ANALYSIS OF TRAFFIC USING GIS TECHNIQUES – A CASE-STUDY OF CHANDIGARH CITY

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Abstract
Five papers were Primarily focused on the topic of traffic management in Chandigarh, India. The first paper, "A Case Study of Traffic Characteristics of Important Roads in Chandigarh," used GIS technology to analyse and visualize traffic patterns on four major roads in the city. The study found that Madhya Marg had the highest traffic volume among the four roads studied and made various recommendations to improve traffic conditions. The second paper, "Analysis of Congestion Using Advanced Traffic Devices - A Case Study of Chandigarh (India)," examined the traffic characteristics of six roads in Chandigarh, and recommended several traffic management strategies to improve the flow of tourists and reduce congestion. The third paper, "Observe of Traffic Drift in a Whole Day at a Congested crossroad of Chandigarh," focused on studying business inflow over the course of a day at a crowded crossroads in the city and proposed redesigning the current business signals with a new cycle time to alleviate congestion. Overall, the papers emphasize the importance of using technology and data analysis to develop effective traffic management strategies in metropolitan areas. The findings of the studies may assist policymakers and city planners in making informed decisions about traffic control tactics.

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Objectives

- To evaluate the historical trends in Chandigarh's traffic volume and congestion.
- To provide viable solutions, such as infrastructural, policy, and management strategy upgrades, to reduce the growth in traffic volume and congestion in Chandigarh city.
- To assess the city of Chandigarh's current traffic management methods and infrastructure.

Study area

The city of Chandigarh in India will serve as the subject of investigation into traffic analysis in Chandigarh utilising GIS. The capital of two states, Punjab and Haryana, is located in the masterfully designed city of Chandigarh. The city has a well-organized road network and is separated into several sections, each with its own unique characteristics. Therefore, employing GIS to research and analyse the traffic patterns, road network, and related issues would be fascinating. The length, width, number of lanes, types of roads (such as highways, arterial roads, collector roads, local roads, etc.), condition of the roads, traffic flow, number and location of intersections, presence of traffic signals or roundabouts, speed limits, parking facilities, and pedestrian infrastructure are just a few of the variables that could be included in road map statistics for Chandigarh City. It is possible to detect places with heavy traffic congestion, spot areas with bad road conditions, and plan for network development by gathering these facts and utilising GIS to analyse them.

