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Students Commuting Patterns: A Shift towards More Sustainable Modes of Transport

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Abstract: ***Since students make up the majority of the school and college population, their mobility frequently influences the city's transportation needs. The transportation, social, and environmental effects of students travelling to and from school and institutions are significant. Based on a Questionnaire survey completed by 500 parents and students from different areas of a city, this study examines the commuters' preferred modes of transportation and the possibility of switching to more environmentally friendly ones. Given the generally short travel distances and travel times, many of these auto, van, 2 wheeler, and car trips could potentially be replaced by more environmentally friendly and healthful modes of transportation, such as buses and active modes, reducing auto trips from 32% to 24% and increasing bus trips from 28% to 48.5%. Depending on the scenario examined, switching from driving to taking a bus could ease traffic congestion during rush hours. The study's findings, which showed that 48% of private and semi-private automobiles were switching to bus transit can, aid urban planners in developing planning strategies for more sustainable mobility.***
Keywords: Sustainable mobility, modal choice, questionnaire survey, modes of transport, school trips

I. INTRODUCTION

As opposed to developing countries, developed or high-income countries are where the majority of studies on travel mode selection are undertaken. Additionally, there haven't been many researches about commuters' modes of transportation and the influences on those modes. A commuter's decision may be influenced by a variety of factors, including connectivity or reach, accessibility to a particular mode of transportation, information, time satisfaction, user attendance, comfort, security and safety, and environmental impact [1]. In every subsegment for each criteria, private automobiles were consistently shown to be at the highest levels. Many institutions around the world have adopted policies to discourage driving to school and promote using public transportation and active modes since they are better for the environment and your health. It is acknowledged that students are a diverse population with a great deal of freedom and autonomy in their travel choices [2]. Since most students are young and live close to schools, they are more likely to use public transportation and active means of transportation than to own cars and 2 wheelers. The journey distance and travel time are taken into consideration while analysing the students' mobility patterns: the multimodal class, the bicycle class, the public transportation class, and the walkable class. Since most students rely on cars and vans to get them to school, cities generate a lot of extra trips, especially during the morning and afternoon rush hours, which causes the network to become more congested. Thus, encouraging the use of active modes of transportation, particularly during childhood and adolescence, gives kids the chance to get the daily physical activity they need, which can reduce the likelihood that they'll develop various diseases throughout their lives and reduce the financial burden on society [3]. According to several surveys, driving is preferred because public transportation cannot compete with the appeal of private vehicles or motorcycles. The primary reasons for this were a lack of flexibility, a lack of direct access, longer travel times, and a feeling of uneasiness when utilising public transit. These factors have led to an increase in private vehicle ownership, which has caused a significant drop in the number of people using bus services. According to reports, Belagavi's bus service quality has decreased as a result of traffic congestion. Additionally, at peak hours, there is occasionally too much passenger flow. In the urban/metropolitan area of Belagavi, the second-largest city in the Indian state of Karnataka, there are 610,350 people, of whom 308,905 are men and 301,445 are women. School trips in city has operated different categories in vehicles like 2 wheelers, Auto, van, city bus service, tempo cycle etc. The city bus services are managed by Karnataka State Road & Transport Corporation Ltd. (KSRTC). It has three universities: KLE Medical University, Rani Channamma University, and Visvesvaraya Technological University, where there are more than 200 educational institutions, more than 100 business districts/industries, and numerous recreational facilities, the study was divided into seven zones and survey was conducted in all zones to analyse the potential shift of different modes.

