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Statistical Evaluation of Traffic Congestion, Accidents, and Pollution on S.G. Highway, Ahmedabad

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Abstract: Rapid urbanization and increasing vehicle ownership have significantly strained Ahmedabad's transportation infrastructure, particularly along the Sarkhej–Gandhinagar (S.G.) Highway—one of the city's most vital arterial corridors. This study presents a comprehensive statistical evaluation of traffic congestion, accident patterns, environmental impact, public transport usage, and commuter perception along this route. A mixed-methods research design was employed, integrating primary data (manual vehicle counts, Air Quality Index [AQI], noise level measurements, and structured surveys) with secondary data sourced from government records and news reports. Quantitative analysis was conducted using Microsoft Excel and Jamovi, applying t-tests, ANOVA, chi-square tests, and Pearson correlation to uncover statistically significant patterns and associations. Key findings indicate that weekday peak-hour traffic volume is significantly higher than on weekends, with intersections such as Somnath Chowk and Thaltej consistently experiencing the highest congestion. A strong positive correlation was found between traffic volume and both AQI and noise levels, underscoring severe environmental concerns. Survey results revealed that over 75% of respondents experience daily congestion, largely due to vehicle overflow and commercial-area crowding. While public dissatisfaction was high, chi-square tests showed no significant association between demographic variables (age, gender, occupation) and transport mode preference or congestion impact, suggesting the issue is widespread. The study concludes with recommendations for optimizing signal timings, expanding public transport infrastructure, enforcing pollution controls, and addressing accident-prone zones through engineering interventions. By offering a data-driven and multi-dimensional understanding of traffic behavior, this research provides actionable insights for urban planners, traffic authorities, and policymakers aiming to improve mobility, safety, and environmental sustainability along the S.G. Highway.

Keywords: Traffic Congestion, Urban Mobility, S.G. Highway, Statistical Analysis, Air and Noise Pollution, Road Safety, Public Transport Utilization

I. INTRODUCTION

Rapid urbanization, economic development, and population growth have significantly strained transportation systems across major Indian cities. Ahmedabad, one of Gujarat's fastest-growing urban centers, faces increasing challenges in managing its mobility infrastructure. Among its most critical corridors, the Sarkhej-Gandhinagar Highway (S.G. Highway) plays a pivotal role in connecting key zones such as residential townships, educational institutions, and commercial hubs. However, the rising density of private and public vehicles on this arterial route has led to persistent congestion, extended commute times, increased accident risks, and environmental degradation. According to recent statistics published by the Times of India (2023), Ahmedabad witnessed 1,711 road accidents and 418 fatalities in 2022, raising serious concerns about urban mobility and public safety. A 2024 report by Ahmedabad Mirror further emphasizes that the stretch of S.G. Highway between Vaishnodevi Circle and Vastrapur Lake is among the most congested in the city. These trends expose shortcomings in traffic management systems such as uncoordinated signals, insufficient pedestrian infrastructure, and lack of dedicated public transport lanes.

Furthermore, data from the Regional Transport Office (RTO) shows a 60.8% surge in car registrations and a 74.2% increase in two-wheeler ownership from 2020 to 2023. In the absence of proportionate infrastructure upgrades and sustainable mobility strategies, such developments have placed additional stress on urban roads. This has resulted in deteriorating air quality, elevated noise pollution, and frequent traffic bottlenecks.

Despite ongoing efforts by city authorities, limited research offers a holistic, data-driven analysis of traffic behavior along this crucial highway. The present study addresses this gap by combining primary and secondary data to statistically evaluate traffic conditions along the S.G. Highway. The analysis includes vehicle volume assessment, accident trends, peak-hour congestion patterns, air and noise pollution levels, and public transport usage. Through the application of robust statistical tools such as ANOVA, t-tests, chi-square tests, and correlation analysis, the study aims to provide actionable insights for evidence-based urban traffic management.

II. OBJECTIVES

The primary aim of this study is to conduct a comprehensive statistical analysis of traffic patterns along the S.G. Highway in Ahmedabad, with the objective of enhancing urban mobility and promoting sustainability. Specific goals include identifying key causes of traffic congestion, analyzing accident trends and black spots, and assessing the environmental impact of vehicular traffic in terms of air and noise pollution. Additionally, the study seeks to evaluate the effectiveness of current public transport systems, explore the role of smart transportation technologies, and recommend evidence-based road safety interventions. The ultimate objective is to develop practical, data-driven strategies for improving transportation infrastructure and the overall commuter experience.

III. LITERATURE REVIEW

Traffic congestion, air pollution, and noise pollution are significant challenges in urban India, particularly in rapidly growing cities such as Ahmedabad. Increasing vehicle density coupled with limited road infrastructure in areas like Thaltej, Somnath Chowk, and Gurudwara has resulted in considerable environmental and traffic-related problems. Effective traffic management is therefore essential not only to reduce delays but also to mitigate adverse impacts on public health and promote urban sustainability.

By reviewing previous research and integrating it with newly collected data, this study aims to identify effective strategies for alleviating traffic congestion and enhancing urban transportation efficiency. Lakhtaria et al. (2018) conducted a comprehensive noise pollution assessment along a 22.25 km traffic corridor in Ahmedabad, encompassing various zones such as educational, commercial, and residential areas. Their findings revealed that average noise levels consistently exceeded World Health Organization (WHO) guidelines, with peak levels reaching up to 86.0 dB(A). Notably, segments like Akhbarnagar and Naranpura were identified as the noisiest locations. Kumar et al. (2019) conducted a comprehensive study on traffic congestion in Indian metropolitan areas, emphasizing how rising vehicle ownership and inadequate road infrastructure contribute to peak-hour delays. They recommended adaptive traffic signal systems and the promotion of public transport; however, their study did not address environmental factors such as air quality index (AQI) or noise pollution. A report by the Times of India (2024) highlighted that residential areas in Ahmedabad experience noise levels comparable to industrial zones, with daytime averages around 79.83 dB. These elevated noise levels were attributed to vehicular traffic, urban congestion, and insufficient infrastructure.

Although previous studies have addressed various facets of urban traffic, they often lacked comprehensive integration or local specificity. This study addresses these gaps by combining analyses of vehicle volume, congestion, AQI, noise pollution within a unified framework focusing on the Thaltej, Somnath Chowk, and Gurudwara areas. The findings aim to inform data-driven traffic planning and localized environmental policies for Ahmedabad.