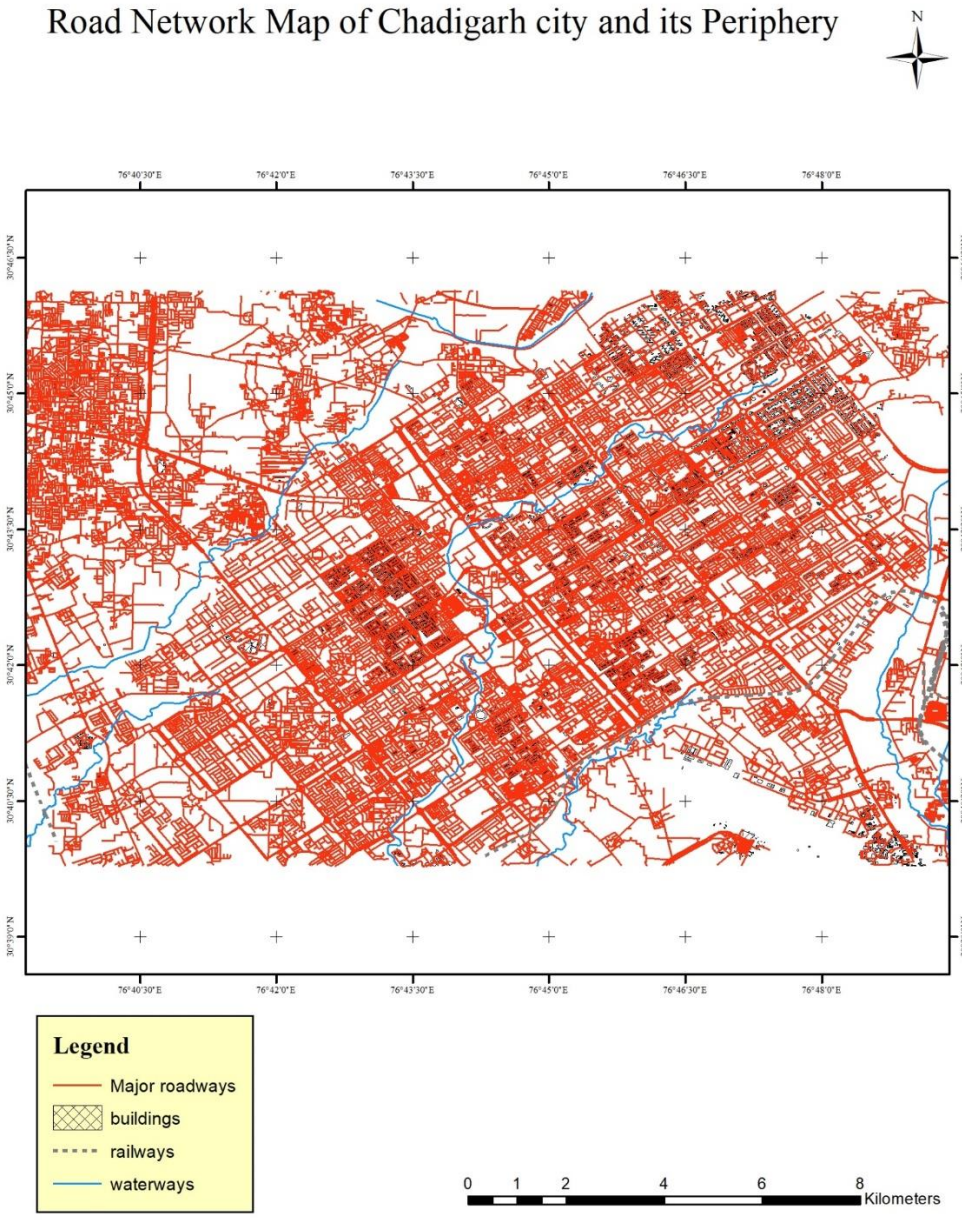

Fig 1.1 Road network map of Chandigarh city and its surrounding areas

Topography

A city called Chandigarh may be found in northern India, near the base of the Himalayas. The city is located 304 metres above sea level and covers a total area of 114 square kilometres. The city's landscape is primarily flat, with a few rolling hills in its north-eastern region.

Sectors, or basically self-contained neighbourhoods with their own markets, schools, and other services, are how the city is divided up. Chandigarh's roadways are well-designed and laid out in a grid-like arrangement. The city's numerous parks and green areas offer a respite from the metropolitan setting.

The Shivalik Hills are to the north and east of the city, which is situated on a plain. Although there are some low-lying places, the topography is mostly level. The city is located on average 304 metres above sea level. Located in the Shivalik Hills' foothills, the Sukhna Lake is a notable feature of the city.

The city's topography has been crucial to the growth of the city. Building infrastructure and transport systems has been made simple by the flat terrain and well-planned highways. The city has become more liveable and appealing to people due to the abundance of parks and green areas.

METHODOLOGY

The methodology for the research involved the review of various topics related to Traffic, Traffic Congestion, City planning, GIS software, GIS techniques and other topics related to traffic analysis. Secondary research method was selected as the research method as primary data was not provided by Chandigarh Traffic Police on time. Secondary research included the review and analysis of relevant literature concerning the relation ‘Traffic analysis of Chandigarh city’.

Research questions

What are the primary causes of the recent rise in traffic in Chandigarh City, and how do they interact with one another?

How may the negative effects of more traffic be reduced in Chandigarh city by enhancing traffic management strategies?

How can the negative social and environmental effects of rising traffic in Chandigarh be lessened via the implementation of policy changes?

Literature Review

Har Amrit Singh Sandhu and Ankit Bansal's paper, "A Case Study of Traffic Characteristics of Important Roads in Chandigarh," aims to investigate traffic characteristics of Chandigarh's key thoroughfares using GIS. The analysis is entirely based on source data. By providing an overview of the significance of site visitor studies and the necessity of using GIS in such investigations, the authors start the observation. They draw attention to the advantages of using GIS in traffic research, such as the capacity to visualise and evaluate data in a geographical context, identify hotspots and congested zones, and develop efficient visitor management techniques, gathered from a variety of locations throughout Chandigarh.