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II. LITERATURE REVIEW

Understanding the elements that affect commuters' mode of transportation choice is one of the key considerations when trying to construct a sustainable transportation system, especially in developing countries where this concept is still relatively new. [1]. A significant amount of the daily motor traffic on metropolitan road networks is caused by school travels. Dependence on automobiles for school travel can regularly cause congestion. Family income was determined to be one of the important determinants for mode choice decisions, with or without bus service, according to the mode choice models[4]. School-related traffic congestion is a significant sort of persistent congestion that affects residents' and travellers' (children, parents, teachers, and other motorists') safety on the road. Bus transportation can be used to reduce this kind of congestion and offer more environmentally friendly forms of transportation. Recent decades have seen a significant rise in the percentage of students who drive themselves to school, which is accompanied by a decline in student physical activity, severe traffic congestion during peak hours, and serious environmental pollution.

Paulo J.G. Ribeiro and Fernando Fonseca 2020, given the analyses of the modes of transportation used for commuting trips, the potential to switch to more sustainable modes, and the corresponding CO2 savings by taking into account two scenarios: an optimistic and a most likely scenario. This is based on a questionnaire given to 686 students from the University of Minho in Portugal. 42% of pupils prefer to drive to school, and 54% travel less than 5 km and 62% less than 20 min. Given the travel durations and distances for the students, active means of transportation could complete 55% of trips, while motorised trips could drop from 70% to 45%. The urban planners may find it easier to embrace sustainable planning practises after considering the study's conclusions.

Uncertainty persists over the fundamental concept of school travel in South Asian cities. In order to analyse schoolchildren's travel choices in the Indian setting, the study by Nishant Singh, Vinod Vasudevan 2018[8], used primary data that was gathered from the Indian city of Kanpur. The decision-making process for scheduling visits to schools was modelled using a multinomial logit framework. The findings showed that students' reliance on additional motorised modes, such as family cars and paratransit, was caused by the lack of a public transit system and high-quality school bus services.

Understanding decision-makers' behaviour with relation to mode choice and directing pattern selection is necessary for controlling the trend of the shift and supporting active modes. [Alireza Ermagun et. al 2013][3]. This study represents the first attempt to mathematically model the mode choice and accompaniment pattern selection by parents for the school trip of pupils. A copula-based model and a nested logit (NL) model are the two modelling formulations that are used. The copula model outperformed the NL model, according to the results.

According to the study by Nedal T. Ratrout et al., mode choice models have been used to examine the usage of sustainable transport strategies in the context of public transportation. The goal of this project was to create mode choice models for public boys' schools in the Saudi Arabian metropolitan areas of Al-Khobar and Dhahran. There is no public transportation available to these schools. For a fictitious bus service, mode choice modelling was carried out using logit models for both the present and the future modes. Family income was determined to be one of the important determinants for mode choice decisions, with or without bus service, according to the mode choice models.

The study set intended to evaluate the Stage model of Self-regulated Behavioral Change (SSBC) in order to comprehend and clarify parents' decision-making process about their children's switch from active school transport to car use [Qiang Mei et al 2022][5]. To examine the parents' intention change process, a structural equation model and generalised ordinal logistic regression were both employed. The findings indicate that, for goal intention, behavioural intention, and implementation intention, respectively, the model explained 94%, 77%, and 69% of the variance.

III. METHODOLOGY

The survey had previously been organised, with some closed-ended questions grouped into four main sections. Gender, age, and student type were among the personal details in the first section. The second was to compile information on the primary mode of transportation that kids used to get to and from their schools. Students were required to provide their residential addresses (home addresses) so that the distances and timeframes between their homes and schools could be estimated precisely for each form of transportation. The final section concentrated on the justifications for adopting the chosen modes and the willingness to switch to alternative modes. The fourth section discussed the obstacles to using active modes of transportation and public transportation. The questionnaire required about 15 min to complete, was administered in Belagavi city.

Each student's address and stated mode of transportation were entered separately into the journey planner during the procedure. Calculating the travel lengths and timings for the commutes made up the second phase of the work.

