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GIS-Based Road Network and Critical Junction Analysis for Traffic Planning in Hinjewadi IT Park, Pune

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Abstract— Hinjewadi IT Park in Pune has rapidly developed into one of India's leading tech hubs, attracting a large workforce and increasing vehicle traffic in the area. This swift growth has brought with it significant traffic challenges, especially at busy intersections, leading to delays and impacting day-to-day productivity. This study focuses on using Geographic Information Systems (GIS) to closely examine the road network in and around the IT Park. By mapping current infrastructure and analyzing how traffic moves through the area, the research identifies major congestion points. The goal is to pinpoint problem zones and suggest practical, data-backed solutions to ease traffic flow. Ultimately, the insights from this study aim to help city planners and authorities make smarter decisions about future upgrades, leading to a more efficient and sustainable way of getting around the region.

.**Keywords—** Urban Mobility ,Congestion Management , Spatial Analysis

A. Introduction

Hinjewadi, located in the western periphery of Pune, has transformed from a rural fringe area into one of India's leading IT corridors. With the establishment of the Rajiv Gandhi Infotech Park, the area now houses major tech companies and startups, attracting over 2.5 lakh daily commuters from various parts of Pune and beyond. However, this rapid urbanization and economic development have outpaced transportation infrastructure, resulting in chronic traffic congestion, delays, and reduced travel efficiency.

The existing road network in Hinjewadi struggles to accommodate the ever-increasing volume of private vehicles, buses, and commercial transport. Key junctions and narrow access roads often act as bottlenecks, especially during peak office hours. Despite ongoing infrastructure projects like the proposed metro and road widening, short-term, data-driven traffic planning is urgently needed to improve mobility and reduce commuter stress.

In this context, Geographic Information Systems (GIS) offer a valuable tool for understanding and addressing traffic-related challenges. GIS can be used to map the current road network, analyze traffic flow patterns, and identify critical junctions that require intervention. This study, therefore, aims to apply GIS-based techniques to evaluate the transportation scenario in Hinjewadi IT Park, identify pressure points in the network, and recommend strategies for effective traffic planning and management.

1) Study Area Description

Hinjewadi IT Park, officially known as the Rajiv Gandhi Infotech Park, is located on the western outskirts of Pune, Maharashtra. It spans across three phases—Phase I, II, and III—and is one of the largest IT hubs in India. Spread over approximately 2,800 acres, Hinjewadi hosts major multinational corporations such as Infosys, Wipro, TCS, Cognizant, and Tech Mahindra, attracting a working population of over 2.5 lakh people.

The area is connected to Pune city via several key roads:

- Mumbai–Bangalore Highway (NH 48)
- Wakad–Hinjewadi Road
- Baner–Hinjewadi Link Road
- Phase-wise internal roads, which vary in width and condition

Despite the presence of a few arterial and sub-arterial roads, the internal road network is inconsistent, often narrow and poorly maintained. The traffic influx during

peak hours creates severe congestion at multiple intersections, especially near company campuses, entry/exit gates, and junctions like Wakad Chowk, Phase I Circle, and Infosys Circle.

- **Problems in Identifying Critical Junctions**

Identifying critical junctions in a dynamic and fast-growing area like Hinjewadi poses several challenges:

1. Lack of Updated Road and Traffic Data

- Official road maps are often outdated or missing newly developed link roads.
- Traffic volume data is not consistently recorded, making real-time analysis difficult.

2. Non-Standardized Junction Designs

- Many intersections in Hinjewadi are **informal or unstructured**, without proper signage or signalization.
- Roundabouts, T-junctions, and intersections merge irregularly, making pattern recognition harder.

3. Unregulated Traffic Behavior

- Absence of lane discipline, roadside parking, and random U-turns add to congestion.
- Auto-rickshaws, company buses, and private vehicles compete for limited road space.

4. Rapid and Uncoordinated Urban Development

- New commercial complexes and residential townships continue to emerge, altering traffic patterns frequently.
- Planning interventions often lag behind development, making static analysis less effective.

