

TRIP GENERATION ANALYSIS OF SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in
Civil Engineering

By

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**DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF BUILDING AND ENVIRONMENT**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade “A++” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

APRIL 2024



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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of **KAUSHIK RAJ M (REGISTER NO: 40200004), RIFAYUDEEN T (REGISTER NO: 40200018)**, who carried out the project entitled **"TRIP GENERATION ANALYSIS OF SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY"** under our supervision from November 2023 to April 2024.

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We RIFAYUDEEN T (REGISTER NO: 40200018), KAUSHIK RAJ M (REGISTER NO: 40200004) here by declare that the Project Report entitled "TRIP GENERATION ANALYSIS OF SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY" done by us under the guidance of Dr. R NIRMALA is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Civil Engineering.

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We wish to express our thanks to all Teaching and Non-teaching staff members of the Department of Civil Engineering who were helped in many ways for the completion of the project.

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We wish to express our thanks to all Teaching and Non-teaching staff members of the Department of Civil Engineering who were helpful in many ways for the completion of the project

ABSTRACT

Trip generation analysis is a crucial component of transportation planning and urban development. This process involves studying the number of trips generated by a specific land use or development, such as residential complexes, commercial establishments, or industrial areas.

It typically summarizes the key aspects of the study, including the methodology, data sources, and findings.

In a typical trip generation analysis, researchers collect data on various factors, such as the type of land use, demographics, transportation infrastructure, and economic activities. They then employ statistical methods to analyze this data and predict the number of trips that will be generated in a given area over a specific period. This analysis is essential for urban planners and policymakers as it helps them understand travel patterns, anticipate traffic volumes, and make informed decisions regarding transportation infrastructure and land use policies.

It provides a concise overview of the research objectives, methods employed, data sources utilized, and the main findings and conclusions. It serves as a summary for stakeholders, allowing them to grasp the study's significance and applicability without delving into the detailed technicalities of the research.

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CHAPTER 1

INTRODUCTION

1.1 GENERAL

Transportation system management involves the coordinated operation and optimization of various transportation modes and infrastructure to ensure efficient, safe, and sustainable mobility. It encompasses traffic control, congestion mitigation, and the integration of public transportation systems. Trip generation analysis, on the other hand, is a fundamental step in urban planning, helping assess the travel demands within a given area by studying factors such as land use, demographics, and economic activity. By understanding how trips are generated, urban planners can make informed decisions about infrastructure development, traffic management, and public transportation expansion. Together, these two disciplines play a vital role in shaping modern cities and regions for the benefit of their inhabitants and the environment.

The process of trip generation analysis involves collecting data on a wide range of factors, including the type of land use, population demographics, economic activities, and transportation infrastructure. Researchers use this data to develop mathematical models and statistical relationships that estimate the number of trips generated by each land use type.

These estimates are not only valuable for current planning efforts but are also essential for predicting future travel patterns and accommodating population growth and urban expansion. Trip generation analysis is an iterative process that evolves alongside changes in land use, demographics, and transportation systems.

1.2 TRIP GENERATION ANALYSIS

Trip generation analysis is a foundational tool for understanding the relationship between land use and transportation demand. It provides critical insights that guide transportation and land use planning, environmental sustainability efforts, and economic development decisions, ultimately contributing to more efficient, livable, and sustainable communities. This analysis is an integral part of the broader field of transportation planning, helping shape the future of our cities and regions.

Effective transportation planning relies on accurate predictions of travel demand. By quantifying the number of trips generated by various land uses, planners can anticipate future traffic volumes, assess the need for transportation infrastructure improvements.

In Trip Generation Analysis of Sathyabama institute of science and technology, various types of transportation modes are considered to understand how students, faculty, staff, and visitors travel to and from the campus

1.3 TYPES OF TRANSPORTATION

The types of transportation commonly considered in trip generation analysis include:

1. Personal Vehicles
2. University Vehicles
3. Walking
4. Bicycling
5. Shuttle Services
6. Special Events and Visitors
7. Online Learning
8. Delivery and Freight
9. Accessibility for Individuals with Disabilities

Personal Vehicles:

This includes private automobiles used by students, faculty, and staff to commute to the university. The analysis considers factors like the number of parking spaces required, traffic volumes, and parking demand.

University Vehicles:

University has buses that allow students and staff use on daily basis to come to university from home on.

