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A Survey on Intelligent Transport System in Bangalore at a Selected Stretch

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Abstract: ***India is the second most populated country in the world. Due to economic growth and rapid urbanization, there is rapid growth in population especially in metropolitan cities like Bangalore. This population growth causes lot of traffic congestion in urban roads and sometimes, leads to accidents. This problems can be solved by effective use of Intelligent Transport systems. Electronic toll collection at urban toll plaza, needs to be implemented for avoiding congestions at peak hours. Also, separate bus lanes need to be constructed in congested areas of the city. This bus lanes, known as BRT(Bus Rapid Transit) systems should be equipped with electronic fare collection, passenger information systems etc. This paper presents survey details of electronic toll collection and also propose BRT lanes for the selected stretch in Bangalore city.***
Keywords: Electronic toll collection, bus rapid transit systems, fastag, passenger car units, dwell time, intersection time, traffic volume, elevated bus circle, multi axle vehicles, radio frequency identification system.

I. INTRODUCTION

Intelligent Transport System (ITS) is inclusive of the usage of advanced technologies like information and communication (ICT), also known as telematics, collection and storage of data , navigation systems etc. The purpose of usage of these technologies in transport is to solve the problems of traffic congestion, air, noise pollution etc. These technologies help in better collection of data to address the issue related to transport. India has emerged as a leader in information technology in the past two decades or so. With the boom in economy, there has been a phenomenal increase in the number of vehicles leading to traffic congestion in urban areas and the pollution of air in metropolitan and mega cities. As India has strong IT and telecom infrastructure, it is in a position to benefit from the employment of ITS for solving many transport related problems. These technologies can be utilized at two levels – vehicular and infrastructural.. With the growth of Indian economy and more and more urbanization, the usage of ITS will certainly increase manifold. The most important areas of ITS use will be air quality, road safety, traffic congestion and methods of communication. In the sector of transportation, the usage of automated technologies has increased abundantly with the development of Golden Quadrilateral, i.e. the network of highways connecting Delhi, Mumbai, Chennai and Kolkata, along with the various expressways like Yamuna Expressway, Ahmedabad–Vadodara Expressways etc. Some isolated or standalone applications of ITS like automated parking systems, electronic toll collection, automated traveler information systems, intelligent signal control etc. are in use in some metropolitan cities like New Delhi, Bangalore and Pune. Moreover, where there is BRT system, passenger information system (PIS) is being used. However, there is the greater employment of technologies like sensors, detectors, communication devices and global navigation satellite system.

II. OBJECTIVES

A. To reduce congestions at tolls with help of automatic toll collection.
B. Avoid every lane at tolls to be converted into FASTag lanes.
C. Make the travel time for road users uniform during peak and off-peak hours.
D. Integrate Bus Rapid Transit (BRT) system in such a way to reduce traffic congestion.

III. SCOPE OF THE PROJECT

The desideratum of the project is to utilize the Intelligent Transport Systems(ITS) effectively so that it benefits the society by controlling the traffic and thereby reducing the rates of accidents and congestion delays.

IV. LITERATURE REVIEW

Increase in traffic leads to congestion problems and accidents. It was seen that in the year 2015-2016 alone,2.6 million motor vehicles were sold in Bangalore. Research suggest that Bangalore falls in Level of Service E in terms of traffic quality.Further increase in traffic leads to breakdown which is highly unstable condition.

Bangalore is experiencing such traffic problems due to slow growth in transport infrastructure, poor urban traffic planning, lack of adequate public transport and parking infrastructure etc (Gurdit singh et al.,2014). Intelligent transport systems(ITS) provide solutions to all this problems with help of new technologies. Intelligent transport systems is being used in developed countries but it is not as much effectively used in developing countries like India. Intelligent transport systems include many subdomains like electronic toll collection(ETC),traffic management system etc. Intelligent Transport System (ITS) is inclusive of the usage of advanced technologies like information and communication (ICT), also known also telematics , collection and storage of data , navigation systems etc. The purpose of usage of these technologies in transport is to solve the problems of traffic congestion, air, noise pollution etc. These technologies help in better collection of data to address the issue related to transport(Bhupendra Singh, & Ankit Gupta,2015). Introduction of ETC technology at tolls helps in saving of operating costs of vehicles ,time saving due to reduced congestion, emission control, enhanced cash handling, incident reduction etc (Amol A. Chapate & D.D. Nawgaje,2015).However, in India, ETC is at the development stage. With the aim of achieving the benefits to road users, Ministry of road transport and Highways has decided to make all toll plazas on national highways as ETC enabled. This ETC programs are rolled out under the brand name “FASTag”. This program is part of the National Electronic Toll Collection(NETC) initiative under the guidelines of National Highway Authority of India(NHAI) and Indian Highways Management Company Limited(IHMCL).FASTag is presently operating at more than 350 toll plazas across national highways(Deepashree K. Mehendale & Reshma S. Masurekar,2015).