IV. METHODOLOGY

This study employed a mixed-methods approach, integrating both primary and secondary data to conduct a comprehensive statistical analysis of traffic conditions along the S.G. Highway in Ahmedabad. Data collection focused on five core domains: vehicular traffic volume, air quality index (AQI), noise pollution levels, road accident statistics, and public perception through structured surveys.

Primary data were collected through manual vehicle counts conducted during morning and evening peak hours at three major intersections: Thaltej Circle, Gurudwara Circle, and Somanath Chowk. This facilitated the identification of congestion patterns, vehicle composition, and temporal traffic trends. Additionally, AQI and noise pollution levels were recorded on-site using standard environmental monitoring tools to evaluate the environmental impact of vehicular flow.

Survey data was gathered through structured questionnaires created on Google Forms. The survey was disseminated to a diverse group of daily commuters, drivers, and public transport users. It captured key information such as demographic profile, commuting behaviour, mode of transport, and individual perceptions regarding traffic congestion, road safety, and environmental conditions on the highway.

Secondary data on road accidents, including frequency and severity (fatal, injury, and property damage), were obtained from EMRI-108 emergency call records and verified reports from credible news sources such as Times of India and Ahmedabad Mirror (2023). These data were instrumental in identifying black spots and analyzing accident patterns along critical stretches, particularly between Sarkhej and Vaishnodevi Circle. Quantitative analysis was performed using Microsoft Excel and the Jamovi statistical software package. Chi-square tests were applied to examine relationships between categorical variables such as age group and mode of transport, as well as gender and vehicle type preference. Graphical tools including bar charts, pie charts, and correlation plots were used to visualize traffic trends and support data interpretation. Furthermore, hypothesis testing and correlation analysis were conducted to investigate relationships between traffic volume, AQI, and noise pollution levels.

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This methodological framework enabled a data-driven and multi-dimensional understanding of traffic behaviour and its associated environmental and safety implications, thereby providing a solid foundation for formulating sustainable traffic management recommendations for the S.G. Highway corridor.

V. DATA ANALYSIS AND RESULTS

A. Traffic Volume Analysis

Understanding vehicle flow during peak hours is crucial for identifying congestion patterns on urban corridors. This study analyzes traffic volume data collected at three major intersections along the S.G. Highway — Thaltej Circle, Gurudwara Circle, and Somnath Chowk — with the objective of pinpointing critical congestion zones and supporting targeted traffic management strategies.

1) *Peak Slot Volume Analysis:* Traffic congestion demonstrates clear temporal variation, with certain time intervals exhibiting significantly higher vehicular density. The Peak Slot Volume (PSV) denotes the time frame with the highest recorded traffic count and serves as a critical metric for identifying congestion hotspots and high-density corridors along the S.G. Highway.

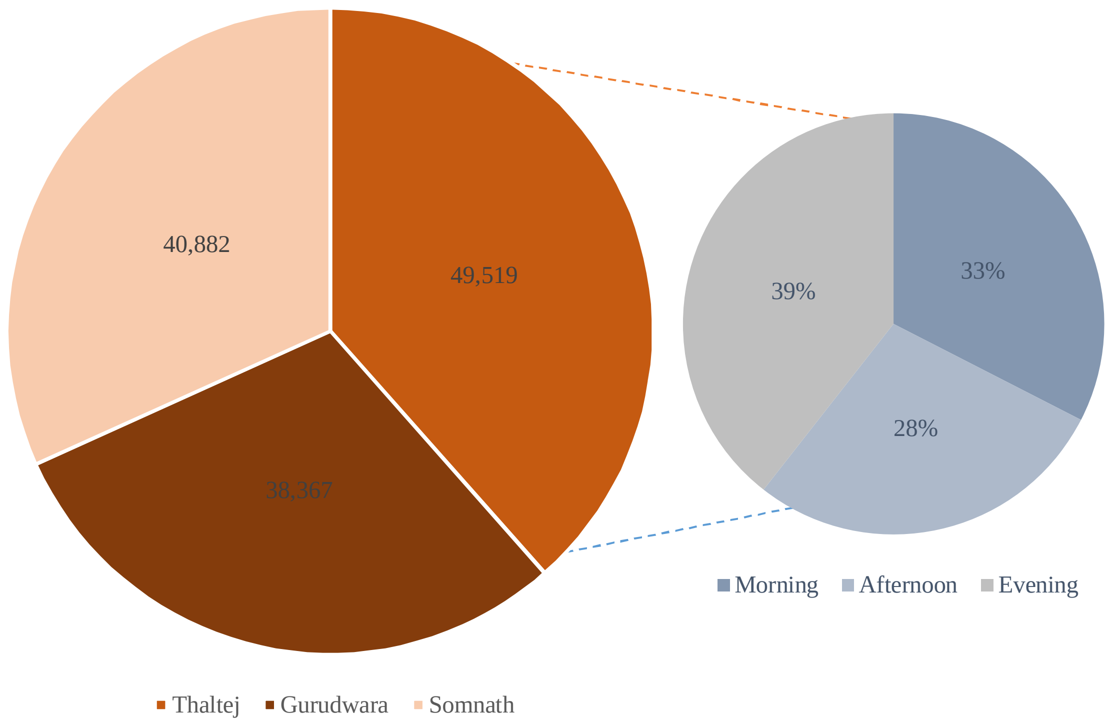

Fig.1. Distribution of Traffic Volume Across Time Slots on S.G. Highway

Key Insights:

- Evening peak hours (6-8 PM) record the highest traffic, accounting for 39% of total vehicles across all locations.
- Afternoon traffic is the lowest (28%), suggesting reduced movement during this time.
- Morning peak is moderate (33%), primarily driven by office and school commutes.

2) *Statistical Analysis:* Weekdays vs. Weekend Traffic Volume Comparison

To evaluate whether there is a significant difference in traffic volume between weekdays and weekends on the S.G. Highway, statistical hypothesis testing was conducted using peak hour vehicle count data from three major circles: Thaltej, Gurudwara, and Somnath Chowk. The analysis involved testing for normality, homogeneity of variances, and group mean differences using Shapiro-Wilk, Levene's Test, and Welch's independent samples t-test.