Walking:

Walking is a significant mode of transportation on university campuses, especially for students who live on or near the campus. The analysis assesses pedestrian activity, sidewalk usage, crosswalks, and pathways.

Bicycling:

University campus promote cycling as an eco-friendly mode of transportation. The analysis may examine bike racks, bike-sharing programs, and the use of bicycles for commuting and getting around campus.

Shuttle Services:

University operates shuttle services to transport students and staff between different parts of the campus. The analysis assesses the usage and demand for these shuttles.

Special Events and Visitors:

University often hosts special events, conferences, and visitors. The analysis considers the additional transportation demand generated by such events and the need for temporary parking and transportation services.

Online learning:

The growth of online courses and telecommuting for university staff may reduce the need for physical trips to campus. The analysis may examine the effect of telecommuting and online learning on trip generation patterns.

Delivery and freight:

The analysis may include the movement of goods and services on campus, such as deliveries, maintenance vehicles, and water and food supply.

Accessibility for individuals with disabilities:

Specialized transportation services for individuals with disabilities, such as accessible shuttles or para transit, may be assessed to ensure campus accessibility.

1.4 TYPES OF LAND USE PLANNING

Academic buildings: These include classrooms, lecture halls, laboratories, and academic offices. Analysis of academic buildings considers the number of students, faculty, and staff accessing these facilities, which affects trip generation patterns during class hours.

Residential facilities: University housing, such as dormitories, apartments, and residential colleges, contributes to trip generation both in terms of students traveling to and from their residences and visitors coming to campus

Administrative offices: Administrative buildings house university staff and management. The number of employees, their work hours, and their commuting habits are relevant factors in trip generation analysis.

Sports facilities: Gymnasiums, sports fields, and recreational facilities may attract visitors, students, and staff. Events and games can lead to peak trip generation during specific times.

Dining halls and food services: Dining facilities, cafes, and food courts generate trips, especially during mealtimes. Analysis accounts for students, faculty, staff, and visitors dining on campus.

Green spaces and parks: Campus parks and recreational areas may lead to trip generation for leisure activities.

Parking facilities: Parking lots and garages influence trip generation due to vehicles entering and exiting the campus. The analysis assesses parking demand, utilization rates, and potential congestion points.

1.5 TYPES OF ENVIRONMENTAL IMPACT

Air Quality Impact: The transportation associated with the university, including student and staff commuting and visitor trips, can contribute to air pollution. Emissions from vehicles, such as carbon monoxide, nitrogen oxides, and volatile organic compounds, can degrade air quality in the surrounding area.

Greenhouse Gas Emissions: Assessing the carbon footprint of transportation to and from the university is crucial. The analysis should estimate the emissions of greenhouse gases, especially carbon dioxide, which is a major contributor to climate change.

Traffic Congestion Impact: Increased vehicular trips to and from the university can lead to traffic congestion on nearby roadways. Traffic congestion not only causes delays but also results in additional fuel consumption and emissions, contributing to environmental problems.

Noise Pollution Impact: The higher volume of traffic associated with the university can lead to increased noise levels in the surrounding area. Noise pollution can disrupt the quality of life for nearby residents and have adverse effects on local wildlife.

Water Quality Impact: Storm water runoff from parking lots, roadways, and other impervious surfaces can carry pollutants, such as oil, heavy metals, and sediment, into nearby water bodies. Analyzing the impact on water quality and implementing storm water management practices is essential for mitigating these effects.

Habitat and Biodiversity Impact: Expansion of the university campus may lead to habitat disruption and loss. This can impact local biodiversity, including plant and animal species. Assessing the potential effects on local ecosystems and implementing measures to protect and enhance biodiversity is crucial.

1.6 TYPES OF ECONOMIC CONSIDERATIONS

Parking Costs: Assessing the cost of providing and maintaining parking facilities on campus is crucial. This includes construction expenses, maintenance costs, and the opportunity cost of using valuable land for parking instead of revenue-generating purposes.

Transportation Infrastructure Costs: Evaluating the cost of developing and maintaining transportation infrastructure, such as roads, sidewalks, and bike lanes, is essential. Efficient transportation systems can reduce congestion, wear and tear on roadways, and associated maintenance costs.

Operating Costs: Analyzing the operating costs of transportation services provided by the university, such as shuttle buses or transit services, helps determine their financial sustainability. This includes fuel, maintenance, labor, and administrative expenses.

