of available queue slots when necessary, and respond quickly to potential congestion 8 situations. This improves overall coordination and supports better decision-making for crowd management. Another useful feature of the platform is the live crowd status update available to users. Before

starting their journey, pilgrims can check the expected crowd level through the application. This information encourages visitors to choose less crowded time periods, which helps distribute temple visits more evenly throughout the day.

Overall, the proposed, Structured Digital Queue Architecture for Temple Visitor Entry provides a practical and technology-based approach for managing large numbers of temple visitors. By introducing a digital queue application and live booking management, the application can reduce waiting time, improve visitor convenience, and assist temple authorities in maintaining safer and more organized temple environments.The system uses a structured slot allocation mechanism based on a fixed-capacity model. Each time slot allows a limited number of pilgrims (for example, 200 visitors per 30-minute interval). The booking process follows a FirstCome-First-Serve (FCFS) approach. When a user selects a time slot, the system checks the current number of bookings for that slot. If the capacity limit has not been reached, the booking is confirmed; otherwise, the slot is marked unavailable. This ensures balanced distribution of visitors and prevents overcrowding.

IV. System Architecture

The architecture of the proposed Smart Temple Crowd and Queue Management System is designed as a simple webbased platform that connects pilgrims with temple authorities through a centralized system. The architecture mainly consists of three major components: the user interface, the application server, and the database layer. Each component performs a specific role in managing visitor information, queue bookings, and administrative control.

The second layer is the application layer, which is implemented using the Spring Boot framework in Java. This layer acts as the core processing unit of the system. It manages user requests, processes queue registrations, verifies available time slots, and communicates with the database. When a pilgrim books a slot, the application server records the request, checks the number of existing bookings for that time period, and either confirms or restricts the booking based on the allowed capacity. The application layer also supports the administrative functions of the system.

The administrative dashboard is an important part of the architecture. Temple authorities can log in to the admin panel to monitor visitor bookings, update crowd information, and manage queue limits. Through this dashboard, administrators can view the number of registered visitors for different time slots and adjust entry limits when necessary. This feature helps authorities maintain a controlled flow of devotees within the temple premises.

The third layer is the database layer, where all system data is stored. MySQL is used to maintain records such as user details, queue bookings, time slot allocations, and administrative updates. The database ensures that all information is stored securely and can be retrieved quickly when required by the application server.

In addition to these components, the system also includes an informational portal developed using WordPress. This portal provides general information such as temple timings, announcements, and guidance for visitors. The WordPress site can display updates from the main system, helping pilgrims stay informed before visiting the temple. Overall, the architecture follows a structured approach where the user interface communicates with the Spring Boot backend, and the backend interacts with the MySQL database to store and manage information. This layered structure makes the system organized, easy to maintain, and suitable for future improvements.

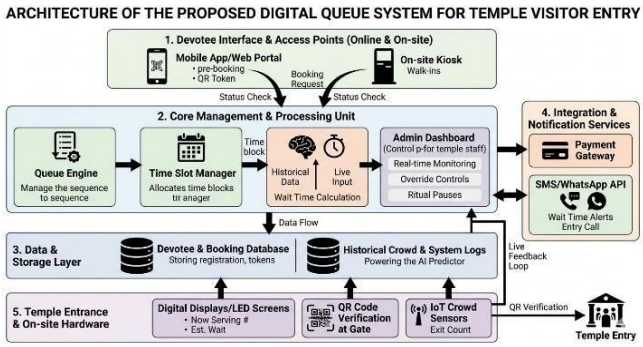

Figure 1: Architecture of the Proposed Digital Queue System for Temple Visitor Entry

V. Methodology

The development of the proposed Smart Temple Crowd and Queue Management System follows a structured process to ensure that the system is organized, reliable, and easy to use. The methodology includes several stages, beginning with understanding the problem and ending with system testing and deployment.

The first stage is requirement analysis. In this stage, the challenges faced by temple authorities and pilgrims during large gatherings are studied. Common problems such as long waiting queues, overcrowding near temple entrances, and lack of proper information about crowd conditions are identified. Based on these observations, the main system requirements are defined. Two primary users of the system are considered: pilgrims who want to book queue slots and temple 11 administrators who need to manage visitor flow.

The next stage is system design. In this phase, the

structure of the application and the interaction between different components are planned. The system is designed as a web-based platform with a frontend interface for users and an administrative dashboard for temple authorities. The backend services are developed using the Spring Boot framework, while MySQL is used for storing system data such as bookings and visitor records. The design also includes defining the data flow between the user interface, the server, and the database.

After the design stage, the project moves to the development phase. In this stage, different modules of the system are created. The pilgrim module allows users to register, log in, view crowd information, and book a virtual queue slot. The administrative module enables temple authorities to monitor bookings, update crowd status, and manage queue limits for different time slots. Each module is developed separately and later integrated into the main system. The implementation of the Smart Temple Crowd and Queue Management System focuses on creating a functional web-based platform that assists both pilgrims and temple authorities in managing temple visits more efficiently. The system is implemented using modern web technologies that support easy development, scalability, and maintenance.