FASTag is a simple and reusable tag based on radio frequency identification(RFID) technology(Satyasrikanth et al.,2016).Each tag is linked to a registered wallet to facilitate automatic deduction of toll charges. Tag reader at toll plaza reads the vehicle FASTag and applicable toll charges gets automatically deducted from the linked account. In India, Yamuna expressway is one of the tolls where there is effective use of ETC technology. the non-peak hours. Delays and stoppages can be reduced by integrating the bus stop and signal in such a way that the timing required for boarding and de-boarding of passengers matches the delays at signals. Providing BRT lanes also helps in stabilizing the traffic volume-capacity ratio. It was observed in Ahmedabad that there was a reduction of 20% usage of private vehicles as people started to use public buses for transit, thus, resulting in stabilizing the traffic volume-capacity ratio. As the construction cost of metro rail is high compare to BRT(Bus Rapid Transit) systems, BRTS was thought as a viable option. Construction of metros involves a lot of inconvenience to road users due to blocked roads for a long time as compared to BRTS construction (Sumedh Bang et al.,2017).

V. METHODOLOGY

Electronic toll collection (ETC) survey Toll Plaza which has both Fastag and Non-Fastag lanes are selected. The survey is carried out to find out the percentage of Fastag users for a particular month and the increase in usage to the next month. The pros and cons of the Fastag lane are also noted in the form of questionnaire survey from the users.

A. Bus Rapid Transit (BRT) System survey

Stretch of minimum 4.5 Km is selected for the survey. Survey is carried to and fro via the selected stretch during peak and off-peak hours. During the survey Dwell time, Intersection time, Traffic volume time and travel time are noted.

1) Dwell time - Time taken by the passenger to reach the bus-stop from place of residence or work.
2) Intersection time - Time spent by the bus at junction or intersection.
3) Traffic volume time - Time spent by the bus during motion.
4) Travel time - Total time taken by the bus during its journey from origin to destination.

From travel time and the length of selected stretch, the existing speed of the bus is calculated and is compared with the actual speed of the bus to emphasize on the requirement of BRT lane.

B. Traffic volume Survey

Traffic volume survey is carried out at the same stretch where BRT survey is done in order to find the type of BRT lane to be provided. Data of different categories of vehicles are collected during peak and off-peak hours. Then the data collected is converted to Passenger Car Unit(PCU) for all categories of vehicles using their respective equivalency factors, from which passengers per hour per day (pphpd) is found from which the type of BRT lane to be provided is inferred. Volume/Capacity ratio is also obtained from this survey for the existing traffic congestion which implies that implementation of BRT system can stabilize V/C ratio and reduce the congestion.