Due to its precision in measuring routes, the Google Maps journey planner was chosen as the tool to calculate travel distances and timeframes. School Interview Technique is similar to the home interview technique which involves preparation of a questionnaire and visiting the schools from where the data is required. The questionnaires are handed out to students and are then explained about the contents of the questionnaire and are requested to fill the details to the best of their knowledge. We had prepared a questionnaire regarding the origin, mode of travel, comfort of travel, mode of transport preferred etc. The students were explained about the purpose of the study and the contents of the questionnaire. The students were then instructed to fill the forms. Following are the information given by the students in the Questionnaire; Details like

1) Mode of transport to school
2) Time of journey from home to school
3) Reason for delay
4) Condition of traffic
5) Percentage of mode of Transportation
6) Locations of the students
7) Willingness to shift towards Bus transportation

IV. STUDY AREA AND DATA COLLECTION

The 58 municipal wards that make the study area, from which the data were gathered, have a combined population of 4,88,157 and about 1,11,436 dwellings, including defence area. The table below lists the city's key distinguishing characteristics, including the number of wards and traffic zones, total area, average land area per zone, average population per zone, population density, etc. The table below contains information about Belagavi city current land use pattern as provided by BUDA (Belgaum Urban Development Authority).

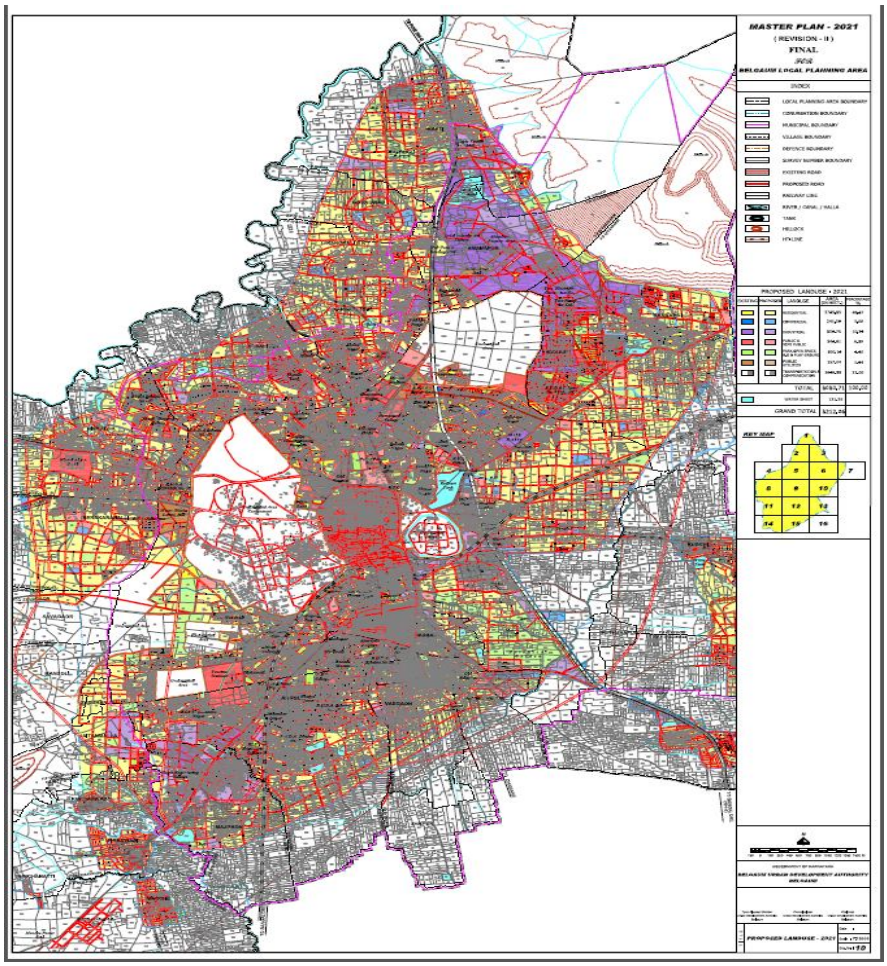


Fig. 1 Proposed landuse 2021, Belgaum Urban Development Authority (BUDA)

