

KumbhSahyogi A Service Provider Platform: Smart Transport and Parking Management System

Vaishnavi Chaudhari¹, Priti Lahane², Mayuri Daga³, Prathamesh Patil⁴, Kailas Adhav⁵

^{1,3,4,5}Department of Information Technology MET Institute of Engineering Nashik, India

²Associate Professor, Department of Information Technology MET Institute of Engineering Nashik, India

Abstract- Maha Kumbh 2027 at Nashik is expected to attract millions of devotees from around the world. This presents significant challenges in managing transportation, parking, and emergency response. Traditional systems often fail to handle large crowds effectively, resulting in congestion, delays, and security problems. This paper introduces KumbhSahyogi, a GPS-based, AI-powered smart mobility and service management system designed to maximize parking allocation, optimize routes, and coordinate transportation for large events like the Kumbh Mela. The system includes various features such as real-time parking slot availability, AI-powered route optimization through Dijkstra's algorithm and congestion heatmaps, multimodal transport integration, and a smart chatbot for user support. The backend uses Node.js and Express along with MongoDB Atlas to manage data securely and effectively. The system greatly improves safety, reduces traffic congestion, and increases user convenience through smart routing, predictive analytics, and instant SOS communication. Experimental testing under simulated event conditions shows faster response times and optimized crowd movement, demonstrating the platform's potential to efficiently manage large-scale religious and public events.

Keywords: Index Terms: Kumbh Mela 2027, Smart Transportation, Artificial Intelligence (AI), GPS Navigation, Smart Parking, Dijkstra's Algorithm, Crowd Management, AWS.

I. INTRODUCTION

The Maha Kumbh in Nashik is one of the largest religious gatherings in the world. It is expected to welcome millions of devotees from across the globe. Managing such a large crowd presents significant challenges, especially concerning transportation and parking. This paper discusses the scale and complexity of Maha Kumbh 2027 in Nashik, which is expected to host over 100 million visitors. This research arises from the growing need for a single digital system that can address the diverse requirements of millions of pilgrims at Maha Kumbh 2027. As visitor numbers rise, traditional methods struggle with transportation, accommodation, and emergency management. To overcome these challenges, technology-based solutions are essential for improving crowd management, enhancing safety, and providing real-time support to devotees.

II. EASE OF USE

A. User Interface and Accessibility

The platform features a clear and user-friendly interface. It caters to all age groups, including those

without technical skills. The system supports multiple languages to serve users from around the world. Maps and clear directions indicate parking locations, routes, and points of interest. The app is available on both Android and iOS, ensuring accessibility for most users. The design is straightforward and easy to navigate.

B. Functionality and Convenience

The app will help users find nearby transportation, check parking availability, and access an AI chatbot that provides cost estimates and travel details for various Kumbh Mela events. Users can book or request emergency assistance with just one tap, enabling quick action in challenging situations. Voice and chat features simplify navigation and provide information without requiring text input. Users can save preferred locations and access critical information even during internet outages using heat maps.

III. IMPORTANCE OF SMART TRANSPORTATION AND PARKING

A. Effective Crowd and Resource Management

This system addresses public transport, shuttles, private vehicles, Ola/Uber services, parking, and numerous routes.

It ensures smoother travel, reduces crowding, and enhances safety for everyone.

C. Technology-Driven Smart Solution

The system employs AI, GPS, and data to create efficient pathways. This setup facilitates quick movements, effective spot finding, and speedy assistance. It aligns with India's Smart City and Digital India initiatives. It can scale up for larger events and city operations.

IV. OBJECTIVES

- To provide Real-Time Parking Slot Availability in and Around Nashik: The system offers live updates on available parking spots in and near the city. Using GPS, heat maps, and an AI chatbot helps users find parking quickly, reducing search time and preventing traffic jams.
- To suggest Optimized Routes Using AI and GPS: The platform uses AI and GPS algorithms, including Dijkstra's algorithm and congestion heatmaps, to determine the shortest and fastest routes. Simple plans and heat maps guide users. This approach helps pilgrims reach their destinations quickly while avoiding busy areas during peak times.
- To integrate Public, Private, and Ride-Hailing Services: The platform connects various transportation options, including city buses, electric vehicles, shuttles, and rideshare apps like Ola and Uber. This integration offers multiple eco-friendly and budget-friendly transportation choices.
- To Deploy an AI Chatbot for User Assistance and Travel Recommendations: An AI chatbot within the platform provides support and suggestions. It assists users with parking, cost estimates, and ride options. The chatbot communicates in simple language, offers quick help, and adapts to individual user needs.
- Enhance Safety and Reduce Congestion Through Intelligent Routing and Dynamic Updates: The platform continuously monitors real-time data

from heat maps and GPS networks to update routes and parking availability. It keeps users informed about road and parking changes as necessary. This approach allows pilgrims to navigate crowds, minimize congestion, and maintain safety during gatherings.