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VI. RESULTS

A. Electronic Toll Collection

1) Fastag lane survey

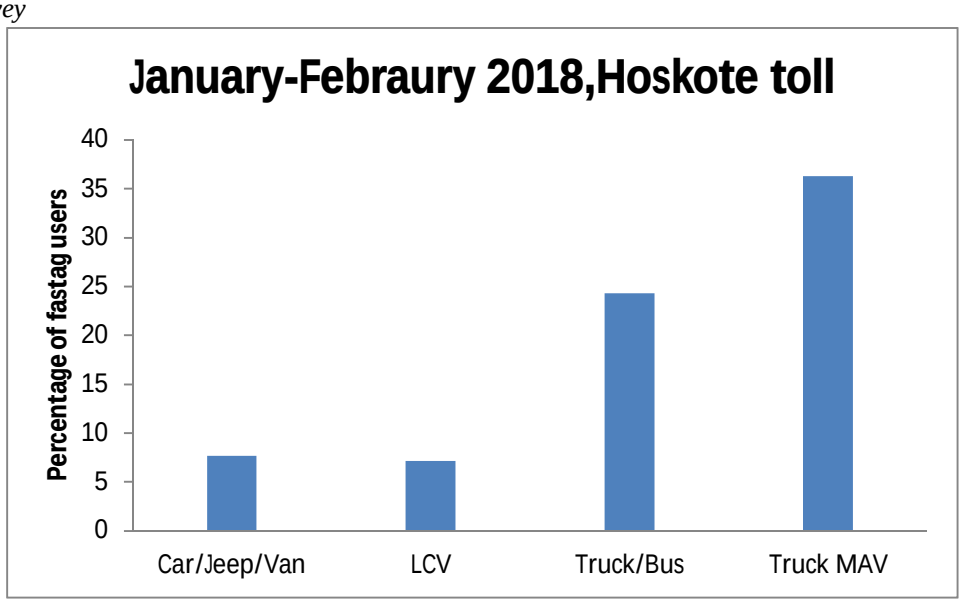

Figure 4.1 Bar graph showing the percentage of fastag users at Hoskote toll

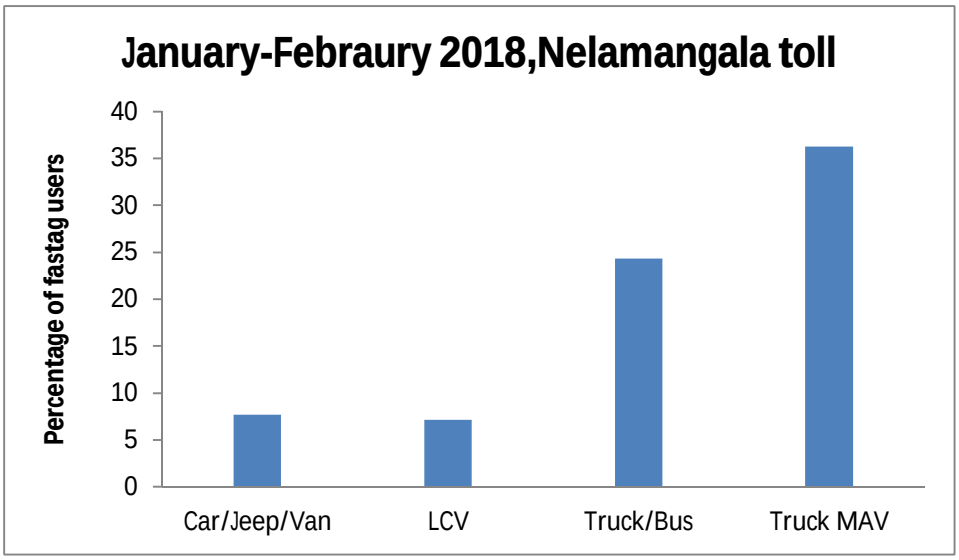

Figure 4.2 Bar graph showing the percentage of fastag users at Nelamangala toll

From the graphs of figure 4.1 and 4.2, it can be inferred that maximum number of FASTag users are for the truck, buses and MAV's with 24.23 % in January and 24.15% in February at Hoskote toll. At Nelamangala toll plaza, it was found that the maximum number of FASTag users are for the truck, buses and MAV's with 17.82 % in January and 18.44% in February. Therefore, it is observed that the maximum users of FASTag are commercial vehicles like trucks, buses and MAV's. It is found that that many non-commercial vehicle users are unaware of the FASTag as they hardly travel on such routes. In case of commercial vehicles users, many have complained about standing in long queues with non FASTag users even though they are using FASTag. It is also found that FASTag users get a benefit of 7.5% at tolls.

B. Traveller Information System

1) Bus Rapid Transit(BRT) Survey

2) Cunningham road to Majestic

Distance – 4.5 km

	At peak hours	At off-peak hours
Dwell time	120 sec	120 sec
Intersection time	670 sec	386 sec
Traffic volume time	418 sec	158 sec
Travel time	1343 sec	662 sec
Bus speed	12 Kmph	23 kmph

From the above table, it can be inferred that the length of stretch for Cunningham road to majestic BRT system is 4.5km with the expected travel time of 11 minutes but according to current prevailing scenario the travel time is 22 minutes. ITI gate to Baiyappanahalli

Distance – 5.0 km

	At peak hours	At off-peak hours
Dwell time	150 sec	150 sec
Intersection time	1320 sec	260 sec
Traffic volume time	780 sec	960 sec
Travel time	2011 sec	1384 sec
Bus speed	10 Kmph	15 kmph

From the above table, it can be inferred that the length of stretch for ITI gate to Baiyappanahalli BRT system is 5km with the expected travel time of 15 minutes but according to current prevailing scenario the travel time is 35 minutes. Therefore, BRT system reduces travel time by 15min.