Revenue Generation: Universities may generate revenue from transportation-related sources, such as parking fees, transit fares, or leasing transportation-related facilities (e.g., bus stops or advertising space on vehicles). These revenue streams contribute to the institution's financial well-being.

Cost of Congestion: Traffic congestion can result in economic costs due to increased travel time, fuel consumption, and potential productivity losses for students and staff. Quantifying these costs can help justify investments in transportation infrastructure improvements.

Economic Impact on Local Businesses: Understanding how the university's transportation patterns affect local businesses, including retail and dining

establishments, is important. Increased patronage from students and visitors can have economic benefits for the local community, which, in turn, can impact the university's reputation and community relations.

CHAPTER 2

LITERATURE SURVEY

2.1 GENERAL

The following major research project has been taken from international journals as reference to analyze the concepts for the project.

2.2 REVIEW OF THE LITERATURES

Bhowmik and Islam (2016) states that it is necessary to select relevant predictors with a priority index in order to rank the predictors. Multiple Classification Analysis (MCA) is used in this study to identify relevant factors. The major goal of the study is to identify the socio-demographic factors that influence infant, toddler, and young child mortality by fitting a linear regression model and ranking those factors using multiple classification analysis. This study demonstrates that MCA analysis can be used in place of linear regression analysis to find determinants with rank that aid policymakers in prioritizing their projects.

Samuel P. and Padmini A. K (2013) used Multiple linear regression analysis to create a trip production model. The study area was chosen to be three medium-sized towns in Kerala: Ponnani, Perinthalmanna, and Tirur. For the purpose of gathering data, a home interview survey was conducted. The study region is divided into zones for the survey. The residential region was divided into 50 wards. The socioeconomic factors used for this study include household size, age, vehicle ownership, and income. A matrix of origin and destination is also created. Multiple regression analysis was used to construct the model with 60% of the entire data and was used to validate the model with 40% of the whole data. The number of trips made from the research region is a dependent variable, and income, vehicle ownership, age, household size, and dwelling type are independent variables. Students, those in the workforce, married people, and gender. Using independent and dependent variables, multiple regression models are created. (R^2) 0.8784 is the co-efficient of determination value. Which means that vehicle ownership, the percentage of houses with porches, the percentage of students, and the percentage of people who are employed all have an impact on 87.84% of trips that

are generated. This model's standard error is 5.8842. This indicates that the predicted error in trip output is 5.8842 trips off.

Moussa (2013) In order to ascertain the household travel characteristics pattern for Gaza City, creates a trip production model utilizing Multiple Classification Analysis and Cross-Classification Analysis. The study's objective is to contrast the trip rates in Gaza City produced by Cross Classification Analysis and Multiple Cross Classification. According to a study, household size, vehicle ownership, income level, and the total number of licensed drivers are the key variables that strongly influence trip output in Gaza City. Additionally, it demonstrates that MCA models outperform CCA models in expressing trip rates for trip production. The performance of both MCA and CCA matrices in forecasting trip rates will improve as sample size increases.

Ashnagar (2010) utilized multivariate regression and Cross classification analysis to construct a trip generation model for the Malaysian town of Skudai in the state of Johor. Data were gathered using Origin & Destination (O&D) interview surveys. We contrasted and compared cross classification analysis and multivariate regression models. Regression modeling seems to be considerably better and simpler than cross classification analysis, despite the fact that earlier studies have predicted that cross classification and regression models will produce equal results. The study suggests more research into the household regression strategy since it offers advantages over other model-building techniques and makes better use of sample data.

Oyedepo and Makinde (2009) states that people with higher incomes and greater access to automobiles travel more than those with lower incomes and less access to automobiles. In addition, the majority of persons in Ado, Ekiti, traveled for home-based other purposes (52%), with non-home-based and home-based work accounting for 31% and 17% of the total. For the regression analysis of the population's socioeconomic level, the outcome of using trips as the dependent variable in comparison to other factors such as age, family size, income, and automobile ownership, among others, yields an average value of R and R² of 63.5% and 40.45%, respectively.

Henrik Lolle's (2008) research states that social scientists frequently examine the impact of categorical factors on a dependent, interval scaled variable. Here, he demonstrated how "Multiple Classification Analysis (MCA)" utilizing ANOVA in SPSS is a simple and viable option for such a case. He employed linear regression using a dummy variable and the multiple classification analysis method in one example. The examples provided as evidence illustrate that MCA has a number of very practical qualities. The standardized effect measures for these variables are easier to understand on an intuitive level. Compared to comparable methodologies, the category effects from categorical variables are significantly more intuitively logical.

