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Trip Attraction Models for Shopping Malls: A Case Study

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Abstract: ***Trip attraction is an important parameter in planning of transportation facilities. It aims at forecasting total number of trips generated or attracted towards zones of study area. It is important for the traffic engineer and urban planner to consider the impact of trip attraction at commercial complex, shopping malls and residential areas. This paper aims to build a suitable trip attraction model for selected malls at Vadodara city.***
Keywords: Trip attraction, TransCAD, Correlation, Multicollinearity, Regression analysis, Trip attraction rate

I. INTRODUCTION

The major problem that developing countries are facing today is Urbanisation. As a result of urbanisation the standard of living of people have also improved. Shopping malls have played a major role in this process. People have shifted towards the mall culture instead of shopping from individual stores or retail outlets. The trip attraction rate of shopping mall depends upon the following such as time of the day, day of the week and facilities provided by the mall. Location of malls impact existing traffic operations on urban road network. Evaluation of impact on traffic is supported by trip attraction models.

II. NEED OF THE STUDY

The development of various commercial recreational malls have resulted into problems such as parking, traffic congestion due to more number of trips attracted to the mall. Hence the increased trips are considered for providing efficient facilities. Estimation of increased trips due to location and attributes of mall is very important in understanding traffic impact.

III. OBJECTIVES

A. The Objectives of Study are

1) To develop questionnaire and methodology which can be followed for other similar cases.
2) To develop attraction rates and trip attraction model.

The scope of study is limited to the selected malls in Vadodara city.

IV. LITERATURE REVIEW

A. Walejo(2012)

Determined trip attraction at the market land use and developed an attraction model at Dinoyo market area. Model formulation was done using correlation and regression analysis.

B. Udin (2004)

Examined trip attraction rate of shopping centre at dhanmondi area in Dhaka city. He used trip rate analysis instead of regression analysis because of small sample size.

C. Innes (1990)

He determined various factors affecting shopper's destination choice and it included store hours operation, accessibility to the shopping centers and quality of goods offered.

D. K.Mert Cubuku (2001)

It attempted to answer two question 1. Factors that affect the shopping trips and 2. Did the demand of internet and online shopping has any effect on shopping trips. The dependent variable considered were number of trips and independent variables were related to

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shopping factors.

V. METHODOLOGY

Study area was delineated. The zoning of study area is divided into 13 wards in order to simplify travel pattern. Primary data of the study area and malls were collected from municipal corporation and mall owners. The primary data which gives socio economic character of traveller was collected using well designed questionnaire. Survey was done starting from opening of the mall to the closure of the mall in order to determine the total number of trips attracted towards each mall from different wards of the city. The data was complied in MS Excel sheet.