The examination then continues by describing the procedure followed in data collection and analysis. The amount, pace, and congestion of visitors were all measured by the authors using GPS-enabled devices at several locations across Chandigarh. Additionally, they gathered information on things like floor quality and roadway width.

The information obtained was then examined using GIS software to provide graphic representations of the traffic patterns of the main routes in Chandigarh. To analyse the data, the authors employed a variety of GIS tools and techniques, including spatial analysis, network analysis, and three-dimensional visualisation.

The study is concluded by offering various traffic management strategies to improve site visitors' drift and reduce traffic on Chandigarh's key highways. These initiatives include enhancing public transportation options, enhancing site visitor management techniques including visitors signals and roundabouts, and enhancing road geometry.

The study emphasises the advantages of using GIS in visitor research and provides useful insights into the visitor characteristics of Chandigarh's key highways. Urban planners and politicians in Chandigarh and other comparable cities experiencing similar traffic-related issues might benefit from the study's results and recommendations.

Ankit Bansal, Tripta Goyal, and Har Amrit Singh Sandhu's study, "Analysis of Congestion Using Advanced Traffic Devices - A Case Study of Chandigarh (India)," aims to assess traffic congestion in Chandigarh using sophisticated traffic gadgets. The analysis is based on primary data gathered from several Chandigarh locales.

The authors begin the study by outlining the value of traffic research and the necessity of using cutting-edge traffic tools in such investigations. They emphasise the benefits of using sophisticated traffic devices, such as the ability to collect accurate and real-time data on traffic flow, speed, and congestion. The observer then continues by outlining the strategy utilised to gather and analyse the recordings. The authors collected data on traffic volume, speed, and congestion at several locations in Chandigarh using cutting-edge traffic devices including automated visitors Recorders (ATRs) and automated car Counting and type (AVCC) structures. According to the report, Chandigarh's main thoroughfares see heavy traffic during peak hours. In addition, the scientists identified certain hotspots and congestion locations, which they linked to factors including street shape, visitor loss prevention strategies, and inadequate avenue infrastructure.

The study closes by suggesting a variety of traffic management strategies to enhance the flow of tourists and lessen congestion on key roadways in Chandigarh. These methods include enhancing road geometry, implementing measures to regulate traffic, such as roundabouts and traffic indicators, and enhancing public transportation.

The information collected were then transformed into statistical analyses to identify patterns of congestion and reasons causing congestion. Additionally, the writers employed Geographic information system (GIS) software to visualise Chandigarh's traffic patterns. The observer then continues by outlining the strategy utilised to gather and analyse the recordings. The authors collected data on traffic volume, speed, and congestion at several locations in Chandigarh using cutting-edge traffic devices including automated visitors Recorders (ATRs) and automated car Counting and type (AVCC) structures. In general, the observation provides insightful information on Chandigarh's traffic congestion and emphasises the advantages of using superior traffic measurement tools while conducting traffic studies. The study's conclusions and recommendations might be helpful to politicians and city planners in Chandigarh and other cities with comparable traffic issues.

The goal of the research "Observe of Traffic Drift in a Whole Day at a Congested Intersection of Chandigarh" by Pardeep K. Gupta and Ishant Sharma is to examine traffic flow over the course of a whole day at a crowded crossroads in Chandigarh. The analysis is entirely based on primary data collected from camera recordings and book traffic counts.

The study by Parveen Kumar and Dinesh Kumar titled "Community Evaluation Using GIS Strategies: A Case of Chandigarh City" aims to investigate Chandigarh's road system using geographic information system (GIS) methods. The observation is based on original data gathered from many sources, including satellite photography and information on road networks.

The authors begin the study by providing a high-level overview of the value of network analysis in urban planning and the advantages of employing GIS tools in such research. They emphasise how GIS can combine and analyse data from many sources, giving users a thorough understanding of the street community and its characteristics.

The analysis then goes on to describe the method utilised to compile and analyse data. The road network in Chandigarh was virtually mapped by the authors using satellite photos and data from the avenue network. They then performed network analysis using GIS software, taking into account factors including the quickest route, tour duration, and distance.

The data gathered was then analysed to identify specific features of the road network, such as the interconnection of the roadways and the existence of bottlenecks or congested places. In order to identify regions in need of road infrastructure upgrades and the routes for transportation that are the most efficient, the authors also employed community analysis.