Guevara et al (2007) employ an unusual assumption to define the "Multiple Classification Analysis" technique that is most frequently used in transportation engineering. They employed the MCA_SM1 and MCA_SM2 models, described by Stopher and McDonald in 1983, as well as the MCA methods of linear ordinary least square and simple average by category. Real data from Santiago was used in a Monte Carlo simulation to compare several MCA techniques. Analysis demonstrates that the MCA technique, which is the most widely used to estimate other home-based trips, should be disregarded since it is based on an assumption that has a very low likelihood of being true in reality. The MCA with linear ordinary least square and MCA with simple average by category approaches clearly outperform the earlier ones in terms of precision and theoretical underpinning. The investigation's case will determine the method choice, a choice that can be statistically tested. The MCA method, which is more accurate to the underlying model's structure, involves the straightforward calculation of trip rates as averages for each category.

Al-Taei and Amal (2006) developed a trip generation model utilizing cross-classification analysis. Dohuk City is used as the study area, and it is broken up into 27 zones for traffic studies. Data collecting involves conducting a home interview survey. 2437 Sample size for his Socio-economic characteristics considered in survey are

- Total number of persons living in the household
- Family income level

- Number of students in the household
- Number of persons older than six years living in household
- Number of employments in the household
- Car-ownership
- Number of workers in the household
- Occupation of head of household

Cross-classification predictions for family size are highly correlated with total person trips, and vehicle trips. For estimating total private trips, the income level yields better estimation than family size. Largest sample sizes and small number of categories in cross classification matrix will reduce the number of invalid cells. This study describes that data can be used directly in the prediction analysis of trip rates. Family size and workers number are the most effective independent variables.

Takyi (1990) studied household trip rate analysis in Kumasi, Ghana, and presented it as a developing country context. He did this by using the cross-classification technique. For the analysis, four independent variables—household income, household size, the number of cars each household owns, and the number of employed people living there—were used. The variables that seem to have the strongest connections to trip making by purpose and mode of travel were identified using a one-way ANOVA (Analysis of Variance). The outcomes were utilized to choose the most effective data grouping for the cross-classification analysis. The household size variable, which exhibited a nonlinear relationship to the average number of trips per home, has a drastically reduced impact thanks to the cross-classification method utilized in this study.

Stopher and McDonald (1983) employed the the Multiple Classification Analysis (MCA) technique in transportation planning by . The MCA process was detailed in detail, and its benefits—including statistical evaluation, the capacity to compare various models, and lack of sensitivity to tiny samples in individual cells—were carefully covered. Research demonstrates that the cross-classification model's limitations are overcome by MCA. This technique enables the cross-classification model's variable selection to be statistically based. In addition to reducing the inherent variability of rates calculated from household samples of

various sizes, the method also offers a statistically sound method for estimating cell means and is able to produce estimates for some cells for which the base data set may be deficient. Third, all of these steps in the process produce good-ness-of-fit statistics that allow for more precise comparisons, reliable hypothesis testing, and evaluation of the results in terms of the variability of the dependent variable that is accounted for by the model. The method also considers interactions between the alternative independent variables, which are crucial because they have never been considered in conventional cross-classification models. An example case study is used to demonstrate the process of choosing independent variables and choosing groupings of the choice variables by ANOVA.

2.3 INFERENCE FROM THE LITERATURES

The Literature shows the project has done in various methods and Techniques by different authors and experts including,

- Cross-classification analysis
- Multiple Classification Analysis
- Multiple linear regression analysis
- Multiple Classification Analysis

2.4 NEED OF THE STUDY

- To conduct a comprehensive analysis of trip generation patterns within a designated area, aiming to understand the factors and trends influencing travel behavior.
- Provide evidence-based recommendations for optimizing land use planning, transportation infrastructure investments, and policy interventions to promote sustainable and efficient travel patterns.

2.5 OBJECTIVE OF THE STUDY

- To collect trip generation data at Sathyabama Institute of Science and Technology
- To Analyse the collected trip generation data by considering the independent variables of study area
- To determine the pollution emission of each type of vehicle using JAVA.

2.6 SCOPE OF THE PROJECT

The scope of trip generation analysis in a university project is extensive and encompasses a wide array of factors related to transportation and mobility within and around the university campus. It involves a comprehensive examination of travel patterns and behaviors, considering various user groups such as students, faculty, staff, and visitors. This analysis delves into understanding not only the number of trips but also the modes of transportation chosen, the temporal variations in travel demand, and the influence of different land use types and campus facilities on trip generation.