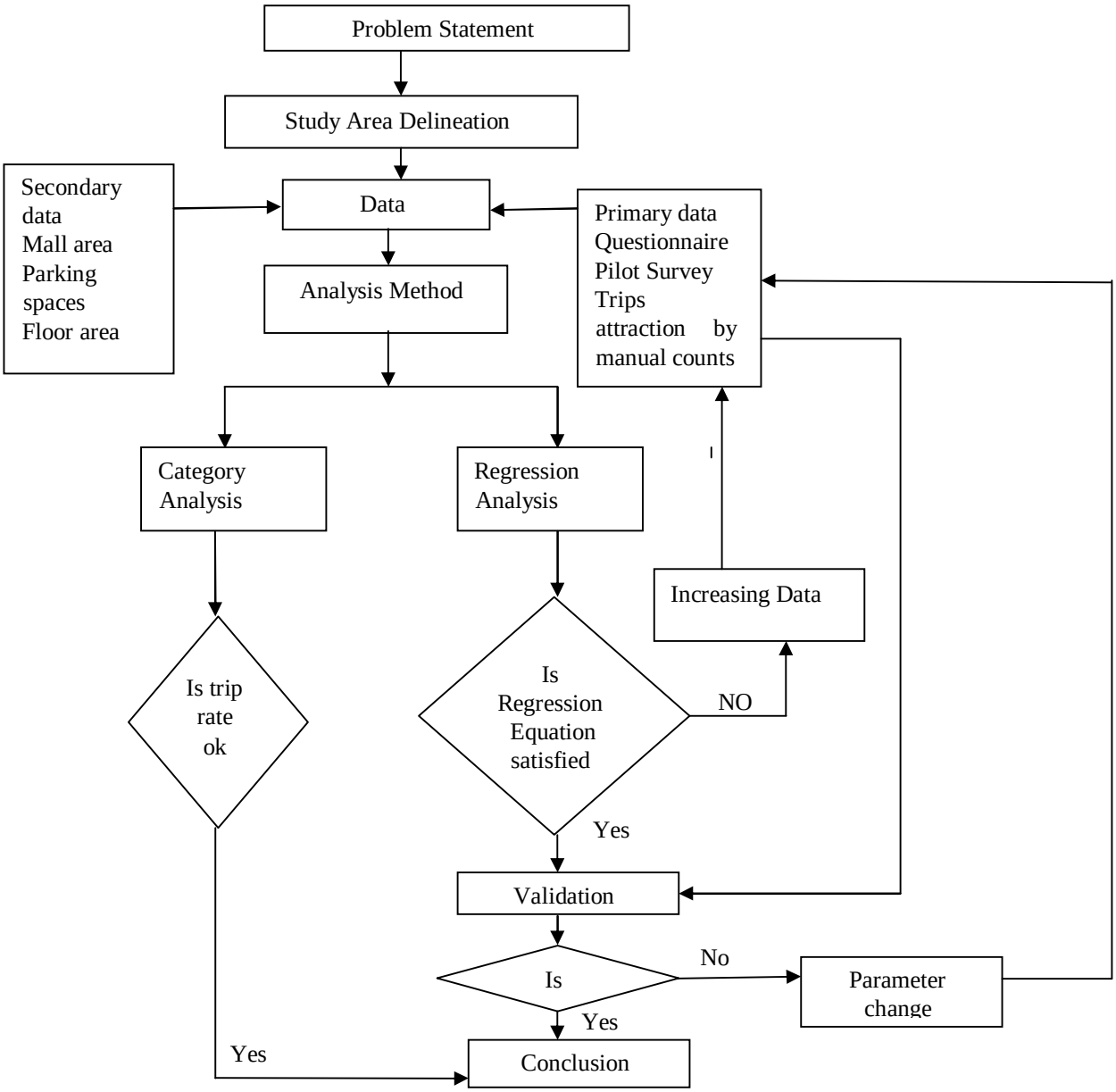

Fig-1 Methodology chart

VI. STUDY AREA

The position of selected malls were plotted using TransCAD software as shown in the figure-2