V. LITERATURE SURVEY

Yadav [1] examined how large religious gatherings shape urban development. He observed how land use and road layouts change during major events. His study utilized technological tools to map land use from 2016 to 2022. His findings indicate that temporary camps expand with event size, but he did not closely analyze parking or accommodation details. The paper highlights land use changes due to the Kumbh, showing how temporary setups affect urban layout and create additional space needs for vehicles. The primary focus is broad and lacks in-depth technological solutions or specific plans for parking spaces. It offers limited insights into tech-based parking booking solutions.

Kanaujiya et al. [2] focused on the Prayagraj Kumbh Mela 2019. They demonstrated how vehicles, crowds, and urban planning work together. They noted that effective crowd management operates cohesively. However, they indicated the lack of technological approaches to optimize parking or rides. They see potential for future innovations in this area. They discuss how to manage large volumes of vehicles, cover waiting areas, short-term urban planning, and peak crowd times. Although they provide practical limits for busy days and exits beneficial for parking planning, they do not include a step-by-step guide for parking bookings. Nonetheless, they present valuable data on operations to inform planning.

Lei and Ouyang [3] proposed a new pricing and reservation model for parking spots. Their approach reduces search time for spaces while maximizing revenue through smart tools. However, this model requires user engagement, which may not hold up in diverse settings like the Kumbh Mela. They illustrated how place-based pricing shifts and reservations can enhance system efficiency (reduce

search time, increase usage). Their findings on smart pricing variations, driver behaviors, and demand may not apply to the unpredictable environments of large events. Adjustments may be needed for short-term parking and high traffic volumes.

Ahmed et al. [4] developed an improved smart parking system using innovative algorithms. They tested it against real urban traffic data. Their approach increased parking efficiency and reduced congestion, but its effectiveness for large, short-term events with high attendance remains unproven. Their model leverages real-time data to maximize parking usage and minimize disruptions, accommodating more vehicles in limited spaces. However, dealing with significant demand spikes during major events may require further refinement, and their exploration of planning and costs needs expansion.

Likewise, Dutta [5] used a mapping algorithm to explore parking search behavior. The study highlighted how road layouts influence decision-making. It provided insights into how these factors contribute to traffic congestion. However, it focused solely on parking search and did not incorporate alternative transportation methods. Their framework offers limited estimates on search durations, demonstrating the impact of street layouts on timely parking accessibility. Understanding how pilgrims navigate crowded areas is essential. The goal was to discern search patterns rather than booking or pricing strategies, which should be integrated into a comprehensive planning tool.

Zheng et al. [6] developed a model for parking allocation and route planning during large events. Their strategy utilizes real-time space and congestion data to manage parking efficiently and reduce vehicle congestion. However, the study has limitations due to its small scale, utilizing minor urban test sites that do not reflect the temporary setups and density seen in large religious gatherings like the Kumbh Mela.

Ala'anzy et al. [7] created a smart parking strategy using Internet of Things (IoT) sensors and fog

computing to quickly locate available spaces. Their model distributes tasks between fog nodes and cloud servers, reducing latency and ensuring rapid data access, unlike traditional methods. However, it does not address the complexities of large events, where installations and internet connectivity present significant challenges. Zhang [8] investigated parking reservation methods. The study delved into strategies like guaranteed parking, price-based selections, and user compliance. It suggested that advance bookings and flexible pricing could reduce search times. However, most approaches assume that drivers respond uniformly to stable pricing, which may not apply to crowded venues like the Maha Kumbh.

Patil and Patil [9] examined bus and van services in Nashik, focusing on fleet routes, timetables, and access. They identified gaps in coverage and assistance when seeking rides. The study suggests increasing bus services and adding new routes. However, it overlooks technology-driven routing strategies or diverse transportation options, which are crucial for large events.

AG Horizon Pvt. Ltd. [10] reported on Maha Kumbh 2025, highlighting key points about transportation, healthcare facilities, and online support. It emphasized the need for comprehensive bus services, crowd control measures, and fast assistance. The report provides valuable recommendations but lacks specific data and plans for implementing these strategies in real time.

Tripathy and Vishnolia [11] performed a simulation-based analysis of shuttle bus operations during the Nashik Kumbh Mela. They utilized city logistics simulation techniques to evaluate schedules, depot locations, and routes, aiming to reduce wait times and improve passenger flow. While the study offered practical recommendations for transport operations, it relied on static simulation models and did not incorporate adaptive routing or IoT updates, which are crucial for managing dynamic high-density events like the Kumbh.