Additionally, trip generation analysis in a university project may have a broader impact, considering the environmental consequences, economic considerations, and potential policy implications. It aims to provide data-driven insights and recommendations that can inform transportation planning, infrastructure development, and sustainability initiatives on campus, ultimately contributing to a more efficient, environmentally friendly, and user-centric transportation system within the university community and its neighboring areas.

CHAPTER 3

METHODOLOGY AND DATA COLLECTION

3.1 METHODOLOGY

The methodology of the project is shown in figure 3.1 below.

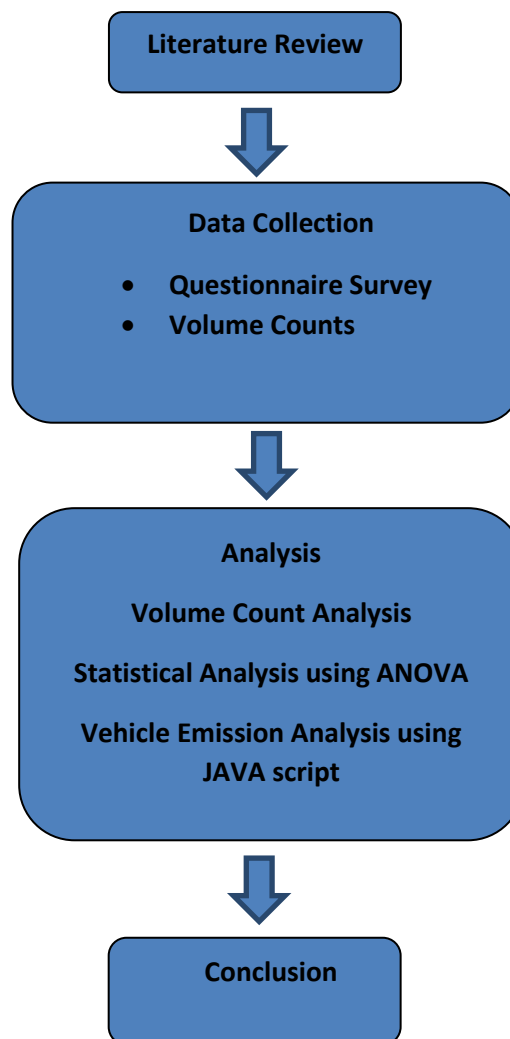


Fig. 3.1 Methodology

3.2 STUDY AREA



Fig. 3.2: Study Area

This Project is done in the study area of “Sathyabama Institute of Science and Technology” located in semmanchery which was founded in 1987 shown in Figure 3.2. The Campus is covered in 140 Acres. Sathyabama institute of science and technology has a population of approximately 19,000 in total inclusive of 986 teaching faculties and Non-teaching staffs and 17856 students.

3.3 DATA COLLECTION

The data for trip generation analysis would involve collecting information directly from the university campus or its users.

3.3.1 Questionnaire Survey

The questionnaire was prepared covering the information related to trip generation of Sathyabama Institute of Science and Technology. such as student / teaching faculty / non – teaching faculty, origin of trip, mode of travel, travel time, preferred mode of transport. The survey or interviews with 120 students and faculty are conducted to understand their travel patterns to and from the university and mode of transportation used (e.g., car, bus, bikes, walking).

The format of questionnaire is as follows:

1. Category: Student / Teaching Faculty / Non-Teaching Faculty
2. Origin of Trip:
3. Mode of Travel: University Bus / Own Car / Bike / Outside Bus / Taxi or Auto
4. Starting time of Trip:
5. Ending time of Trip:

3.3.2 Vehicle Volume Counts

The vehicle volume counts at Sathyabama Institute of Science and Technology were carried out on 2 working days like Tuesday and Wednesday during Peak hour in the morning and evening which is shown in Table 3.1 and 3.2 in Vehicles per hour.