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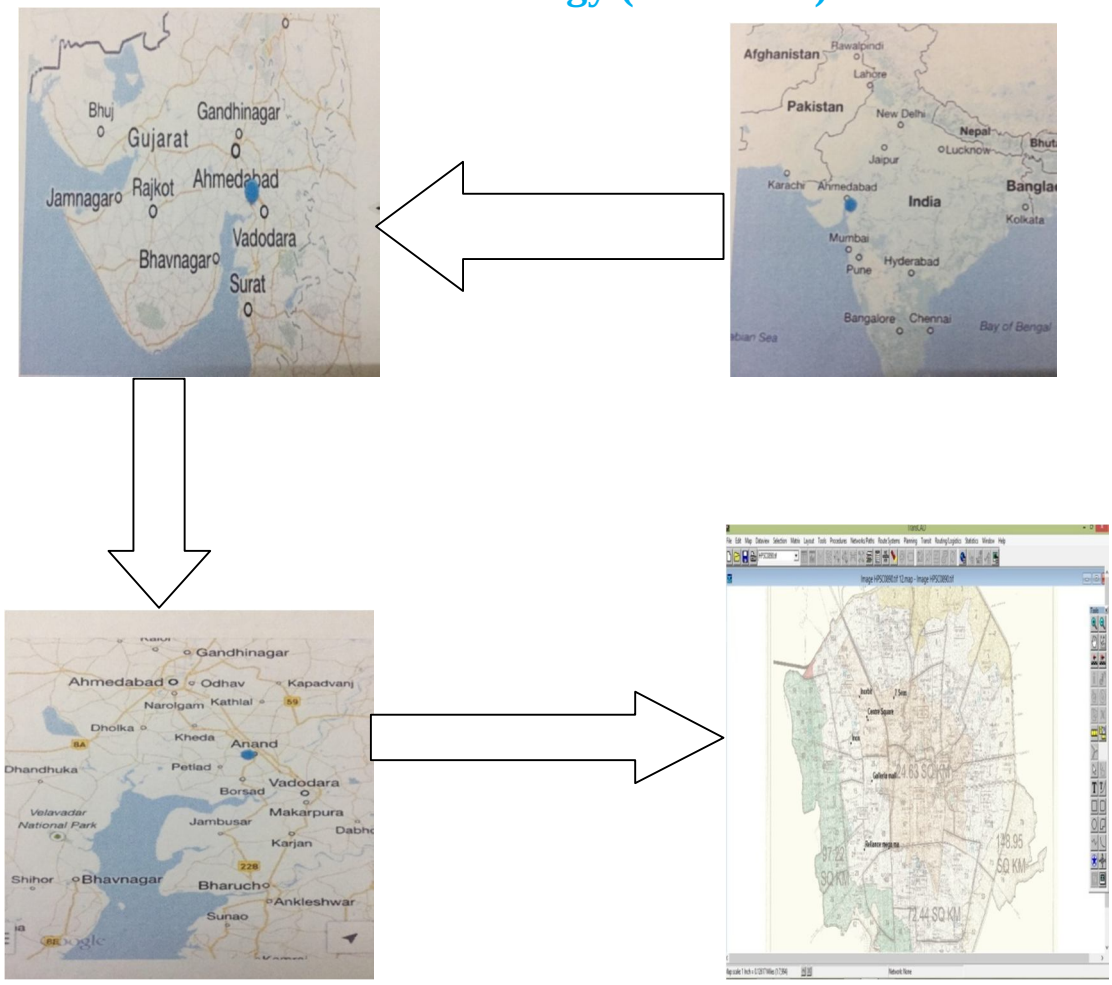

Figure-2 Layout Map

The details of selected shopping malls are shown in the following table1

Table-1 Mall Details

Name of Malls	Location	Parking space 2w	Parking space 4w	Floor area Lacs sqft	Restaurant Floor area sqft
Inorbit Mall	Gorwa	380	150	4.05	87000
Centre square Mall	Genda Circle Alkapuri	370	50	1.5	13000
Vadodara central	Genda Circle Alkapuri	330	70	1.6	4000
7 Seas Mall	Fathegunj	400	110	1.85	47000
Reliance Mega Mall	Old Padra Road	450	100	1.97	30000
Galleria Mall	Akota	350	40	1.75	6000
Inox	Race Course	300	50	1.45	2500

VII. DATA ANALYSIS

A. *To find the Peak Period at Malls*

Hourly trip attraction survey was carried out at each mall to determine the peak period. The data collected is shown in the following

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table.