5. Limited Use of Technology in Traffic Management

- There is minimal integration of **real-time traffic data**, such as from CCTV, Google Maps, or ITS.
- Without smart sensors or traffic modeling software, predicting junction stress points remains a challenge.

6. Commuter Dependency on Private Vehicles

- Lack of efficient public transportation within the park increases the number of two-wheelers and cars.
- Parking spillover and pick-up/drop-off delays further choke key junctions.

B. ***Objectives***

1. To create a detailed GIS-based road network map of Hinjewadi IT Park.
2. To analyze spatial traffic patterns and identify congestion-prone junctions.
3. To suggest strategic interventions for traffic decongestion and improved junction design.
4. To support urban planners with a data-driven approach for future infrastructure development.

C. Methodology

a) Study Area Delimitation

- Define the geographical boundaries of **Hinjewadi Phase 1, 2, and 3**, covering all major arterial, sub-arterial, and internal roads.
- Collect base maps and administrative boundaries from official sources such as **PMRDA**, **Pune Municipal Corporation (PMC)**, and satellite imagery.

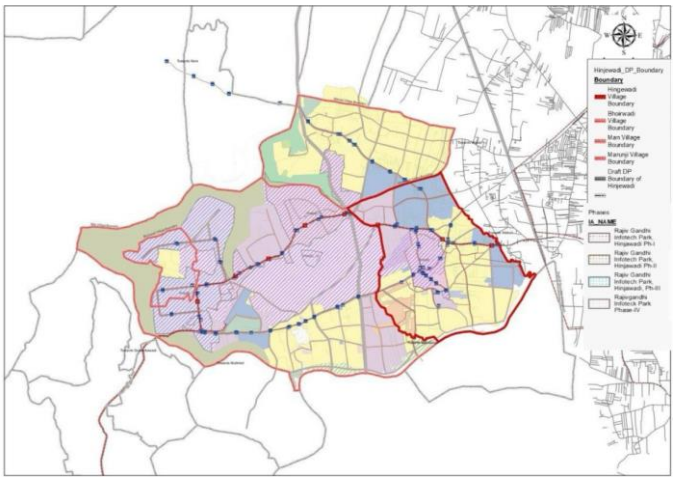

Fig 1.Map of **Hinjewadi IT Park and Surrounding Areas**, Pune

Secondary data was collected from:

- **Municipal Corporation Reports (PMC)**
- **Traffic Department Logs**
- **Smart City Traffic Control Center**
- Previous traffic studies, urban transport master plans, and development authority proposals

This data provided information on:

- Historical traffic volumes
- Existing Level of Service (LOS) ratings
- Junction delay reports
- Known congestion zones and prior recommendations

This helped shortlist high-traffic junctions already under monitoring or reported for delays.

2) GIS Spatial Analysis

Using GIS tools (like **QGIS**), spatial layers were created for:

- **Road network**
- **Accident hotspots**
- **Land use (residential, commercial, institutional)**
- **Connectivity to major nodes like IT parks, schools, metro stations**
- GIS allowed visualization of high-stress corridors and helped spatially identify junctions that align with traffic overload and urban growth zones.

3) Commuter Feedback

Feedback was collected via:

- **Short interviews at junctions**
- **Google Forms circulated among IT employees and locals**
- Informal conversations with **auto drivers**, **delivery personnel**, and **residents**

Insights gained:

- 78% of commuters rated their daily junction experience as "poor" or "very poor."
- Top complaints:
    - Long signal wait times (65%)
    - No footpaths or pedestrian crossings (57%)
    - Risk of accidents due to turning conflicts (49%)
- Opinions on enforcement and traffic signals

This user-centric feedback added a **human dimension** to the technical data, revealing practical challenges commuters face daily.

4) Field Observation

Site visits were conducted during **peak (8–11 AM, 5–8 PM)** and **non-peak hours** to observe:

- **Queue lengths**
- **Signal functioning**
- **Driver and pedestrian behavior**
- **Encroachments or illegal parking**
- **Movement of public transport and non-motorized traffic**

Junctions were visually assessed and scored based on:

- Delay
- Safety
- Infrastructure condition
- Congestion severity

Field logs and photographs were maintained to document findings.

