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Study and Control Traffic Management in Shirdi Using Modern Transportation Technique

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ABSTRACT:

The study and control of traffic in Shirdi, a major pilgrimage destination, is vital for managing increasing visitor numbers, ensuring smooth vehicle flow, and minimizing congestion. With rising tourist and local traffic, adopting advanced transportation methods has become essential. This research focuses on analysing Shirdi's current traffic scenario, identifying major challenges, and exploring modern solutions like Intelligent Transportation Systems (ITS), real-time monitoring, automated signals, and data-driven analysis to enhance traffic efficiency.

Key objectives include examining existing infrastructure, studying vehicle flow patterns during peak and off-peak hours, and assessing the impact of pilgrim influx. Tools such as GIS mapping, traffic simulation software, and mobile applications will support the development of smart systems that adjust traffic signals dynamically and provide real-time updates. The goal is to propose a sustainable, efficient traffic management model tailored to Shirdi's unique needs, improving safety, reducing congestion, and enhancing the travel experience for both residents and visitors.

Keywords: Traffic, vehicle flow, Intelligent Transportation Systems, Real-time Monitoring, Peak Hours, Improving Safety.

1. Introduction to Shirdi and its Transportation System: Proposed Methodology:

Shirdi, located in Maharashtra's Ahmednagar district, is globally recognized as a major pilgrimage destination associated with the revered saint Shri Sai Baba. The town, though small in geographic area, witnesses an enormous inflow of visitors on a daily basis, particularly on weekends and during religious festivals such as Ram Navami, Guru poornima, and Vijayadashami. On such days, the town's population can temporarily swell to over two lakh people, placing immense strain on its transport and infrastructure systems.

The transportation network of Shirdi comprises a mix of narrow internal roads, major approach highways (such as SH-10), and public transport hubs, including the Shirdi Bus Stand, Saisnagar Shirdi Railway Station, and the newer Shirdi International Airport. However, the town's infrastructure has not been upgraded proportionately with the growing number of vehicles and tourists. In addition, the layout of Shirdi—with its concentration of temples, hotels, shops, and local vendors within a small area—creates significant vehicular-pedestrian interaction zones, especially around the Shri Sai Baba temple.

This has led to a wide range of traffic-related problems, including congestion, unsafe pedestrian movement, disorganized parking, slow vehicle flow, emergency access delays, and poor visitor experience. Most of the current traffic control measures are manually operated, dependent on the availability of traffic police, and limited by outdated infrastructure. These issues are further exacerbated during festivals or public holidays, when the influx of devotee's surges beyond the town's carrying capacity.

1.1 Need for Study:

There is a pressing need to assess the existing traffic control mechanisms in Shirdi and identify practical, cost-effective solutions that leverage modern technology. Unlike metropolitan cities where extensive ITS (Intelligent Transportation Systems) have already been deployed, towns like Shirdi offer unique challenges and opportunities due to their compact size, event-based congestion patterns, and religious significance. This study is motivated by the observed inefficiencies in current systems and the increasing availability of modern, scalable traffic management tools. It aims to propose comprehensive traffic control model that is data-driven, sustainable, and tailored to the specific demands of a pilgrimage town.

2. Proposed Methodology:

2.1 Overview of the Methodology:

The methodology adopted for this research is designed to systematically analyse the current traffic scenario in Shirdi and propose feasible, smart, and sustainable transportation solutions. The approach is both exploratory and diagnostic, incorporating a mix of primary data collection, secondary data analysis, field observations, stakeholder engagement, and comparative assessment of modern transportation practices.

The methodology comprises five main phases:

i. Identification of problem areas through physical and observational surveys.
ii. Collection and analysis of primary and secondary traffic data.
iii. Assessment of stakeholder perceptions and constraints.
iv. Mapping problems to appropriate modern transportation techniques.
v. Development of a conceptual implementation model with impact evaluation.

This structured methodology ensures that the research remains grounded in local realities while leveraging advanced techniques suitable for modern traffic management.

2.2 Primary Data Collection:

Primary data collection is central to understanding Shirdi's traffic problems at the grassroots level. This involved:

2.2.1 Manual Traffic Volume Counts:

Manual counts were conducted at key intersections and junctions including:

i. Pimpalwadi Road Junction
ii. Near the Main Temple Gate
iii. Sai Nagar Railway Station Approach
iv. Shirdi Bus Stand Entry Points
v. Counts were conducted for:
vi. Morning peak (7:00 AM – 10:00 AM)
vii. Evening peak (5:00 PM – 8:00 PM)
viii. Midday off-peak (12:00 PM – 2:00 PM)

The data captured vehicle classifications (two-wheelers, cars, buses, autos, etc.), pedestrian flow, and traffic movement patterns.

2.2.2 Field Observations:

Field visits were conducted to visually inspect:

i. Traffic congestion zones
ii. Informal parking spots
iii. Pedestrian crossings (or lack thereof)
iv. Areas of vehicle-pedestrian conflict
v. Local commercial encroachments
I. Behaviour of drivers, pilgrims, and vendors

These observations helped map real-time traffic behaviour which is often missed in static data.