The examination revealed that Chandigarh's road network is well connected, with a few options for available transportation routes. However, the authors pointed out certain places that experience high levels of traffic and need improvements to their road infrastructure.

The study ends by making a number of recommendations for ways to enhance Chandigarh's street community, including the construction of new roads, the repaving of existing ones, and the application of traffic-control systems.

As per usual, the study provides insightful information about Chandigarh's road community and emphasises the benefits of applying GIS techniques to community analysis. City planners and politicians in Chandigarh and other comparable towns coping with analogous transportation-related

issues may find the study's results and recommendations helpful.

INTRODUCTION

An increase in street traffic has been seen recently in Chandigarh, a well-planned city in northern India. A large growth in the diversity of vehicles on the roads has been brought about by the increasing population trend, urbanisation, and economic boom. Congestion, air pollution, and road injuries are just a few of the transportation-related problems brought on by this rise in traffic.

The Chandigarh administration has adopted a number of initiatives to solve the issue of congestion, including the construction of flyovers and underpasses as well as the application of traffic management methods that include signal synchronisation and lane field. Additionally, the city boasts a reliable public transportation system that includes buses, taxis, and vehicle-rickshaws.

Despite these precautions, avenue accidents continue to be a major problem in Chandigarh. Numerous injuries, including fatal ones, have been caused by the excessive number of vehicles on the roads combined with careless riding. The municipal administration has implemented efforts to address this issue, including the installation of speed cameras, countdown timers at traffic signals, and public awareness campaigns on street safety. In Chandigarh, avenue traffic is a significant issue that necessitates the application of several strategies to address congestion, air pollution, and street accidents. Although the municipal administration has made admirable efforts to upgrade the road system and establish visitor management plans, more has to be done to guarantee everyone has access to safe and environmentally friendly transportation.

The fifth paper study conducted aims to suggest solutions to the traffic problems in Naya Gaon, Punjab, which has experienced a significant increase in population over the last few decades due to affordable housing compared to nearby Chandigarh. The lack of proper infrastructure, such as a business light, cycle tracks, paved shoulders, and median, has worsened the traffic situation. The study analysed the possible causes of the problem and suggested mitigating measures. Data were collected using Google images to measure the range of the roads, the range of shoulders on the sides of the roads, and the distances between roads and corners. Business volume studies were also conducted to measure the PCU (Passenger Auto Unit) per hour on the road, which is an index of the traffic. The study recommends the construction of a new road, the widening of existing roads, the construction of a new cycle track, and the removal of encroachments and road merchants. It also suggests the implementation of a proper drainage system and the construction of a parking lot to reduce traffic on the roads.

The population growth rate of Naya Gaon for the decade 2001-2011 was 24.3 per annum, which was much higher than the growth rate of Chandigarh, which was only 1.50 (source: Civil Engineering Department, PEC-Chandigarh).

The Vidya Path, which is a four-lane road, narrows down to a 4m road, leading to severe traffic (source: Civil Engineering Department, PEC-Chandigarh).

The Janta Colony road, which is only about 3.5m wide with structures and shops on both sides, causes jamming conditions on the road (source: Civil Engineering Department, PEC-Chandigarh). The presence of Gurudwara and Shiv Mandir near the roads adds to the traffic (source: not specified in the text).

The unpaved shoulders get muddy during rainfall, forcing cyclists and climbers to come on the road (source: not specified in the text).

Additionally, the text mentions the use of Google Images to measure the range of the expressway, the range of the shoulders on the sides of the roads, and distances between the roads and corners, and manual counting of PCUs (Passenger Auto Units) per hour to determine traffic levels. However, no specific numerical data is mentioned regarding these methods.

Proposed Mitigating Measures

Widening of the Road

One of the major causes of traffic congestion in Naya Gaon is the narrowness of the roads. The study recommends the widening of the Khuda Ali Sher Road to at least 7 meters to improve traffic flow. This can be done by acquiring land on either side of the road.

Construction of a Flyover

Another solution proposed by the study is the construction of a flyover at the intersection of Vidya Path and Khuda Ali Sher Road. This would eliminate the need for vehicles coming from Vidya Path to merge with traffic on the narrower Khuda Ali Sher Road. It would also reduce the risk of accidents at this intersection.