5) . Police Station Visit and Traffic Department Interaction

Meetings were held at nearby **traffic police stations** (e.g., Wakad, Hinjewadi, Sangvi) to gather:

- **Accident records**
- **Complaint logs**

- **Traffic fine data**
- **Junction-specific enforcement challenges**

This helped identify **accident-prone areas** and places requiring **higher enforcement or engineering solutions**.

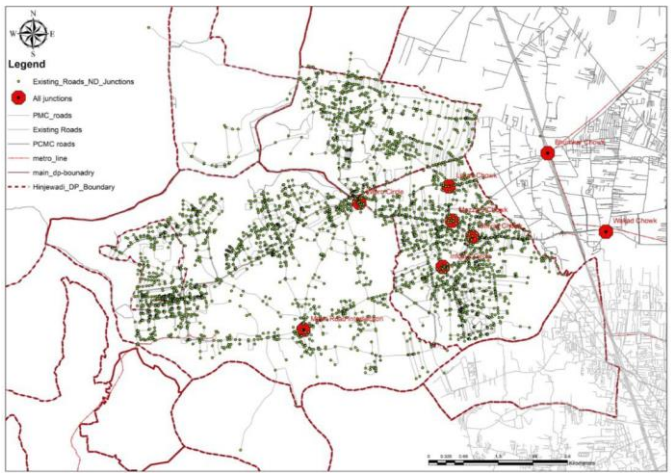

Fig 2: Links and Nodes of Hinjewadi Area

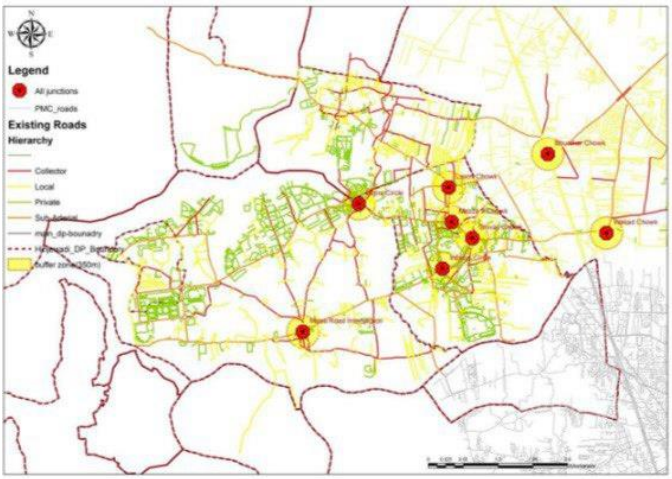

Fig 3: Identified Critical Junctions in Hinjewadi IT Park

- ***Conclusion***

*BY INTEGRATING **TECHNICAL DATA**, **SPATIAL TOOLS**, **ON-GROUND REALITIES**, AND **STAKEHOLDER INSIGHTS**, THIS MULTI-DIMENSIONAL APPROACH PROVIDED A HOLISTIC AND RELIABLE METHOD TO IDENTIFY THE MOST **CRITICAL TRAFFIC JUNCTIONS** IN THE HINJEWADI REGION. THIS GROUNDWORK IS ESSENTIAL FOR TARGETED INFRASTRUCTURE UPGRADES, TRAFFIC MANAGEMENT STRATEGIES, AND URBAN MOBILITY PLANNING.*

Summary of Observed Issues at Major Junctions

Junction	Key Issues Identified
1 .Wakad Chowk	Extreme congestion, poor signal coordination, pedestrian conflict
2.Bhumkar Chowk	High accident frequency, multiple approach arms, geometric flaws
3.Shivaji Chowk	Narrow approach, illegal parking, weak pedestrian infrastructure
4.Mezza9 Circle	Turning movement delay, inadequate signage, shared space
5.Maan Junction	Poor lane discipline, growing traffic, absence of signal system

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