Table-2 Hourly Trip Attraction

Name of malls	10-11am	11-12am	12-1pm	1-2pm	2-3pm	3-4pm	4-5pm	5-6pm	6-7pm	7-8pm	8-9pm
7seas	162	212	222	269	411	453	483	575	745	797	540
Vadodara central	72	134	215	317	373	325	350	475	545	440	275
Centre square	56	174	243	197	155	312	295	345	425	373	250
Reliance mega mall	79	127	153	177	159	197	166	352	369	275	243
Galleria mall	105	179	205	243	151	167	347	392	453	551	558
Inox	83	175	159	236	197	263	256	230	357	383	405
Inorbit	897	653	743	549	693	804	885	975	1575	1793	1675

The hourly trips of different malls were plotted using TransCAD software in order to determine peak hour of each mall.

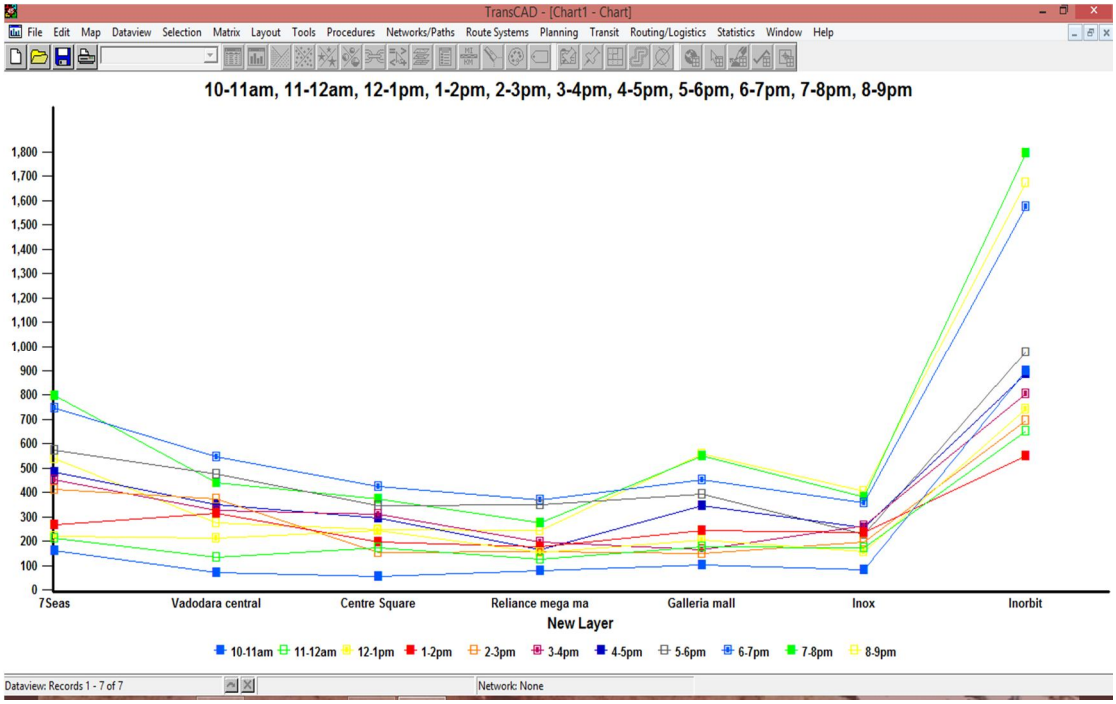

Figure-2 Hourly trip attraction chart

From the above chart it can be said that the peak period for each mall is from 5pm-9pm during weekdays.

B. Trip Attraction Rate

After esmitating peak hour, Trip attraction rate was calculated relating peak hour trip with attributes of shopping mall. The rip attraction rate was determined using the following equations

1) Trips per 1000 sqft per hour = (Peak hour person trips/floor area)*1000
2) Trips per hour per shop = (Peak hour person trip/total number of shops)
3) Trips per entry gate per hour = (Peak hour person trip/number of entry gate)
4) Trips per 1000 sqft per hour = (Peak hour person trips/ restaurant floor area)*1000

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Table-3 Calculation of Peak hour person trip attraction (trips/1000sqft/hour)