Null hypothesis: There is no significant difference in average traffic volume between weekdays and weekend.

Alternative hypothesis: There is a significant difference in average traffic volume between weekdays and weekend.

TABLE I
Peak Hour Traffic Data: Weekday and Weekend

Circle	Peak Hours	Days	Vehicle Count
Thaltej	9:00 A.M- 11:00 A.M	Week-end	8939
Thaltej	6:00 P.M- 8:00 P.M	Week-end	9112
Gurudwara	9:00 A.M- 11:00 A.M	Week-end	5358
Gurudwara	6:00 P.M- 8:00 P.M	Week-end	6094
Somnath Chowk	9:00 A.M- 11:00 A.M	Week-end	18659
Somnath Chowk	6:00 P.M- 8:00 P.M	Week-end	19721
Thaltej	9:00 A.M- 11:00 A.M	Weekday	24126
Thaltej	6:00 P.M- 8:00 P.M	Weekday	25393
Gurudwara	9:00 A.M- 11:00 A.M	Weekday	21134
Gurudwara	6:00 P.M- 8:00 P.M	Weekday	17233
Somnath Chowk	9:00 A.M- 11:00 A.M	Weekday	20541
Somnath Chowk	6:00 P.M- 8:00 P.M	Weekday	20341

TABLE II
Shapiro-Wilk Test for Normality of Traffic Volume

	Days	vehicles count
Mean	Week-end	11314
	Week-day	21461
Shapiro-Wilk W	Week-end	0.825
	Week-day	0.949
Shapiro-Wilk p	Week-end	0.098
	Week-day	0.732

Since the p-values are greater than 0.05, traffic volume data for both groups is normally distributed.

TABLE III
Levene's Test for Homogeneity of Variances in Traffic Volume

	F	df	df2	P
vehicles count	6.07	1	10	0.033

The p-value is less than 0.05, indicating unequal variances between the groups. Therefore, Welch's t-test was applied.

TABLE IV
Results of Independent Samples T-Test Comparing Vehicle Count Between Weekdays and Weekends

		Statistic	**df**	**P**
Vehicle count	Welch's t	-3.58	7.06	0.009

Since $p = 0.009 < 0.05$, the null hypothesis is rejected. Thus, there is a statistically significant difference in traffic volume between weekdays and weekends.

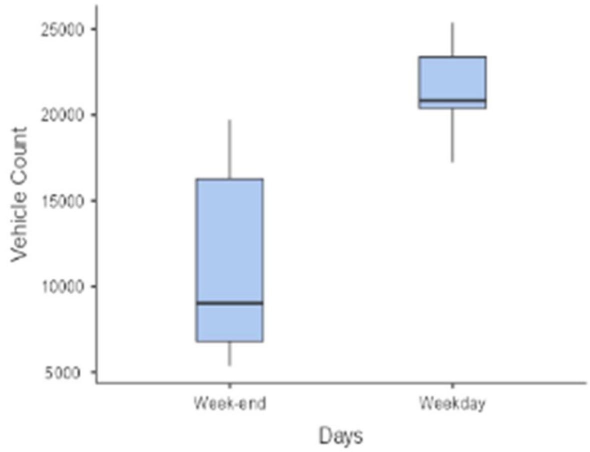

Fig.2. Box Plot Showing Comparison of Traffic Volume Between Weekdays and Weekends

The statistical results confirm that weekday traffic volumes are significantly higher than weekend volumes across all surveyed locations on the S.G. Highway. This variation is primarily attributed to routine work and school commutes that dominate weekday peak hours. The finding emphasizes the need for focused weekday-specific traffic interventions, such as signal optimization, dedicated bus lanes, and congestion pricing models during morning and evening peaks.

B. Peak Hour Congestion Patterns:

Peak hour congestion on the S.G. Highway in Ahmedabad exhibits significant spatial and modal variation, influenced by uneven traffic distribution, infrastructural limitations, signal phasing, and road user behavior. This section investigates congestion variability across locations, vehicle categories, and signalized intersections, based on peak hour data collected during both weekdays and weekends. The objective is to assess the differential impact of congestion on various commuter groups and transport modes, and to inform time- and location-specific traffic management strategies.

TABLE V
Total Peak Hour Traffic Volume (Morning and Evening) — Weekday and Weekend Combined

Circle	Morning Traffic volume	Evening Traffic Volume
Gurudwara	26492	23327
Thaltej	33065	34505
Somnath Chowk	39200	40062

1) *Comparison of Peak Hour Congestion Patterns Across Three Circles:* To evaluate whether traffic volume during peak hours significantly differs across the three key circles—Thaltej, Gurudwara, and Somnath Chowk—a one-way Analysis of Variance (ANOVA) was performed. Separate analyses were conducted for morning and evening peak hours using combined weekday and weekend traffic volume data. The Shapiro–Wilk test confirmed that the data for both time slots followed a normal distribution ($p > 0.05$), while Levene's test indicated unequal variances ($p < 0.05$). Therefore, Welch's ANOVA was applied for a more reliable comparison.

Null hypothesis: There is no significant difference between traffic congestion among the three circles.
Alternative hypothesis: At least one of the circles has a significantly different traffic congestion level.

TABLE VI
Welch's One-Way ANOVA for Comparison of Traffic Volume Across Circles

	F	df1	df2	P
Traffic Volume	41.2	2	1.72	0.035

Since p- value (0.035) < 0.05, the null hypothesis is rejected. Thus, there is a statistically significant difference in traffic volume across the different groups.

TABLE VII
Tukey Post-Hoc Test for Pairwise Comparison of Traffic Volumes

		Gurudwara	**Thaltej**	**Somnath chowk**
Gurudwara	Mean difference	—	-8876	-14722
	p-value	—	0.018	0.004
Thaltej	Mean difference		—	-5846
	p-value		—	0.056
Somnath chowk	Mean difference			—
	p-value			—

The analysis highlights the importance of location-specific traffic interventions. Somnath Chowk and Thaltej experience consistently high volumes, indicating the need for enhanced signal coordination and infrastructure upgrades. Uniform congestion across peak periods calls for continuous traffic regulation measures rather than time-specific solutions.