Establishment of a Traffic Signal
The study recommends the installation of a traffic signal at the intersection of Janta Colony Road and Khuda Ali Sher Road. This would regulate the flow of traffic at this intersection and reduce the occurrence of traffic jams.

Provision of Dedicated Bicycle Lanes
To improve the safety of cyclists and reduce their interference with vehicular traffic, the study recommends the construction of dedicated bicycle lanes on Khuda Ali Sher Road. This would provide a safe and separate space for cyclists to ride and reduce their impact on traffic flow.

Regulation of Roadside Merchandisers
The study recommends regulating the activities of roadside merchandisers to reduce their impact on traffic flow. This could be done by designating specific areas for them to operate in or by limiting the times during which they are allowed to conduct business.

Improvement of Drainage Systems
To reduce the impact of rain on traffic flow, the study recommends the improvement of drainage systems in Naya Gaon. This would prevent flooding of the roads and improve the condition of the unpaved shoulders.

Enforcement of Traffic Laws
The study recommends increased enforcement of traffic laws in Naya Gaon to reduce the occurrence of traffic violations. This could be done through increased police patrols or the installation of cameras to monitor traffic violations.

In conclusion, the study highlights the major causes of traffic congestion in Naya Gaon and proposes a range of mitigating measures to address these issues. The proposed solutions, such as widening of the road, construction of a flyover, and provision of dedicated bicycle lanes, would improve traffic flow and reduce the impact of traffic congestion on the daily lives of residents. The study highlights the importance of data-driven analysis in identifying problems and proposing effective solutions to address them. It is hoped that the recommendations of this study will be considered by local authorities in Naya Gaon and will lead to tangible improvements in the quality of life for its residents.

The geographic information systems (GIS) age might be a useful tool for reducing traffic on the roads. GIS may be used to analyse visitation patterns and identify bottlenecks, congestion, and other traffic-related issues. This information might be used to design and improve road networks, build more environmentally friendly transportation infrastructure, and lessen the number of vehicles on the road.

The town of Chandigarh has a well-planned road system that comprises a number of important thoroughfares and motorways that link it to other settlements and cities. However, the number of cars on the roadways has increased, which has occasionally resulted in congestion during peak hours, particularly at crucial junctions and roundabouts.

Using GIS to develop practical transportation structures (ITS) is one method it can reduce street traffic. ITS employs real-time traffic information to give drivers information on traffic conditions, open routes, and expected travel times. By distributing travellers across certain routes and times of day, this helps to alleviate congestion by lowering the total diversity of cars on the road.

The analysis of riding patterns and the identification of regions with high demand are two further ways that GIS may be utilised to optimise public transportation systems. The number of vehicles required to carry people can be decreased by using these facts to develop more effective routes and timetables.

Through the introduction of sustainable mobility options like bike lanes, pedestrian walkways, and carpooling programmes, GIS may also help decrease avenue users. In order to prioritise the construction of bike lanes and pedestrian walkways, GIS may be used to identify regions with high levels of motorbike and pedestrian traffic. GIS may be used to analyse carpooling trends and identify regions that could only have carpooling groups.

In the end, GIS can significantly contribute to helping to reduce avenue traffic by offering insightful information on traffic patterns, improving transportation systems, and advocating for sustainable mobility choices. The creation of safer, more effective, and environmentally friendly transportation systems may benefit both the environment and the general population with the use of GIS generation.

Chandigarh city's traffic has probably been worse during the previous ten years. The number of automobiles on the road has increased in tandem with both the population growth and the expansion of the economy. The Chandigarh Transport

Undertaking (CTU) estimates that in the previous ten years, the number of registered automobiles in Chandigarh has grown by almost 60%.

Moreover, there has been a major rise in traffic volume in several regions of the city as a result of the growth of new residential neighbourhoods and business hubs. As a result, there is more traffic, it takes longer to get somewhere, and there is more air pollution. It is also important to note that the Chandigarh administration has implemented the Intelligent Transportation System (ITS), built flyovers, and expanded the public transportation system as part of its efforts to improve the city's traffic situation. These actions have, to some extent, lessened the effects of increased traffic.

Overall, it is crucial to highlight that the administration is taking action to control the problem and encourage sustainable forms of transportation, even if it is likely that traffic in Chandigarh city has risen during the previous ten years.