C. *Traffic Management System*

1) Cunningham Road to Majestic

TIME INTERVAL	TWO WHEELER	AUTO RICKSHAW	CAR /JEEP/TAXI	VAN /TEMPO	MINI BUS	BUSES	LCV	2-AXLE RIGID VEHICLE	3-AXLE VEHICLE	TRACTOR WITH TRAILER	PEDAL CYCLE
2:00 – 3:00PM	518	526	842	25	2	96	23	63	9	9	6
3:00 – 4:00 PM	445	432	962	48	6	132	30	39	69	14	1
4:00 – 5:00 PM	502	336	1137	36	15	147	41	24	51	-	2
5:00 – 6:00 PM	556	463	1073	53	34	168	20	51	39	9	-
TOTAL	2021	1757	4014	162	56	543	114	177	168	23	9

From the above table,peak hour was found to be from 5pm to 6pm from the survey carried out i.e, 2466 PCU per hour. Passengers travelling at peak hour from Cunningham road to majestic = 2466 x 4 = 9864 pphpd (passengers per hour per day).As per global benchmark for bus based systems, passengers ranging between 5000 pphpd and 12000 pphpd need to be provided with light

capacity BRT system. This is characterized by kerb side bus stops or median side bus stops. The bus lanes needs to have slight segregation from other traffic.

D. ITI gate to baiyappanahalli

TIME	TWO WHEELER	AUTO RICKSHAW	CAR/ JEEP/TAXI	VAN/TEMPO	MINI BUS	BUSES	LCV	2-AXLE RIGID	MAV
2:00 – 3:00PM	1928	793	1328	53	8	173	13	9	-
3:00 – 4:00 PM	1852	985	1462	41	19	186	15	12	2
4:00 – 5:00 PM	2071	1237	1489	78	27	210	23	5	1
5:00 – 6:00 PM	2185	1163	1607	67	31	235	22	7	1

From the above table,peak hour was found to be from 5pm to 6pm from the survey carried out i.e 4723 PCU per hour. Passengers travelling at peak hour from ITI gate to Baiyappanahalli = 4723 x 4 = 18892 pphpd.As per global benchmark for bus based systems, passengers ranging above 12000 pphpd need to be provided with high capacity BRT system. This is characterized by only median side bus stops. The bus lanes needs to have full segregation from other traffic. Therefore, light capacity BRT needs to be provided Cunningham road to majestic and high capacity BRT needs to be provided from ITI gate to Baiyappanahalli.

VII. CONCLUSION

A. Hybridization of Tolls

From the questionnaire survey, it was found that converting every lane into electronic toll collection(i.e hybridization of tolls) lanes is not a perfect solution for promoting ETC technology because India needs much time to go digital and also converting all lanes into FASTag lanes leads to mixing of FASTag and non-FASTag users at tolls leading to congestion and thus contradicting the primary objective of using the FASTag lanes. Government should encourage the use of ETC technology by making it compulsory for all automobile manufacturers to install RFID tags in every vehicle. They should also frame polices for toll collection agencies to maintain centralized servers at government offices and to implement RFID based readers effectively. In this way, ETC provides precise solution for traffic congestion and air pollution which are at high risk.

B. Separate Bus Lanes

A separate width of 7 meters should be provided to bus lanes. Bus lane are separated from normal traffic by road barricades To reduce construction cost of dedicated bus lane grass could be provided in between of pavements. Due to dedicated bus lanes there is no intersection of traffic flow and buses which allows free flow of traffics, thereby, v/c ratio of the carriageway also comes down.Also,this lanes provides uniform travel time for bus passengers during eak and off peak hours.

C. Kerb side And MEDIAN side Bus Stops

Providing of kerb side bus stops facilitates in straight flow of traffic without bulging for bus lanes and and median side bus stops avoids crossing the lane and makes the BRT system hassle free. Heavy capacity BRT needs to be provided with median side bus stops and light BRT can be provided with median or kerb side bus stops. Therefore, providing bus stops would increase the width of carriageway by 2m on either side and the predicted v/c ratio would come down to 1.06-1.24 which is ideal.

D. Elevated bus Circles at KR Circle and Tin factory

Providing elevated bus circles at KR circle and tin factory helps to evade the delay caused due to signals at intersections. KR Circle is an intersection of 5 roads meeting at a junction. To overcome the problem of Buses travelling in two directions, an elevated circle is to be constructed which would be accessible only to buses and buses can take a right towards Anand Rao circle or travel left and continue in the BRT lanes towards Majestic. Elevated bus circle is to be provided at KR Circle, since the BRT system has been made an open BRT and according to the route of the system it turns right towards Anand rao circle. To allow buses to flow to and fro from vidhana soudha, elevated Circle is provided. Since the KR circle has 5 intersection and constructing bus corridors on roadway gets complicated, thus elevated KR circle helps in smooth flow of traffic. Elevated bus circle is to be provided at Tin Factory, since the BRT system has been made an open BRT and according to the route of the system it turns left towards Hoodi and Marathalli. To allow buses to flow to and fro from Baiyappanahalli , elevated Circle is provided .Since Tin Factory is Narrow constructing bus corridors on roadway gets complicated, thus elevated Tin Factory helps in smooth flow of traffic. A wide variety of ITS technologies can be integrated into BRT System to improve BRT System performances in terms of travel times, reliability, convenience, operational efficiency, safety and security.