Name of mall	Peak hour trip	Floor area Lacs sqft	Trip attraction rate
7 Seas	664.25	1.85	3.59
Vadodara Central	452.5	1.6	2.82
Centre Square	359.5	1.5	2.39
Reliance mega mall	309.75	1.97	1.57
Galleria Mall	488.5	1.75	2.79
Inox	343.75	1.45	2.37
Inorbit	1504.5	4.05	3.71

Table-4 Calculation of Peak hour person trip attraction (trips/total number of shops)

Name of mall	Peak hour trip	Number of shops	Trip attraction rate
7 Seas	664.25	20	32.21
Vadodara Central	452.5	15	30.16
Centre Square	359.5	28	12.83
Reliance mega mall	309.75	15	20.65
Galleria Mall	488.5	1	488.5
Inox	343.75	5	68.75
Inorbit	1504.5	88	17.09

Table-5 Calculation of Peak hour person trip attraction (trips/ number of entry)

Name of mall	Peak hour trip	Number of entry	Trip attraction rate
7 Seas	664.25	2	322.12
Vadodara Central	452.5	1	452.5
Centre Square	359.5	2	179.75
Reliance mega mall	309.75	1	309.73
Galleria Mall	488.5	2	244.25
Inox	343.75	1	343.75
Inorbit	1504.5	2	752.25

Table-6 Calculation of Peak hour person trip attraction (trips/restaurant floor area)

Name of mall	Peak hour trip	Restaurant Floor area sqft	Trip attraction rate
7 Seas	664.25	47000	14.13
Vadodara Central	452.5	4000	113.125
Centre Square	359.5	13000	27.65
Reliance mega mall	309.75	30000	10.325
Galleria Mall	488.5	6000	81.41
Inox	343.75	2500	137.5
Inorbit	1504.5	87000	17.29

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VIII. MODEL FORMULATION

For model formulation correlation and regression analysis were performed using Microsoft excel.

A. Correlation Analysis

A correlation coefficient indicates linear relationship between two variables. The value of coefficient ranges between 0 and 1 where 0 indicates no relationship and 1 indicates perfect correlation.

B. Multicollinearity

Correlation matrix is used to detect collinearity. It is said that multicollinearity is present if the value of coeeficient is larger than 0.4. The correlation matrix is as shown below. As most of the variable are correlated they are not considered for regression analysis.

Table-7 Correlation matrix

	2W	*4W*	*RFA*	*FA*
2W	1			
4W	0.424199	1		
RFA	0.480998	0.959454	1	
FA	0.274512	0.85766	0.912271	1

C. Regression Analysis

The best model obtained after correlation analysis is regression model. The independent variable considered are parking space for 2-wheelers and floor area of mall.

The regression equation is as follows

Trips attracted = 167.17 + (-1.0774 2wheeler parking space) + (0.0031floor area of mall)

where,

y= trips attracted to the malls

x_2= Parking space for 2 wheeler

x_4= Floor area of mall.

The first term in the equation 161.17 is a constant represents the predicted criterion value when both predictors equal zero. The values -1.0774 and 0.0031 represent weight or regression coefficient of selected independent variables parking space for 2 wheeler and floor area of mall.

Table-8 Regression Statistics

Regression Statistics	
Multiple R	0.970115402
R Square	0.941123892
Adjusted R Square	0.911685838
Standard Error	84.27368997
Observations	7

R square is a statistical measure of how close the data are to the fitted regression line. It is also known as the coefficient of determination. R square always ranges between 0 and 100%. 0% indicates that the model explains none of the variability of the response around its mean where as 100% indicates that the model explain all the variability of the data around its mean. In general, higher the R square better is the model fit.

IX. CONCLUSION

This study developed a suitable trip attraction model using regression analysis in order to forecast future trips attracted to the shopping malls.

This study gives an idea about factors affecting trip attraction towards the shopping mall.

The model will be beneficial in finding out the impact of the future trips that would be attracted to the malls on the traffic so that proper planning of transportation facilities and services can be effectively done by the urban planners.