The study area is divided into seven numbers of zones, based on number of households, population and total wards. The trips generated in a city are in thousands per day, in this study we draw the conclusion based on 500 sample size in each zone of the study area. Most of the respondents of the study are commuters who are parents (includes all three age group young, middle & old) and school going students. The modes of transport are classified and observed in study as, i) Private (2Wheeler, Car) ii) Semi-private (Auto, Van) iii) Public (Bus, Tempo) iv) Active mode (Cycle, Walk). The study concentrates on internal to internal movement of the traffic in Belagavi city for estimating the travel demand and Service quality is analysed based on users perceptions and expectations in their journey.

Table 1: Salient features of the study area

Sector	Name of the Zone	Total no. of Wards	Population	Households
Zone-I	Angol, Majagoan	08	69,949	17,037
Zone-II	Vadagoan yellur	08	67,515	15,365
Zone-IIIA	Tilakwadi	09	67,986	15,879
Zone-IIIB	Shahpur	10	70,899	15,962
Zone-IV	College road	05	40,510	9295
Zone-V	Shivabasav Nagar	08	69,209	15,438
Zone-VI	Kanabargi	10	1,02,089	22,460
	Total	58	4,88,157	1,11,436

Simple random sampling was considered for the collection of data. Assuming the population to be normally distributed, empirical formulas given by Levy and Lemeshow (2008) were used to determine the sample size. Hence based on the equation, the minimum sample size was obtained as 500 from all zones. Family size analysis shows that nearly 43% households have family size of 4-5 and 28% families have size less than 4 and 28% of families have size more than 5. A two-page questionnaire was filled out by a total of 500 participants in each zone of the study to gauge parents' intentions regarding active school travel. More than 250 questionnaires were kept for the subsequent data analysis in each of the seven zones after thorough data cleaning, which also involved eliminating samples with missing data on crucial factors and those who had not responded to any questions about the children. Table 52 provides an overview of the general samples' sociodemographic data. Male respondents made up 5 of the study's parents, or 47.5% of them. The children were ten years old on average (range 6-15 years old).

Table 2: Demographic details of the samples

Variables		Students from all zones						
		Zone-I [N=484] [%]	Zone-II [N=462] [%]	Zone-IIIA [N=470] [%]	Zone-IIIB [N=450] [%]	Zone-IV [N=280] [%]	Zone-V [N=424] [%]	Zone-VI [N=476] [%]
Gender	Male	46.4	51.4	48.6	57.2	62.4	52.1	49.4
	Female	53.6	48.6	51.4	42.8	37.6	47.9	50.6
Age	10-14	21.3	20.8	28.2	24.6	18.8	20..8	18.2
	15-18	78.7	79.2	71.8	75.4	81.2	79.2	81.8
Type of student	Primary-school	14.6	10.2	11.4	12.8	14.0	14.2	12.4
	Higher-school	85.4	89.8	88.6	87.2	86.0	85.8	87.6
Travel time	≤ 5	4.27	0.20	0.00	0.00	0.00	0.00	0.00
	> 5 - ≤ 10	10.87	1.43	0.83	0.83	0.60	0.47	5.70
	> 10 - ≤ 15	13.67	6.37	3.90	4.87	14.53	7.77	11.87
	> 15 - ≤ 20	13.53	8.33	16.97	21.93	35.07	19.07	24.93
	> 20 - ≤ 25	18.20	19.07	21.93	25.17	29.87	29.23	33.27
	> 25 - ≤ 30	16.37	31.00	30.00	28.90	18.40	29.97	21.50
	> 30 - ≤ 35	16.20	20.60	22.20	9.67	1.53	12.93	2.73
	> 35 - ≤ 40	6.90	13.00	4.17	8.63	0.00	0.57	0.00
	> 40	0.87	0.20	0.00	0.00	0.00	0.00	0.00
Travel Distance	≤ 1	12.5	8.6	16.5	18.6	22.5	8.9	2.1
	> 1 - ≤ 5	40	48.5	56.4	42.8	56.2	32.6	38.3
	> 5 - ≤ 10	42.5	40.6	25.88	36.0	20.1	56.4	50.2
	> 10 - ≤ 15	4.6	2.3	1.02	2.6	1.2	2.1	8.8
	> 15	0.4	0	0.2	0	0	0	0.6