Table 3.1: Vehicle volume Data (day 1)

TRAFFIC DATA SHEET DATE AND DAY OF THE WEEK : TIMING : 8.00 AM IST TO 4.30 PM IST STUDY AREA: SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY LOCATION : RAJIV GANDHI SALAAI SEMMENCHERY 600119				
TYPE OF VEHICLE Timing	CARS, JEEPS, VANS, 3WHEELERS	PERSONAL BIKES	BUSES	HEAVY VEHICLES
8.00 AM TO 9.00 AM	66	494	168	3
9.00 AM TO 10.00 AM	4	30	14	4
10.00AM TO 11.00 AM	0	5	0	3
11.00AM TO 12.00PM	2	25	0	2
12.00 PM TO 1.00 PM	3	21	0	0
1.00 PM TO 2.00 PM	0	8	1	0
2. 00 PM TO 3.00 PM	2	42	2	1
3.00 PM TO 4.00 PM	24	456	185	1
TOTAL TRIP	101	1,081	370	14

From the Table 3.1, it is observed that the counts of two wheelers is 494 during morning peak hour followed by the counts of University Buses.

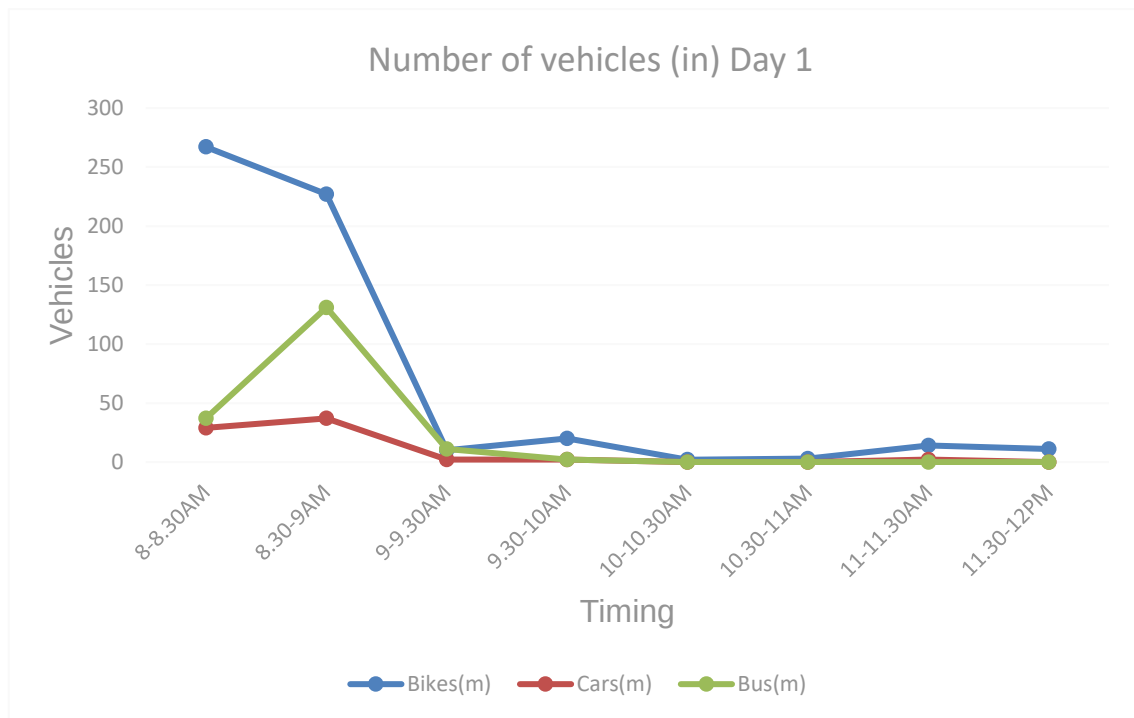


Fig. 3.3: Number of vehicles (in) day 1

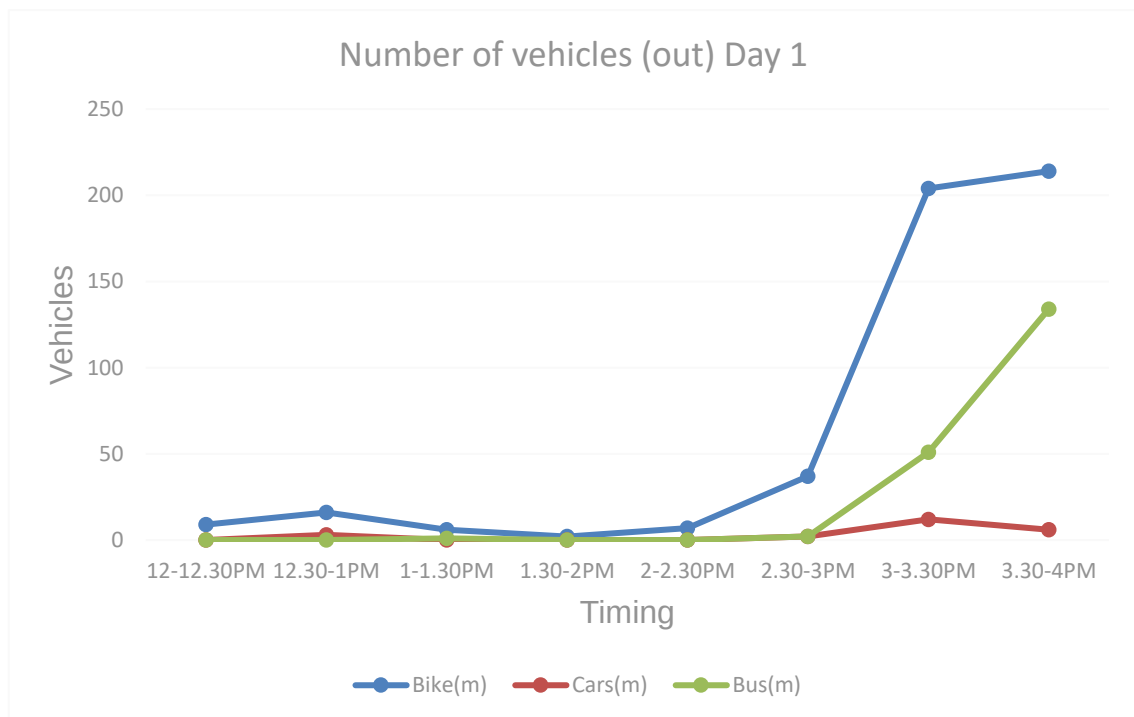


Fig. 3.4: Number of vehicles (out) day 1