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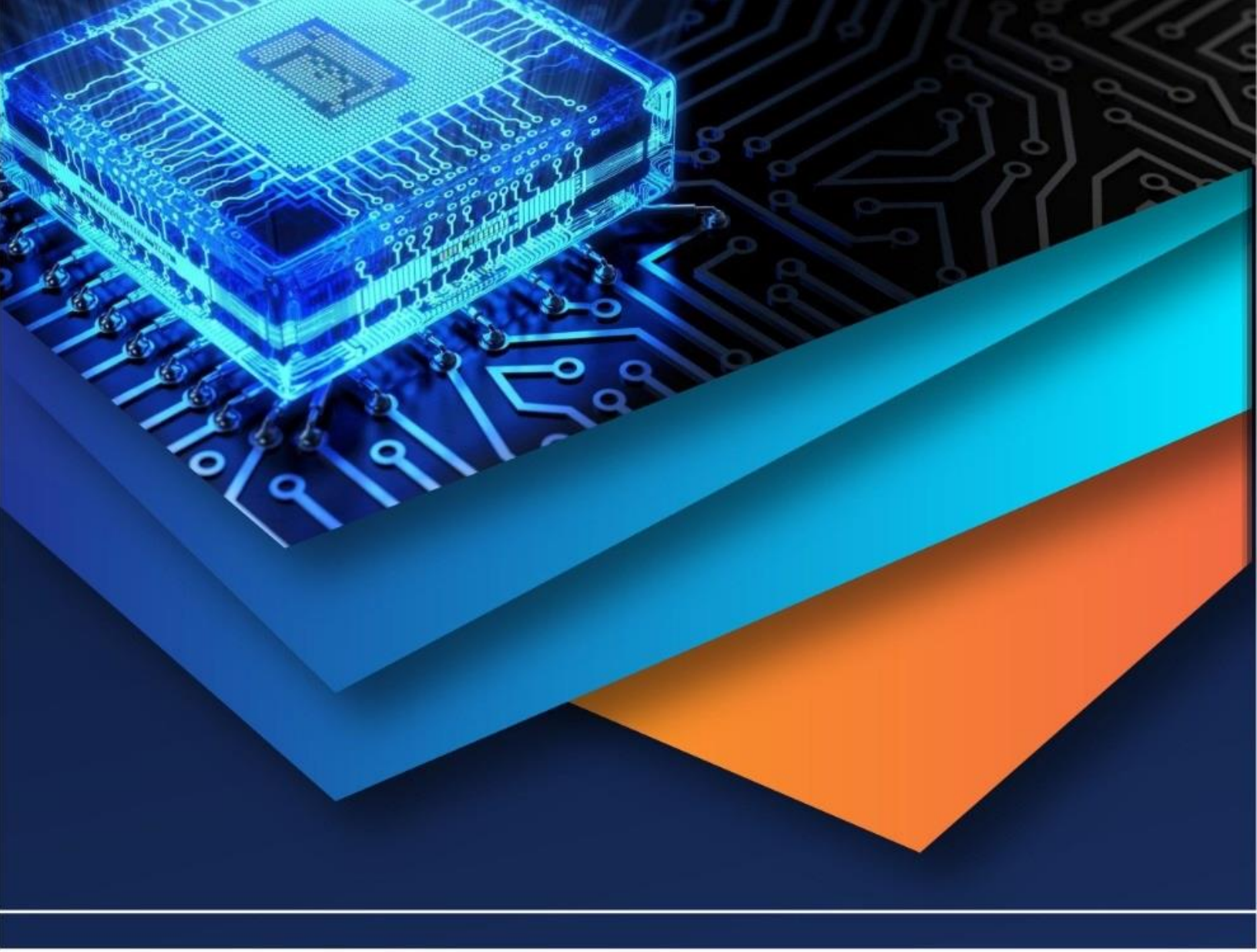

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