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V. RESULTS AND DISCUSSION

A. Mode of Transport used by Students for Commuting to the School in Various Zones

While more students use buses to get to school, there were slightly more pupils using auto rickshaws, motorcycles, and vans. A comparatively small percentage of students used the other transportation options (bicycle, minibus) to go to school. The percentage of students walking decreases with the distance and travel time. Further information regarding the students' commutes is summarised in the fig. Trips in auto rickshaws made up roughly 32.5% of the total distance taken by the major forms of transportation, followed by journeys in 2-wheelers (17.3%), vans (13.6%), and buses (27%). The typical commute from home to school was 7.4 kilometres. Also, it took 20 minutes on average for a vehicle trip to go 15 km, 33 minutes for a bus trip to cover the same distance, and 23 minutes for a bus trip to traverse 5.0 km.

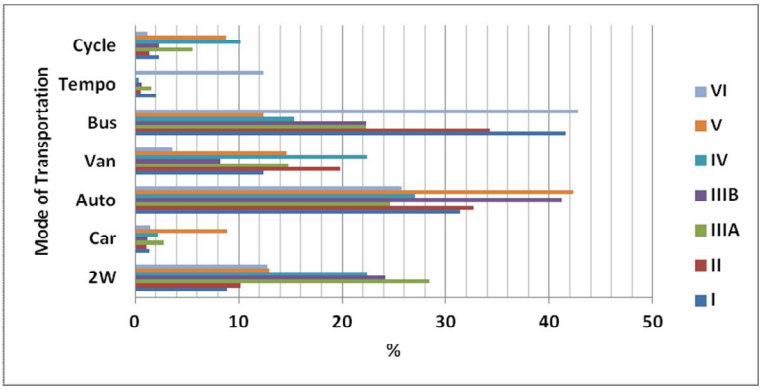


Fig. 2 Modes of transport used by students in various zones

The following table shows the various respondents with respect to category of vehicles showing the willingness towards usage/ shift towards bus transportation within the city.

Table 3: Potential shift towards other modes[Source: Questionnaire analysis]

Modes of transport	Potential shift towards other modes							
	Current mode	2Wheeler	Car	Auto	Van	Bus	Tempo	Cycle
	%	%	%	%	%	%	%	%
2W	17	52	13.6	12.2	4	11.0	1.0	9.1
Car	3	2	40.9	0.6	0	2.2	0.0	0.0
Auto	32	26	23.9	51.8	7	30.6	0.0	14.3
Van	13	11	8.0	12.5	55	9.6	4.1	5.2
Bus	28	7	12.5	19.0	31	41.7	1.2	14.3
Tempo	3	0	1.1	1.1	2	1.8	7.8	0.0
Cycle	4	2	0.0	2.9	0	3.3	0.0	57.1

It is clearly understood that Auto-Rickshaws are playing a major role in student or educational transportation. The bus transportation facility is very poor with no dedicated bus transport facilities available to reach these schools. The rules stated by the government say that only a maximum of five children up to the age of 14 years or not more than three adult passengers are allowed to be accommodated in autos. Yet, many autos in the city continue to break the rule.

VI. CONCLUSION

The more the number of autos plying, the more will be the pollution. The congestion also increases. The most important of all, the students' safety is neglected. In order to overcome these problems, study suggests bus as a mode of transportation with the provision of required facility to the school students. Overall 48% of existing vehicle users is ready to shift their mode as bus transportation. These buses shall pick and drop the students during the opening and closure time of schools. At other times, they can do their usual daily routines to other parts of the city. Adequate picking/dropping points shall be provided so that students can easily access the buses.