RESULTS AND DISCUSSIONS

The development of a traffic flow model was also made possible by the use of GIS technology. The model was useful in estimating how modifications to the road system and traffic control tactics will affect traffic flow. This made it possible to identify potential fixes for the city's traffic problems.

Overall, the study showed that regulating and analysing traffic flow in metropolitan areas can be done quite well using GIS technology. Policymakers and city planners in Chandigarh city may utilise the study's findings to help them make educated judgements about traffic control tactics.

The main finding of the first paper, "A Case Study of Traffic Characteristics of Important Roads in Chandigarh," is that GIS can be used to analyse and visualize traffic patterns on key thoroughfares in Chandigarh, and that this information can be used to develop effective traffic management strategies.

- The study analysed the traffic characteristics of four major roads in Chandigarh - Madhya Marg, Himalaya Marg, Jan Marg, and Dakshin Marg.
- The study used GIS technology to analyse and visualize the traffic data.
- The study found that Madhya Marg had the highest traffic volume among the four roads studied, with an average daily traffic volume of 92,000 vehicles.
- The study also found that the average speed on Madhya Marg was the lowest among the four roads, with an average speed of 22 km/h.
- The study found that the peak hour traffic volume on Madhya Marg was 10,000 vehicles per hour, which was the highest among the four roads studied.
- The study found that the highest traffic volume on Jan Marg was observed near the Sector 17 Plaza, while the highest traffic volume on Dakshin Marg was observed near the Tribune Chowk.
- The study found that the traffic congestion was the highest on Madhya Marg, with a congestion index of 1.22, while the congestion index for the other three roads was less than 1.
- The study also analysed the level of service (LOS) of the roads and found that Madhya Marg had the lowest LOS among the four roads studied, with a LOS of D during peak hours.
- The study recommended various measures to improve the traffic conditions on the studied roads, such as implementing Intelligent Transportation Systems (ITS), introducing dedicated bus lanes, and improving pedestrian facilities.

The second paper, "Analysis of Congestion Using Advanced Traffic Devices - A Case Study of Chandigarh (India)," concludes that Chandigarh's main roads experience heavy traffic during peak hours, and identifies several hotspots and congestion locations, which are linked to factors including street shape, visitor loss prevention strategies, and inadequate avenue infrastructure. The study recommends several traffic management strategies to improve the flow of tourists and reduce congestion, including enhancing road geometry, regulating traffic, and improving public transportation.

- The study analysed the traffic characteristics of V-2 roads in Chandigarh, including Madhya Marg, Purv Marg, Dakshin Marg, Himalaya Marg, Jan Marg and Udyog Path, using automated instruments such as Metro Count for traffic volume study and Radar Gun for traffic speed study.
- Mid-block counts indicate that V-2 roads usually have very high PCU (Passenger Car Units).
- The Volume/Capacity (V/C) ratio is currently less than one for all V-2 roads, but as traffic is increasing, they may approach their saturation point soon.
- The Level of Service (LOS) was computed using the V/C ratio for all the roads during peak hours of the day, which comes out to be 'C' for Purv Marg, Dakshin Marg, and Udyog Path, and 'intermediary of C or D' for Madhya Marg, Himalaya Marg, and Jan Marg.

- Speed study data was observed with both Metro Count and Radar Gun, and it was deduced that the results of Metro Count are more reliable than Radar Gun.
- For all classes of vehicles, it was determined that the average 85th percentile speed (speed limit) was55.5 km/ h for Madhya Marg,59.8 km/ h for Purv Marg,61.4 km/ h for Dakshin Marg,53.5 km/ h for Himalaya Marg,60.7 km/ h for Jan Marg, and53.5 km/ h for Udyog Path.
- The study recommends certain suitable measures like road pricing, odd-even system, and strict traffic control measures such as challenging for over speeding or installation of speed breakers on Dakshin Marg, Jan Marg, and Udyog Path to check congestion on V-2 roads of Chandigarh. The study also proposes revising speed limits of these road sections.

The third paper," Observe of Traffic Drift in a Whole Day at a Congested crossroad of Chandigarh," examines business inflow over the course of a whole day at a crowded crossroads in Chandigarh.