2) Morning vs. Evening peak Hour Trends:
Null hypothesis: There is no significant difference between morning and evening peak hour traffic congestion.
Alternative hypothesis: There is significant difference between morning and evening peak hour traffic congestion.

TABLE VIII
Descriptive Statistics and Shapiro-Wilk Normality Test for Morning and Evening Traffic Volume

	Morning Traffic volume	Evening Traffic Volume
Mean	32919	32631
Median	33065	34505
Standard deviation	6355	8523
Shapiro-Wilk W	1.000	0.964
Shapiro-Wilk p	0.962	0.634

Here p value for Two group is greater than 0.05, We conclude that traffic volume for morning and evening is normally distributed.

TABLE IX
Paired Samples T-Test Comparing Morning and Evening Traffic Volume

			statistic	**df**	**P**
Morning Traffic volume	Evening Traffic Volume	Student's t	0.199	2.00	0.861

p-value (0.861) is much greater than 0.05, which means there is no significant difference between morning and evening peak hour traffic volume.
This indicates that traffic volume remains statistically similar during morning and evening peak hour for the selected locations.

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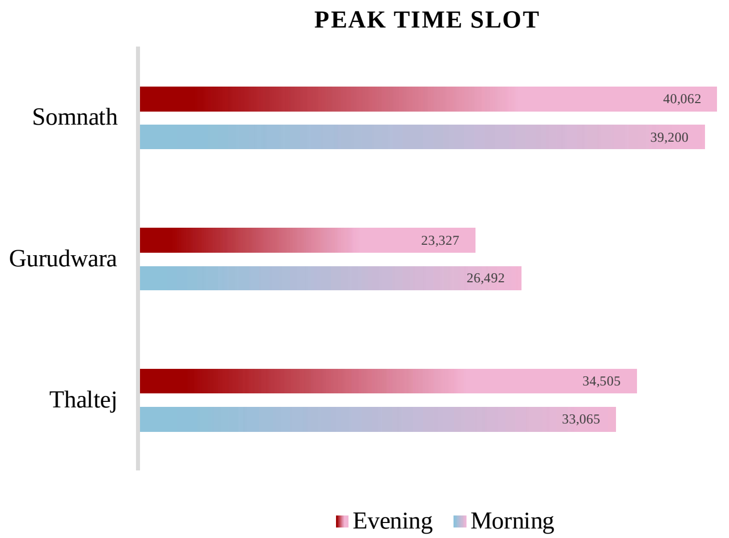


Fig.3. Traffic Volume Comparison Chart - Morning vs Evening Across Locations

The absence of a significant difference in traffic volume between morning and evening peak hours suggests that congestion levels remain relatively consistent throughout both periods. Therefore, time-based traffic variations may not be the primary factor influencing congestion. Alternative variables such as signal timing, roadway geometry, and external conditions (e.g., weather, local events) should be considered for a more comprehensive understanding of traffic behavior and for designing effective management strategies.

C. Accident Statistics and Black Spots

Sarkhej-Gandhinagar (S.G.) Highway, a critical arterial corridor in Ahmedabad, has experienced a notable rise in road accidents in recent years. Based on real-time data obtained from EMRI-108 emergency services and corroborated by verified news reports, this highway segment has emerged as a high-risk zone for traffic incidents. Contributing factors include excessive vehicular speed, poor lane discipline, and suboptimal junction design, all of which increase the likelihood of collisions and injury severity.

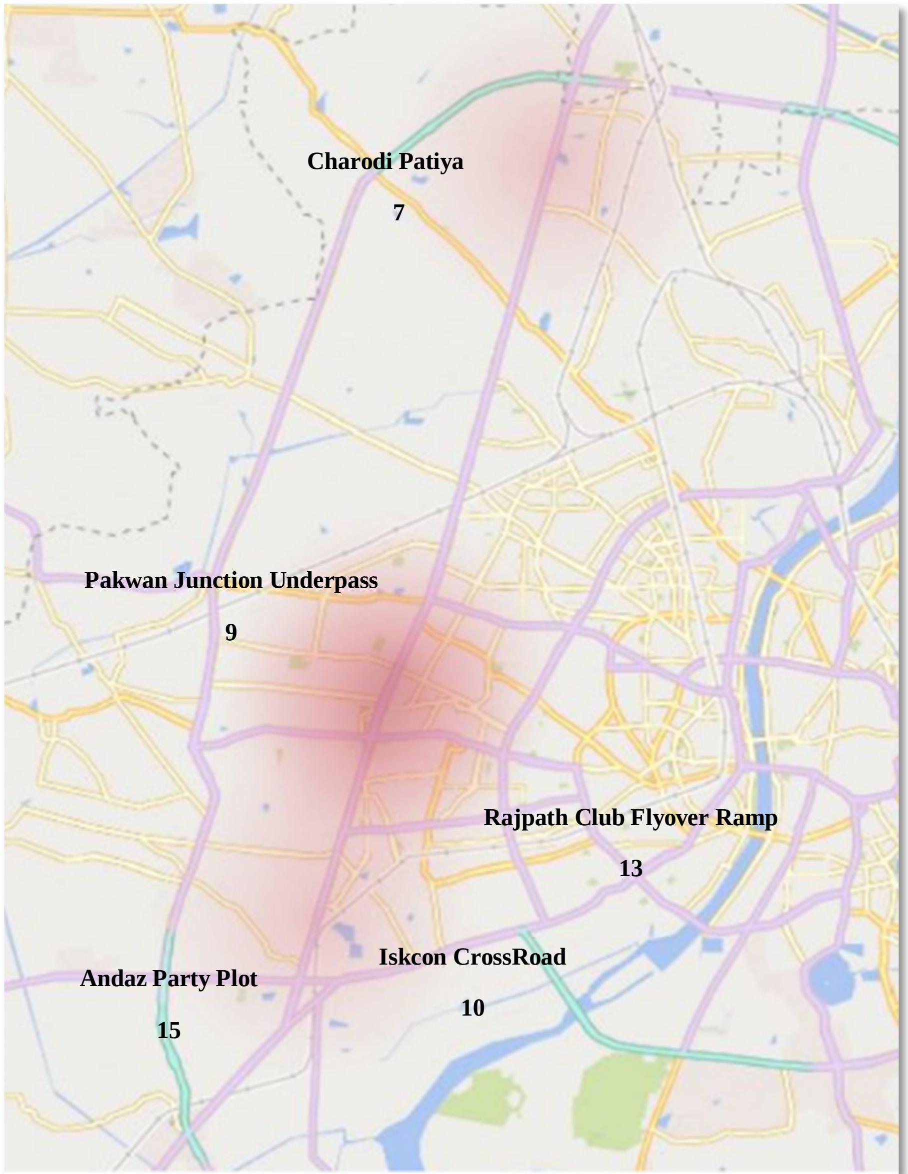
TABLE X
Accident Summary – SG Highway (2022-23)