E. E-ticketing

Provision of smart cards instead of manual ticketing done by conductor makes the ride hassle free for passengers. It also prevents the misuse of money as every transactions are digitally recorded.

VIII. FUTURESCOPE

Detailed area survey, population, economic growth of the area has to be carried out to improve the mass transportation constantly. Alignment in the center of the road, station with off board fare collection and bus priority at intersections work has to be carried out in order to implement BRTS for longer stretch.

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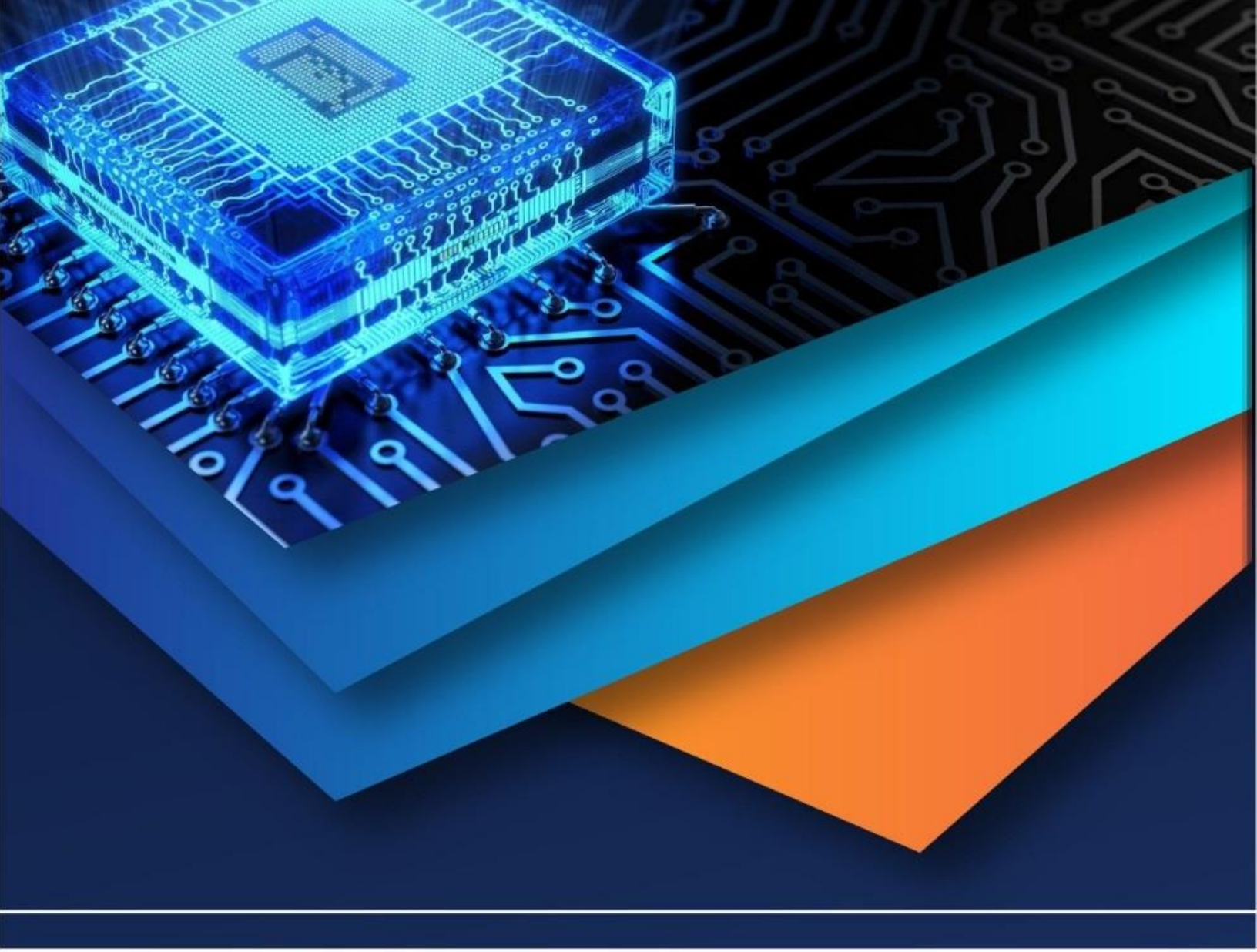

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