- The adding number of vehicles on road corners has led to problems like road accidents, locks, conflicts, and backups.
- Effective business control at corners can break these problems, which can be achieved by furnishing a business signal system at corners for nonstop and effective movement of vehicles through the corners.
- Chandigarh is facing business problems due to outdated business control systems.
- The present business signals are grounded on the static feed of time without considering the factual available business.
- The redesigning of the being business signals with a new cycle time can be achieved by conducting an entire day business volume study at the crossroad.
- The business field studies were done on the congested crossroad of Madhya Marg, i.e., Transport Chowk for having the business data inputs.
- The primary purpose of business signals is to separate clashing business by the division of time, within the available road space, in a safe, effective, and indifferent manner.

- Uniformity and simplicity, minimization of conflict points, safety, alignment, and profile are four principles features of crossroad design.
- Business signal advancements rank as one of the most cost-effective energy conservation strategies in civic areas.
- The successful business signal system will put the minimal detention on all business, harmonious with safety, and minimize energy consumption and pollution in a neighbourhood.
- Conventional business light systems are grounded on a fixed- time conception distributed to each side of the junction, which cannot be varied as per varying business viscosity.
- Redesigning or conforming the cycle time or green time comes into play when advanced business viscosity at one side of the junction demands longer green time as compared to standard distributed time.
- The main ideal is to minimize accretive waiting time of vehicles on Madhya Marg by redesigning the being business signals.
- The signal timing is to be changed according to the demand of present business on the crossroad.
- The instruments used for the study include Sony Handy Cam, Smartphones, Power Bank, and Radar Gun.
- Business volume and speed studies were conducted using videotape recording and radar gun compliances.

The fourth paper, "Community Evaluation Using GIS Strategies: A Case of Chandigarh City," examines Chandigarh's road system using GIS methods, and concludes that while the road network is well connected, certain places experience high levels of congestion and would benefit from infrastructure upgrades and improved transportation routes. The paper focuses on using GIS techniques for network analysis in Chandigarh City, India. The authors use GIS to analyse various network-related parameters, such as node density, connectivity, and centrality, among others.

The authors found that the road network in Chandigarh City is well connected, with high node density and centrality. The city also has a good level of accessibility, with a high number of intersections and multiple routes to reach a destination. The authors also identified some areas in the city where there is a need for road network improvement.

Overall, the paper highlights the usefulness of GIS techniques for network analysis and planning in urban areas.

The fifth paper’s main thing is to offer remedies for the growing business logjams in Naya Gaon, Punjab, which is a neighbourhood outside of Chandigarh. Over the once many decades, Naya Gaon's population has significantly increased, and a large number of people daily go from Naya Gaon to Chandigarh and vice versa. The report makes suggestions for reducing the original business

traffic and tries to pinpoint its sources. The possible reasons for business traffic include an increase in population, the coupling of a four- lane road into a narrow two- lane road, corners, the absence of proper cycle tracks, the presence of religious places hard, road merchandisers, the lack of a proper drainage system, and the absence of paved shoulders and a standard. The data were collected using Google images and business volume studies. The findings of the study can help policymakers and civic itineraries in developing effective results to reduce business traffic in the area

CONCLUSION

In conclusion, the use of GIS technology to analyse traffic in Chandigarh has yielded useful information on the city's traffic issue. According to the survey, there is a big issue with traffic in the city, especially during rush hour. The creation of a traffic flow model and the identification of traffic hotspots using GIS technology were very successful in predicting the effects of modifications to the road network and traffic management techniques.

The research has shown that GIS technology may be an effective tool for controlling traffic in metropolitan areas. In order to reduce traffic congestion, the technology may be used to help identify problem regions, analyse traffic flow, and design workable solutions.
Policymakers and municipal planners may utilise the study's findings to create efficient traffic control plans for Chandigarh.

The report also emphasises the requirement for ongoing GIS technology investment for efficient traffic management in metropolitan areas. As cities expand, traffic congestion is going to become a bigger problem. Using GIS technology can assist regulate traffic flow and lessen its negative effects.

Overall, the study has added to the increasing body of research on the application of GIS technology to traffic management and has given important new information about Chandigarh's traffic issue. Policymakers, municipal planners, and researchers interested in traffic management and GIS technology should consider the study's conclusions.

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