Year	Total Accidents	Avg. Daily Accident	Fatalities(Jan-Jul 2023)	Most Affected Stretch
2022-23	3005	8	23	Sarkhej to Vaishnodevi

Source: EMRI-108 Data, Times of India, Ahmedabad Mirror (2023)

TABLE XI
Top 5 Black Spot Locations on SG Highway – 2023

Location	Number of Accidents
Andaz Party Plot Junction	15
Rajpath Club Flyover Ramp	13
Iscon Crossroads	10
Pakwan Junction Underpass	9
Charodi Patiya	7



Sources: Ahmedabad Mirror (April 2022, July 2023), DeshGujarat (Nov 2023)
Fig.4. Heatmap Representing Accident Density Along S.G. Highway, Ahmedabad (2022-23)

The increasing incidence of road accidents along S.G. Highway underscores the urgent need for improvements in roadway infrastructure, stricter traffic law enforcement, and enhanced public awareness initiatives. Implementing black spot identification and integrating real-time traffic monitoring systems can play a pivotal role in improving road safety and reducing accident-related fatalities.

D. Public Transport Utilization:

Public transportation plays a vital role in promoting sustainable mobility along the S.G. Highway corridor in Ahmedabad. To assess current usage patterns, a structured survey was administered among daily commuters, capturing data related to preferred modes of transport, user demographics, and gender-based participation. The analysis aimed to evaluate the efficiency, accessibility, and inclusivity of existing public transit services while identifying areas requiring policy or infrastructure improvements.

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1) *Transport Mode Preferences:* The survey results revealed that AMTS buses are the most commonly used mode of public transport, followed by GSRTC and the Metro. Male commuters constituted a slightly higher share of ridership across all transport modes compared to female users.

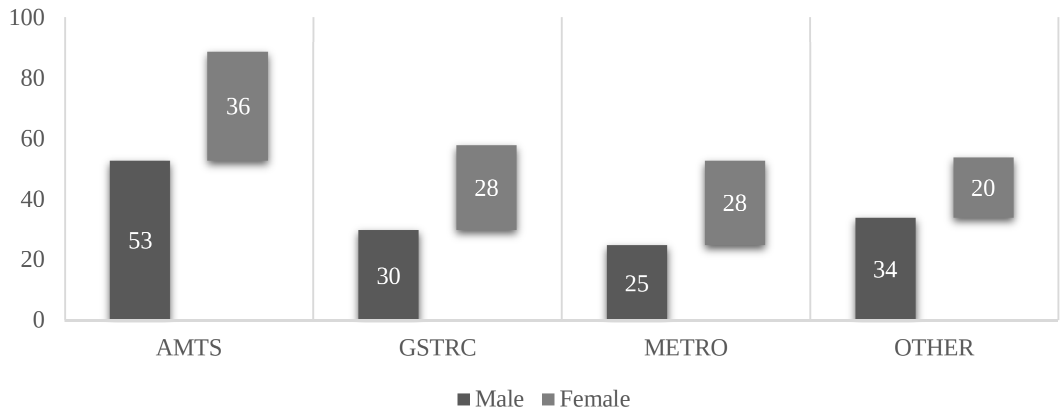

Fig.5. Gender-wise Distribution by Mode of Public Transportation

2) *Age-wise Public Transport Usage:* The highest rate of public transport usage was observed among individuals aged 18–25 years, followed by those in the 26–35 age group. This indicates significant reliance on public transportation among students and early-career professionals.

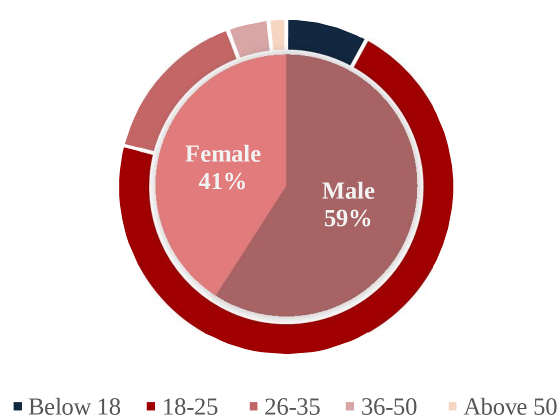

Fig.6. Age-wise and Gender-wise Usage of Public Transportation

In terms of gender distribution, 59% of users were male, while 41% were female. These findings emphasize the importance of designing public transportation policies that address the needs of young commuters and include gender-sensitive infrastructure such as well-lit bus stops, women-only compartments, and enhanced security measures.

3) *Statistical Analysis:* Chi-Square Test: Association Between Age Group and Transportation Mode
Null hypothesis: There is no significant association between age group and preferred mode of transportation.
Alternative hypothesis: There is a significant association between age group and preferred mode of transportation.

TABLE XII
Contingency Table- Age Group vs. Transportation Mode

	Transportation			
Age Group	**Public Transit**	**Four-Wheeler**	**Two-Wheeler**	**Total**
Young-Teen	139	47	92	278
Middle Aged	27	18	23	68
Senior	10	5	5	20
Total	176	70	120	366

TABLE XIII
Chi-Square Test Result

	Value	**df**	**p**
χ^2	4.61	4	0.329
N	366		

Since the p-value (0.329) is greater than the 0.05 significance level, we fail to reject the null hypothesis. This indicates that there is no statistically significant association between age group and transportation mode among the respondents. While younger individuals appear to favour public transit, the preference distribution across age groups may be attributed to general usage trends ex rather than age-dependent behaviour.