VI. METHODOLOGY

- **Data Collection:** Real-time information on parking spots, traffic and transportation availability is collected through GPS feeds, city sensors, and transportation APIs. The history of Kumbh events is also used for predictive modeling.
- **System workflow:** Users authenticate securely, and then their location is identified. The system retrieves nearby parking or transportation facilities, calculates optimized routes with Dijkstra's algorithm, and presents the results through an interactive map.
- **AI and algorithm integration:** Incoming data is processed by an AI engine to create congestion heat maps and forecast parking demand. The chatbot module applies natural language processing (NLP) to help users with questions and recommendations.
- **Booking and Payments:** Users can book slots or transport within the app using the Payments API. **Response Module:** SOS capability sends automatic alerts to nearby police stations, hospitals or command centers with GPS coordinates. **Validation:** Prototypes are tested for response speed, system load, and route stability in hypothetical event scenarios to ensure reliability and scalability.

VII. TECHNOLOGY STACK

A. Frontend:

The Aquarius collaborative frontend is built with React Native or Flutter, allowing seamless cross-platform mobile application development for Android and iOS. The frameworks provide an interactive, responsive and user-friendly user interface, making it easy for pilgrims as well as administrators to access services like route planning, booking and SOS alerts.

B. Backend:

The backend is developed in Node.js with Express as the framework, chosen for its event-driven, nonblocking nature, enabling fast and efficient processing of multiple user requests. It provides real-time interaction between users, servers and

databases, which is important to handle dynamic event situations during the Maha Kumbh.

C. Database:

The system employs MongoDB Atlas as a cloud-based database platform to handle and store user profiles, parking availability, transportation schedules, and reservation information. Both databases are scalable, flexible and have fast data retrieval, making them efficient in supporting high volumes of big data transactions at high speeds. Several APIs have been implemented to provide extended system functionality. Google Maps API provides accurate location, route guidance and distance calculations; Payment API facilitates secure transactions for reservations; And the Transportation Data API combines public transportation, shuttle, and ride-hailing data to enable multimodal travel options.

D. AI models/algorithms:

AI algorithms such as the Dijkstra algorithm, AI-based heatmaps, and chatbot recommendation models are used. Models help perform key functions such as predicting traffic congestion, optimizing travel routes, user behavior analysis, and personalized service recommendations.

E. Hosting and Deployment:

The entire system is hosted on a cloud platform such as Amazon Web Services (AWS) or Microsoft Azure Cloud to be highly available, scalable, and reliable. Cloud hosting also supports real-time updates, load balancing and data security, allowing uninterrupted access even during peak traffic periods of the Kumbh event.

VIII. WORK FLOW

A. User logs in and shares current location

The user (pilgrim or guest) taps on the app and logs in with his/her phone number, OTP or social media. Once inside, the app asks you to use GPS to find the user's current location. This location information is the key to finding nearby parking lots, shuttle spots or other places to go.

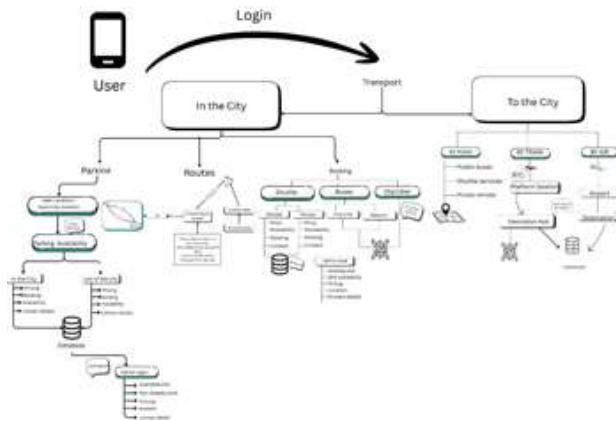


Fig. 1. architecture

B. System retrieves nearby parking/transport data from the database

The back-end system looks for a master data store with live data on all parking areas, shuttle sites, and cab locations. It pulls data like open space, location, distance and cost. This helps give users new options based on how close they are to parks or ride locations.

C. Shortest path calculation using Dijkstra's algorithm

The system uses the Dijkstra algorithm to find the best path from the user's location to a chosen end (such as a parking area or pier). This tool checks scheduled traffic, road miles and route limits for Kumbh. Outside: The nearest and fastest way, shown on the user's map.

D. Heatmap generation to visualize crowd density

Data from cameras or GPS tools is used to create heat maps. This map marks places with lots of people (red = full, green = open). Heatmap helps users and heads to choose smart route and parking by staying away from busy areas.

E. User selects preferred mode (car, shuttle, cab)

By location and what is there, the user can choose: Car – to book a private parking spot. Shuttle – For group rides from distant to close areas. Cab – For on call travel through partner services. The system then shows the possible time, cost and methods for the chosen path.

F. Booking and payment processed via integrated API

After choosing, the user proceeds to book and pay for the park or ride. The system works with secure payment APIs (like UPI, Paytm, Razorpay). Once the payment is processed, a digital

G. Notifications and SOS alerts sent to users and administrators

The system sends push alerts to users about: Book confirmation, Way updates or changes, Park spot state (full/open). In tough times, users can trigger an SOS alert that immediately alerts control rooms, cops, or help teams with location information for fast help.

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