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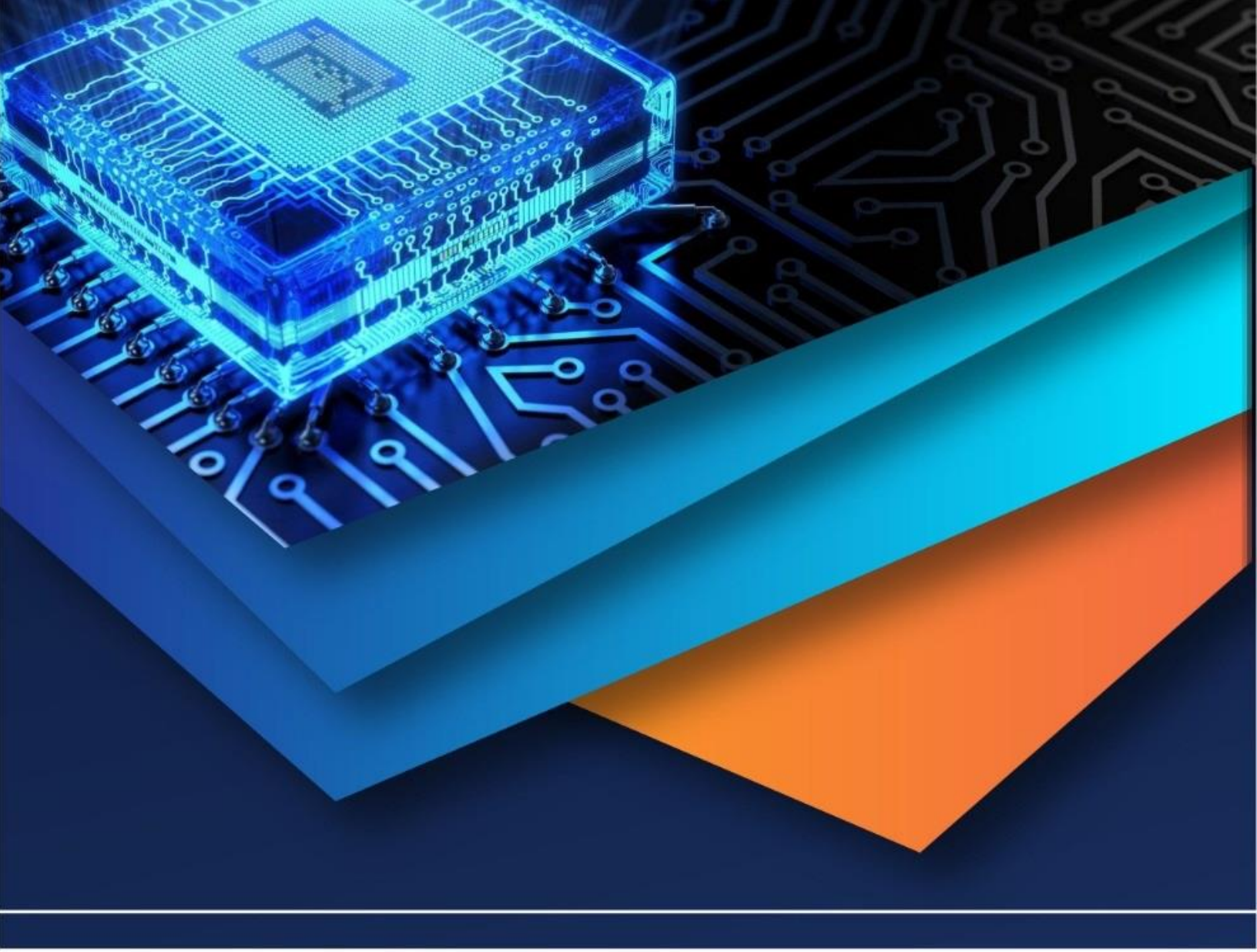
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