E. Air Pollution and noise levels (AQI Analysis):

To assess the environmental impact of vehicular traffic along the S.G. Highway, this study evaluates air and noise pollution using two standard indicators: the Air Quality Index (AQI) and noise levels measured in decibels (dB). The objective is to determine whether increasing traffic volumes correspond to heightened environmental stress.

Air Quality Index (AQI)

The AQI is a standardized metric used to quantify ambient air quality. As per national guidelines:

Good (0-50): Air quality is satisfactory.

Moderate (51-100): Air quality is acceptable but may affect sensitive individuals.

Poor (101-200): Air quality is unhealthy for sensitive groups.

AQI measurements at surveyed traffic routes predominantly fell within the “poor” category, indicating elevated health risks for individuals with respiratory or cardiovascular conditions.

Noise Pollution

Noise levels were monitored using a calibrated sound level meter and categorized as follows:

Low (0-50 dB): Quiet conversation

Moderate (51-70 dB): Background noise

Loud (71-90 dB): Vehicle-heavy zones

Very Loud (91 dB and above): Hazardous to hearing

Excessive exposure to noise levels above 70 dB is known to cause:

Hearing loss

Tinnitus

Sleep disturbances

Psychological stress and fatigue

The data presented in Table XIV reflects environmental and traffic conditions recorded during peak hours, combining both weekday and weekend observations. Total vehicle counts were collected through manual surveys at selected routes during morning and evening peak times, while AQI and noise levels were measured on-site using standardized monitoring equipment. The purpose of this aggregated analysis is to identify correlations between vehicular density and environmental stress indicators across critical segments of the S.G. Highway corridor.

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TABLE XIV
Summary of Traffic Volume, AQI, and Noise Levels During Peak Hours (Weekday and Weekend Combined)

Route Name	**Total Vehicles**	**Average of AQI**	**Average of Noise Pollution**
Gurudwara (Thaltej Gam to Vastrapur)	18733	111.8333	75.66667
Gurudwara (Thaltej to Iscon)	16404	111.3333	75.83333
Gurudwara (Vastrapur to Thaltej gam)	14682	111	72.83333
Somnath chowk to Sola Bhagwat	26002	115.5	79.25
Somnath chowk (Prabhat chowk to Kargil)	18840	110	78.75
Somnath chowk to Gatlodiya	34420	116.75	81.5
Thaltej (Drive in road to Shilaj)	20157	118.5	78.83333
Thaltej (S.G highway)	20033	111	75
Thaltej (Shilaj to Drive in road)	27380	117	77
Grand Total	196651	113.3958	76.85417

1) *Correlation Between Traffic Volume and Noise Pollution:* To quantify the relationship between vehicular movement and noise pollution along key segments of the S.G. Highway, Pearson's correlation analysis was conducted. This statistical method evaluates the strength and direction of the association between traffic volume and corresponding noise levels recorded at each surveyed route.

Null Hypothesis: There is no significant correlation between Traffic Volume and Noise Pollution.
Alternative Hypothesis: There is a significant positive correlation between Traffic Volume and Noise Pollution.

TABLE XV
Pearson's Correlation Between Traffic Volume and Noise Pollution

Variable	**Pearson's R**	**df**	**p-value**
Traffic Volume vs Noise Level	0.769	7	0.015

Since the p-value (0.015) is less than the 0.05 significance level, the null hypothesis is rejected, indicating a statistically significant correlation.

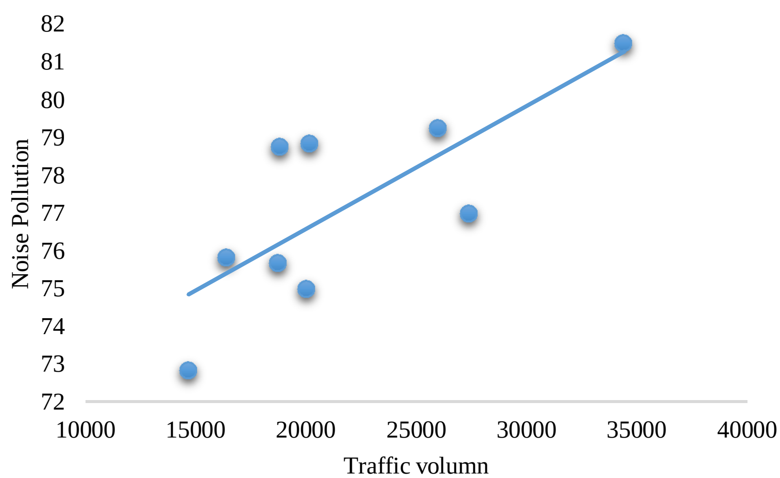

Fig.7. Scatter plot showing the correlation between traffic volume and noise levels recorded at selected junctions along S.G. Highway, Ahmedabad

The Pearson correlation coefficient (r = 0.769) indicates a strong positive relationship between traffic volume and noise pollution. Higher vehicle density consistently corresponds with increased noise levels, particularly in densely trafficked locations. These results underscore the need for targeted noise mitigation measures, such as speed regulations, restrictions on heavy vehicles during peak hours, and the installation of noise barriers in residential zones.

2) *Correlation Between Traffic Volume and AQI (Air Quality Index):* To evaluate the relationship between vehicular traffic and ambient air quality on the S.G. Highway, Pearson's correlation analysis was conducted using average AQI values and corresponding traffic volume data recorded across selected peak-hour routes. This analysis aims to determine whether increased traffic volumes are statistically associated with poorer air quality.

Null Hypothesis: There is no significant correlation between the Traffic Volume and Average AQI.
Alternate Hypothesis: There is a significant correlation between the Traffic Volume and Average AQI.

TABLE XVI
Pearson's Correlation Between Traffic Volume and Average AQI

Variable	**Pearson's R**	**df**	**p-value**
Traffic Volume vs AQI	0.681	7	0.044

Since the p-value (0.044) is less than the significance level of 0.05, the null hypothesis is rejected, indicating a statistically significant correlation.