2.2.3 Stakeholder Surveys and Interviews:

Structured questionnaires and informal interviews were conducted with:

i. Pilgrims (regarding travel inconvenience, safety, and signage)
ii. Local vendors (about road usage and traffic density)
iii. Traffic police officers (on challenges, manpower, and equipment)
iv. Local transport operators (auto-rickshaw and bus drivers)

This provided critical insights into the human and administrative dimensions of the problem.

2.3 Secondary Data Collection:

Secondary sources were essential in supporting field data and benchmarking against national or global practices. Sources included:

i. Google Maps Traffic Density & Timings: Historical congestion data and real-time travel time estimates for major routes in Shirdi.
ii. Municipal and Police Reports: Previous planning reports, traffic incident records, and pedestrian accident statistics.
iii. Published Literature & Government Studies: Research papers, smart city proposals, case studies from cities like Varanasi, Tirupati, and Puri.
iv. Local News Reports: Insights into past complaints, public reactions, and festival traffic management.

2.4 Traffic Analysis and Problem Identification:

After gathering data, traffic flow analysis was conducted using:

i. Vehicle Flow Charts: Diagrams mapping major routes and average traffic volumes.
ii. Heat Maps of Congestion Zones: Created using GPS and Google Maps data.
iii. Conflict Diagrams: To identify and analyse vehicle-pedestrian interaction points.

Key problems identified:

i. Chaotic traffic around temple gates during Aarti and Darshan hours.
ii. Lack of pedestrian-only paths or crossing infrastructure.
iii. Absence of dynamic traffic signal systems.
iv. Poor signage and one-way enforcement.
v. Unorganized auto-rickshaw stands and tourist bus parking.

2.5 Selection and Matching of Modern Techniques

For each problem category, an appropriate modern transportation solution was proposed, based on:

i. Technical feasibility
ii. Cost-effectiveness
iii. Scalability
iv. Ease of local implementation

Problem Area	**Proposed Solution**
Congested Junctions	Adaptive Signal Control (AI/IoT-based)
Pedestrian-Vehicle Conflict	Elevated Footbridges, Barricaded Walkways
Parking Chaos	Smart Parking System with Digital Displays
Informal Auto Rickshaw Zones	Geo-Fenced Auto Stands + Mobile App Integration
Manual Surveillance	CCTV + AI-Based Crowd & Traffic Monitoring
Lack of Real-Time Information	Mobile App for Pilgrims (Navigation + Alerts)

2.6 System Design and Framework Development

A conceptual framework was developed, combining:

i. Real-time data capture through IoT sensors, CCTV, and GPS.

ii. Data analytics module for traffic forecasting and congestion detection.

iii. Centralized Control Center (CCC) for monitoring and coordination.

iv. User interface systems (mobile app, digital display boards).

v. Stakeholder integration and training modules.

This smart system can operate in three modes:

i. Normal Mode: For routine crowd flow with limited oversight.

ii. Peak Load Mode: Activated during festivals and weekends.

iii. Emergency Mode: For rapid-response scenarios such as ambulances, fire engines, or VIP movements.

2.7 Validation and Feedback Loop:

The methodology includes a feedback mechanism through:

i. Public satisfaction surveys

ii. Traffic violation data

iii. Emergency response time records

iv. Pollution level monitoring (optional future extension)

3. Design of system and Probable Technologies for Traffic Reduction:

3.1 Design of the System:

The proposed system is designed as an **Integrated Smart Traffic Control Model** tailored for Shirdi's unique religious-tourism context. It emphasizes modularity and scalability to allow gradual implementation without disrupting daily life.

3.1.1 System Architecture Includes:

1.Smart Traffic Signals:

Fig.no.3.1 Smart Traffic Signals.

Equipped with vehicle detectors (IR or microwave sensors), AI algorithms, and timers, these signals adapt in real-time based on traffic density. Control logic is hosted on a local server at each major junction and coordinated centrally.

2.IoT Sensor Network:

Fig.no.3.2. IoT Sensor Network

Sensors installed at roadsides and overhead gantries gather data on vehicle count, speed, and pedestrian flow. This real-time data feeds into the central dashboard.

3.Centralized Traffic Control Center (CTCC):

Fig.no.5.3. Centralized Traffic Control Center

Located within Shirdi Nagar Parishad or nearby traffic headquarters, this centre house software platforms to monitor live feeds, analyse congestion levels, and override systems manually during emergencies.

4.Smart Parking Management: Entry-exit sensors with a digital display system are proposed for major parking areas. Pilgrims are guided using a mobile app and signboards to the nearest available parking**.**

5.Public Information System:

Fig.no.5.4. Public Information System**:**

LED displays and mobile notifications provide live updates on traffic conditions, parking availability, emergency alerts, and devotional event timing.