DAY 1: On day 1, Approximately, 181 Buses and 26 Other vehicles are recorded that are coming inside the study area in the timings from 8 am to 12 pm, and 522 Bikes which is shown in Figure 3.3.

69 Cars, 184 Buses and 16 other vehicles are recorded that are exiting the study area in the timings from 12 pm to 5 pm respectively given in Figure 3.4

Table 3.2: Vehicle volume Data (day 2)

TRAFFIC DATA SHEET				
DATE AND DAY OF THE WEEK : TIMING : 8.00 AM IST TO 4.30 PM IST STUDY AREA: SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY LOCATION : RAJIV GANDHI SALAAI SEMMENCHERY 600119				
TYPE OF VEHICLE Timing	CARS, JEEPS, VANS, 3WHEELERS	PERSONAL BIKES	BUSES	HEAVY VEHICLES
8.00 AM TO 9.00 AM	62	456	151	2
9.00 AM TO 10.00 AM	2	34	12	2
10.00AM TO 11.00 AM	1	3	0	4
11.00AM TO 12.00PM	2	29	1	1
12.00 PM TO 1.00 PM	4	24	2	1
1.00 PM TO 2.00 PM	0	4	1	0
2. 00 PM TO 3.00 PM	1	38	0	0
3.00 PM TO 4.00 PM	26	431	182	2
TOTAL TRIP	96	1,019	349	12

From the Table 3.2, it is observed that the counts of two wheelers is 456 during morning peak hour on day 2 followed by the counts of University Buses.