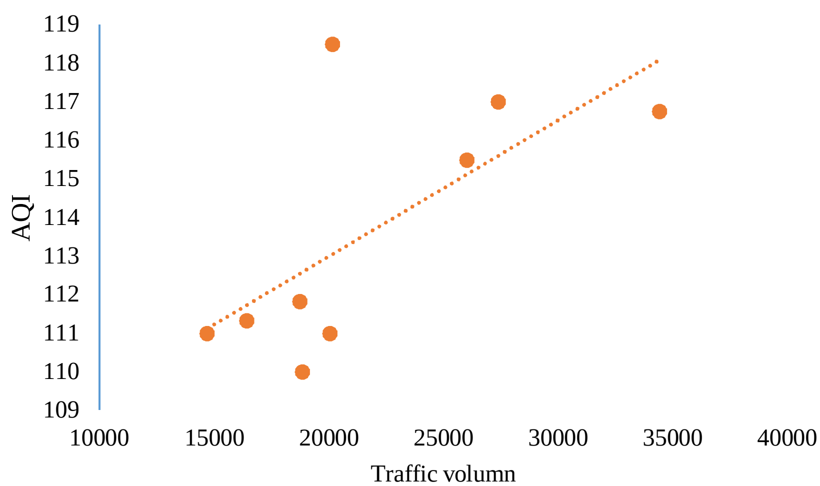

Fig.8. Scatter plot showing the positive correlation between traffic volume and average AQI on S.G. Highway, Ahmedabad

The correlation coefficient (r = 0.681) indicates a moderate positive relationship between traffic volume and AQI values, suggesting that higher vehicle density contributes to deteriorating air quality. These findings emphasize the need for enhanced traffic regulation and air pollution control strategies, such as restricting heavy vehicle movement during peak hours, promoting green transportation, and implementing emission-reducing policies along major urban corridors.

F. Public Perception of Congestion:

Public perception is an important aspect when it comes to understanding the root causes and real-world impact of traffic congestion. While statistical data provides measurable insights into traffic flow and volume, commuter opinions help capture the everyday struggles faced by people on the road. In this study, a structured survey was conducted to gather inputs from regular users of the S.G. Highway, focusing on how often they face congestion, what they believe causes it, and how it affects their daily life.

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1) *Frequency of Congestion Experience:* A significant proportion of commuters (76.9%) reported experiencing congestion on a daily basis. This suggests that traffic delays are not isolated incidents but part of a systemic urban issue that affects most road users consistently.

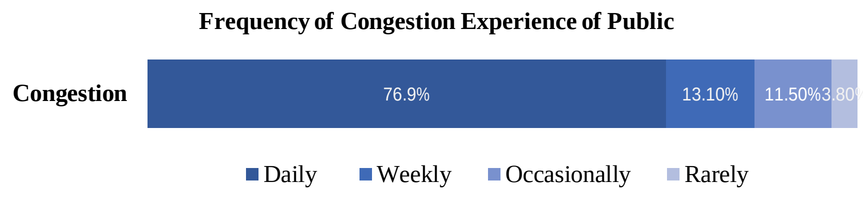

Fig.9. Frequency distribution of respondents based on how often they experience congestion on S.G. Highway

2) *Causes of Congestion:* Respondents were asked to identify the primary causes of traffic congestion. The most commonly cited reason was an overflow of vehicles (70.7%), followed by excessive crowding near metro stations and shopping malls. A smaller percentage attributed congestion to poor road design or the connectivity to main highway.

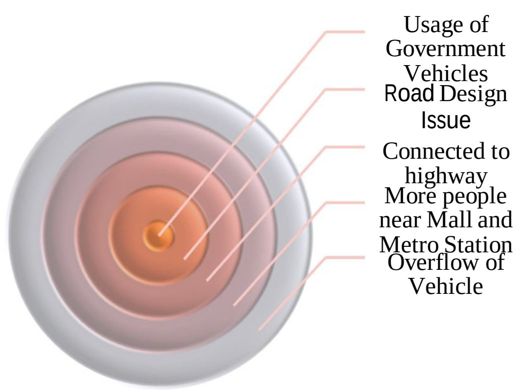

Fig.10. Respondent-identified causes of traffic congestion along S.G. Highway

3) *Impact on Daily Life:* The survey also explored how traffic congestion affects commuters' personal lives. Most participants 97 cited increased travel time as a primary concern. Psychological stress and fatigue were also reported by 79 of respondents, while others noted higher fuel consumption, accident risk, and missed appointments.

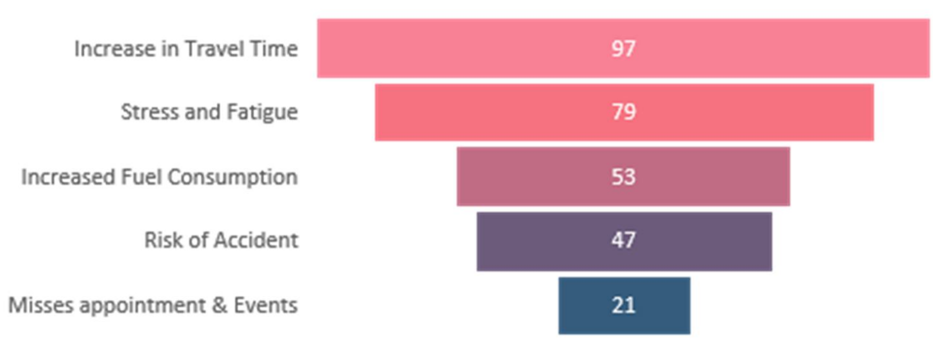

Fig.11. Reported effects of traffic congestion on commuters' daily lives

4) *Statistical Association Analysis:* To explore whether public perception regarding traffic congestion and transport usage varies across demographic profiles, chi-square tests were conducted. The variables included age, gender, occupation, transport mode, public transport usage, congestion frequency, and perceived impact of traffic.

TABLE XVII
Chi-Square Test Summary of Demographic and Traffic Variables

Variable 1	Variable 2	Chi-Square Value	P -value	Conclusion
Age	Transport Mode	12.46	0.409	Not Significant
Gender	Public Transport	3.92	0.141	Not Significant
Occupation	Congestion Frequency	11.40	0.495	Not Significant
Transport Mode	Congestion Frequency	6.87	0.650	Not Significant
Public Transport	Congestion Frequency	6.12	0.106	Not Significant
Gender	Traffic Impact	30.58	0.904	Not Significant

The results indicate that there is no statistically significant association between demographic variables (age, gender, occupation) and traffic-related factors such as transport mode, congestion frequency, and traffic impact. This suggests that traffic congestion is a widespread issue affecting all groups similarly, likely driven more by systemic and infrastructural factors than by individual characteristics.