6.Mobile App for Pilgrims:

The proposed mobile interface will integrate:

- Live traffic updates
- Nearest parking locator
- Emergency help contacts
- Pedestrian-friendly route mapping to temples

Fig.no.5.5. Mobile App for Pilgrims

3.2 The most comm***on devices used to control and regulate the traffic are:***

- Road signs,
- Road markings,
- Road signals and
- Traffic Island
- Over-Bridge

4. Problem and Recommendations for Traffic at Shirdi:

Shirdi, a spiritual hub in the Ahmednagar district of Maharashtra, is globally known as the home of Shri Sai Baba, attracting millions of pilgrims and tourists throughout the year. This constant influx of people has led to serious urban traffic congestion, especially around the temple premises and nearby arterial roads. The existing road network was under tremendous pressure during peak times, with frequent traffic jams, unsafe pedestrian movement, and delays in emergency vehicle response. Recognizing the urgent need to manage this growing challenge, a comprehensive traffic management plan was conceptualized and executed by the local municipal authorities and urban planners, with two key interventions at its core: the construction of an overbridge and the installation of modern zebra crossings.The overbridge, constructed near one of the busiest intersections close to the Shri Sai Baba temple, was designed to separate local town traffic from long-distance and high-speed vehicles entering Shirdi from the Sinnar–Shirdi highway (NH-160). This overpass allows uninterrupted flow of vehicles traveling between Nashik and Shirdi, bypassing the congested inner roads and eliminating the need for vehicles to stop at major signalized junctions

4.1 Shirdi Traffic Volume Study:

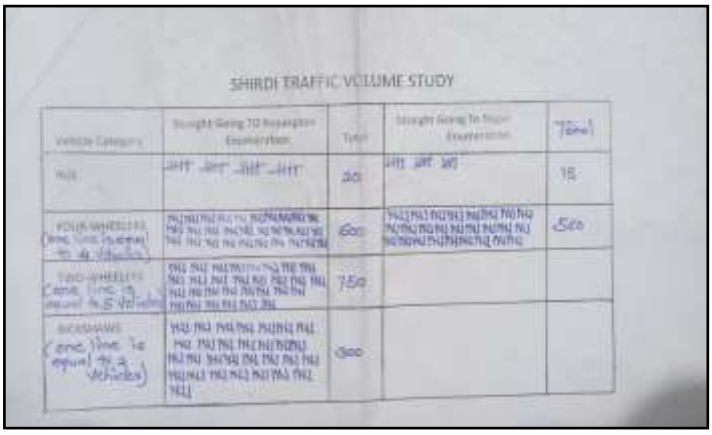

Fig. 6.1 Shirdi Traffic Volume Study

4.2 Recommendations for Implementation:

Based on the findings, analysis, and proposed smart traffic control solutions, the following recommendations are made for implementing the proposed traffic management system in Shirdi.

4.3 Phased Implementation Approach:

The implementation should follow a phased approach, starting with pilot projects in high-traffic zones. This phased rollout will ensure manageable deployment and allow for continuous monitoring and adjustment. The steps include:

4.3.1 Phase 1: Pilot Implementation:

i. Focus on Pimpalwadi Road Junction and Temple Road as key congestion points.

ii. Install adaptive traffic signals with vehicle detection sensors.

iii. Deploy digital parking management at the main temple parking lot.

iv. Roll out the mobile app for pilgrims to access real-time traffic updates.

4.3.2 Phase 2: Expansion to Critical Junctions:

i. Expand adaptive signals and sensors to Sai Nagar Road and Shirdi Railway Station Approach.

ii. Install smart street lighting with automated brightness adjustment based on traffic and pedestrian movement.

4.3.3 Phase 3: Full System Integration:

i. Full implementation of centralized traffic control at the Central Traffic Control Center (CTCC).

ii. Implement CCTV surveillance and AI-based traffic monitoring for congestion and incident detection.

iii. Integrate **smart parking systems** with digital signage and mobile app features for real-time parking availability.

4.3 Budget and Funding:

While the costs may be high, the proposed system offers long-term benefits in terms of reduced congestion, improved safety, and enhanced pilgrimage experience. A mix of government funding (from Smart Cities Mission and other grants), Public-Private Partnerships (PPP), and local municipality contributions can be explored for the financial sustainability of the project.

4.4 Stakeholder Engagement and Training:

Engaging local stakeholders—pilgrims, residents, business owners, and local traffic police—will ensure smooth system adoption. Training modules should be provided for:

- Traffic police: On how to operate and monitor the system.
- Tech support: Ensuring reliable maintenance and troubleshooting of the smart systems.

4.5 Public Awareness Campaign:

A robust public awareness campaign should be launched to educate residents and pilgrims about the benefits of the new traffic system. Information on parking options, mobile app features, and real-time traffic updates should be readily available.

4.6 Future Expansion Plans;

Once the system proves successful in Shirdi, it could be expanded to nearby towns like Shani Shingnapur, Pandharpur, and Nashik, which experience similar traffic challenges during peak pilgrimage seasons.

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