The backend of the application is developed using Java with the Spring Boot framework. Spring Boot is used to create REST APIs that handle user requests such as registration, login, queue booking, and administrative updates. The backend also performs important tasks such as verifying available time slots, processing booking requests, and storing visitor information in the database.

The frontend of the system is designed using HTML, CSS, and basic JavaScript to create a userfriendly interface. Through this interface, pilgrims can access important features such as viewing crowd status, selecting available time slots, and generating digital queue tickets. The interface is designed to be simple and responsive so that it can be accessed easily from both computers and mobile devices.

The system uses MySQL as the database to store important information related to users, queue bookings, time slots, and administrative updates. Each booking is recorded with a specific time slot so that the system can track the number of visitors expected during a particular period. This helps maintain controlled entry and prevents overcrowding.

An administrative dashboard is also implemented as part of the system. Through this dashboard, temple authorities can log in securely and monitor visitor bookings in real time. Administrators can update crowd information, control the 13 number of available queue slots, and manage visitor flow during peak hours or special events.

In addition to the main application, an informational portal using WordPress is included to provide general details about the temple, such as visiting hours, announcements, and guidance for pilgrims. This portal helps visitors access useful information before arriving at the temple premises. Overall, the implementation combines a Spring Boot backend, a simple web interface, and a MySQL database to create a practical system for digital queue management.

After successful booking, pilgrims receive notifications through multiple channels, including SMS, email, and inapplication alerts. These notifications include booking confirmation details and reminders before the scheduled entry time. Additionally, each booking generates a unique QR code that acts as a digital entry pass. At the temple entrance, the QR code is scanned for verification, enabling faster entry and reducing manual checking delays.

VI. Results and Discussion

The analysis of existing crowd management techniques shows that traditional methods alone are often not sufficient to handle large gatherings in temples. Manual monitoring by security staff and the use of physical barricades can help control movement to some extent, but these approaches become less effective when the number of visitors increases rapidly. During peak hours or festival days, the number of devotees can increase suddenly, making it difficult for authorities to respond immediately and maintain a smooth flow of visitors.

The study indicates that digital systems can assist temple authorities in understanding visitor flow more effectively. By analyzing information such as online bookings, queue registrations, and visitor entry records, administrators can estimate the expected number of devotees during different time periods.
This information helps identify time slots that are likely to experience heavy crowds and allows authorities to regulate entry in a more organized manner. For example, controlling the number of bookings for a particular time slot or temporarily limiting new registrations can help reduce pressure on crowded areas.
Another important observation is the role of organized queue management systems. Structured queues, virtual ticketing, and controlled entry points allow devotees to move gradually and maintain a steady flow inside the temple. Instead of waiting in long physical lines for several hours, visitors can book a specific time slot and arrive closer to their scheduled entry time. This

approach not only reduces congestion at temple entrances but also improves convenience for devotees. The discussion also highlights that the combination of digital queue management and proper planning can significantly improve crowd management efficiency. When booking data and visitor updates are available to temple authorities through an administrative dashboard, it becomes easier to monitor crowd trends and make quick decisions. Providing clear guidance and timely updates to visitors further helps in maintaining an organized and safe environment during temple visits.

To evaluate the effectiveness of the proposed system, a comparison was made between two crowd entry models: ***Random Arrival and Scheduled Slot Entry:***

- In the Random Arrival model, crowd density showed sudden spikes during peak hours.
- In the Scheduled Slot model, visitor flow remained evenly distributed across time slots.

This demonstrates that the proposed system significantly reduces congestion and improves overall crowd movement.

VII. CONCLUSIONS

Crowd management in temples has become an increasingly important issue due to the growing number of devotees visiting religious places every year. Large gatherings, especially during festivals and special religious events, can create challenges related to safety, movement control, and visitor comfort. Without proper planning and coordination, overcrowding can lead to confusion, long waiting times, and in some cases serious safety risks.

This study examined the challenges involved in managing large crowds in temple environments and explored how digital solutions can improve the overall management process. The findings suggest that traditional crowd control methods, while still useful, need to be supported by modern technological systems in order to handle largescale gatherings more effectively. Digital queue management platforms and online booking systems can help regulate visitor flow and reduce the need for long physical queues.

In conclusion, systems such as the proposed **A Structured Digital Queue Architecture for Temple Visitor Entry (DarshanFlow**) can support temple authorities in organizing visitor entry more efficiently. By providing features such as virtual queue booking, time slot management, and administrative monitoring, the system helps distribute visitors more evenly and maintain smoother movement within temple premises. Implementing such digital approaches can reduce congestion, improve visitor convenience, and contribute to safer and more organized temple environments.

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