VI. CONCLUSION

A well-designed and efficiently managed S.G. Highway can significantly contribute to the economic development, social welfare, and environmental sustainability of Ahmedabad. By adopting a holistic and inclusive approach to transportation planning, stakeholders can work toward developing a safer, more efficient, and sustainable corridor that benefits all users.

A. *Public Transport Utilization*

Based on the findings related to public transport use, the following recommendations are proposed:

- Enhance public transportation services by increasing the frequency and reliability of buses.
- Upgrade supporting infrastructure such as bus shelters and pedestrian pathways to improve commuter experience.
- Promote multimodal integration to encourage a shift from private to public transport.

B. *Air and Noise Pollution*

Based on AQI and noise pollution data, the following measures are suggested:

- Enforce strict emission regulations for both industries and vehicles to control air pollution.
- Promote the use of clean and renewable energy sources, such as solar and wind power, to reduce dependence on fossil fuels.
- Encourage green cover and noise barriers along traffic-dense zones to mitigate environmental stress.

C. *Peak Hour Congestion Patterns*

The study reveals that peak hour congestion on S.G. Highway remains a major concern:

- Morning peak hours (9:00 AM–11:00 AM) show maximum congestion, with vehicle speeds dropping to 20–30 km/h.
- Evening peak hours (6:00 PM–8:00 PM) also exhibit significant slowdowns, with speeds ranging from 25–35 km/h.
- Primary bottlenecks include intersections, bus stops, and ongoing roadwork zones.

To address these issues:

- Optimize traffic signal timings to reduce delays and streamline flow.
- Expand road capacity where feasible and eliminate critical bottlenecks.
- Promote public transport to reduce reliance on private vehicles during peak hours.

D. Accident Statistics and Black Spot Management:

Findings related to accident-prone zones suggest the following interventions:

- Improve intersection designs by adding clear signage, traffic signals, pedestrian crossings, and turning lanes.
- Implement safety measures such as speed cameras, rumble strips, and improved street lighting at high-risk areas.
- Enforce traffic laws related to speed limits and reckless driving more strictly.
- Conduct public awareness campaigns to educate drivers about road safety practices.

By implementing these evidence-based strategies, authorities and planners can enhance road safety, reduce congestion, and promote a sustainable and commuter-friendly environment on S.G. Highway.

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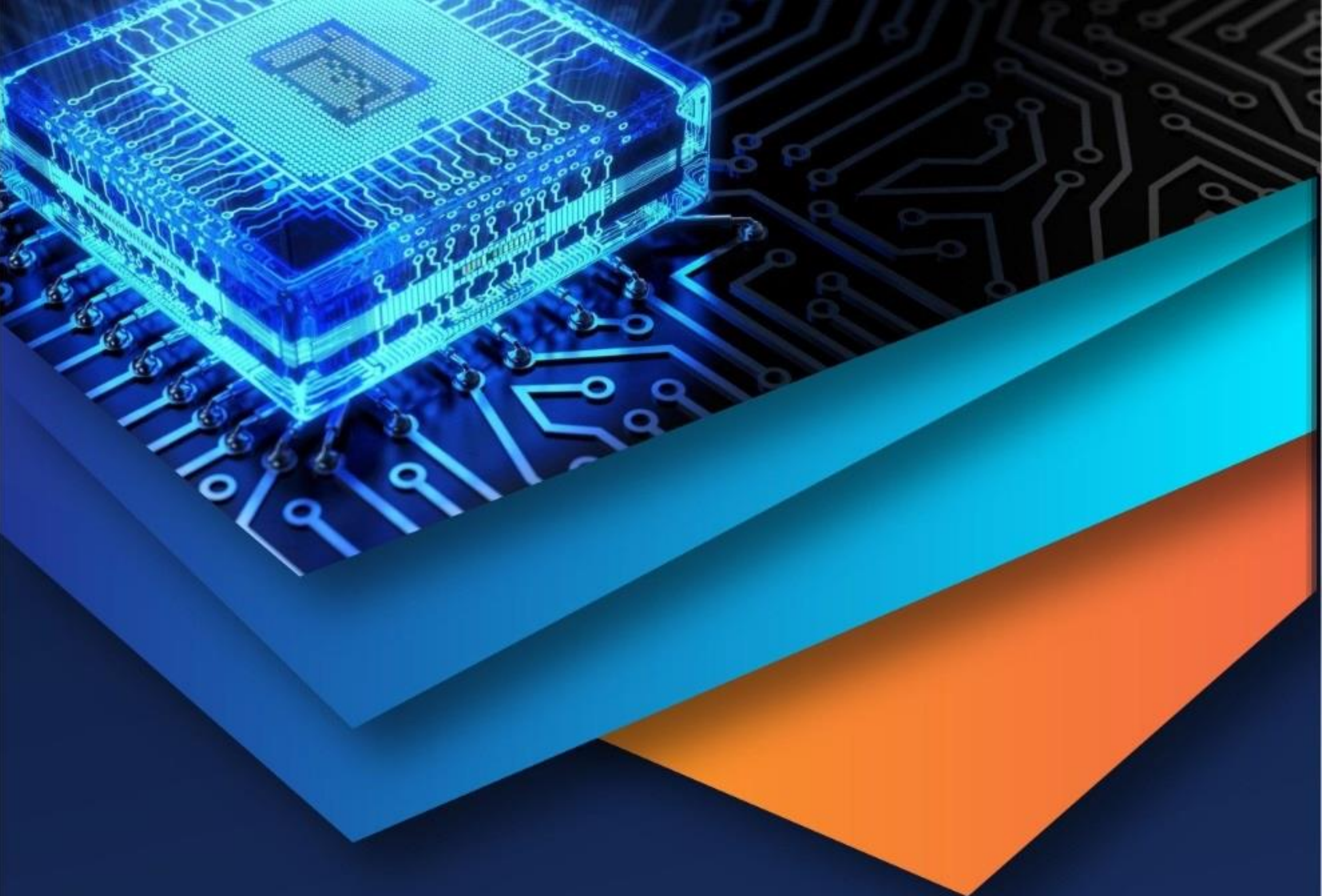

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