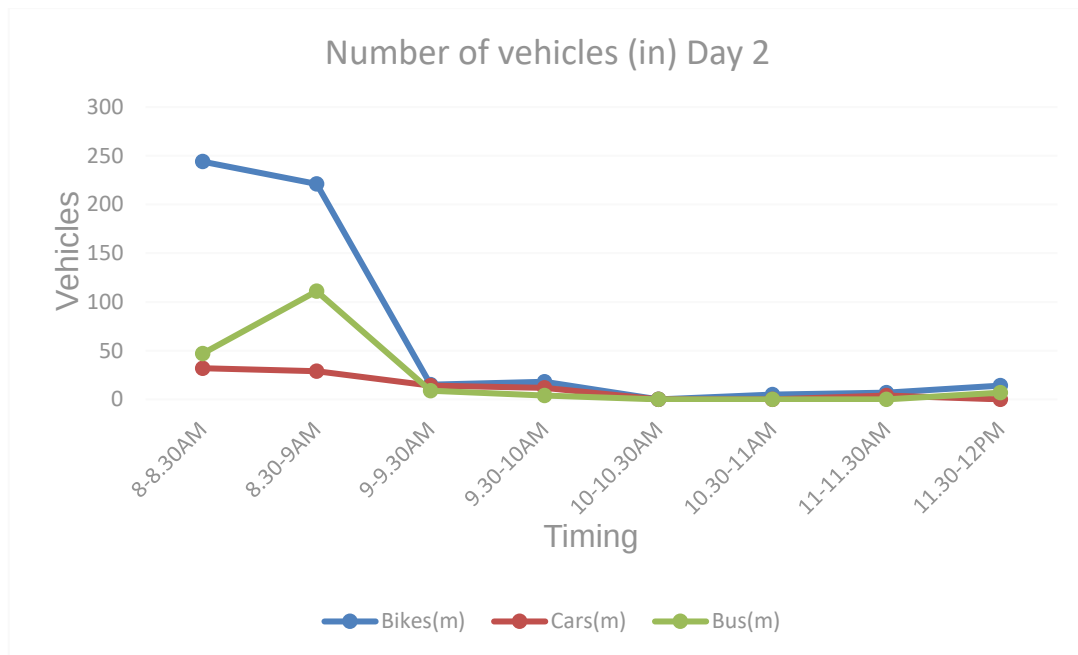


Fig. 3.5: Number of vehicles (in) day 2

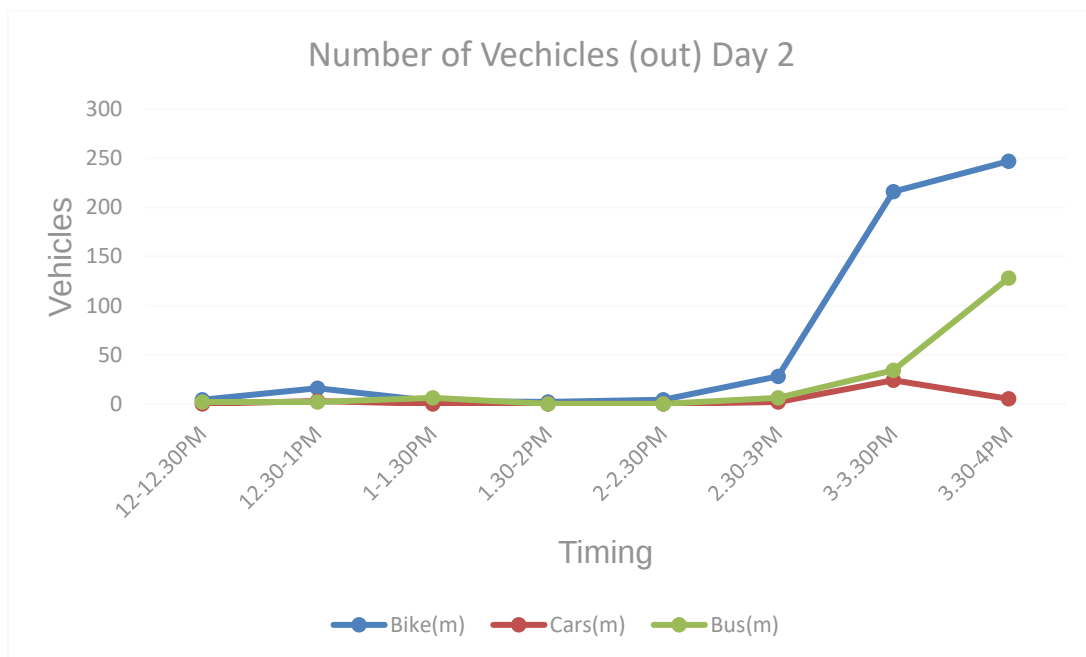


Fig. 3.6: Number of vehicles (out) day 2

DAY 2: On day 2. Approximately there are 524 Bikes, 61 Cars, 178 Buses and 26 Other vehicles are recorded that are coming inside the study area in the timings from 8 am to 12 pm, and 520 Bikes, 52 Cars, 178 Buses and 9 other vehicles are recorded that are exiting the study area in the timings from 12 pm to 5 pm respectively.

CHAPTER 4

DATA ANALYSIS

4.1 PEAK HOUR VOLUME ANALYSIS

The vehicle volume count was taken for the analysis of Trip Generation at Sathyabama Institute of Science and Technology of 2 days Tuesday and Wednesday by counting in three categories such as Cars, Auto, Two wheelers, Heavy Vehicles, Cycles and Buses.

DAY 1 :

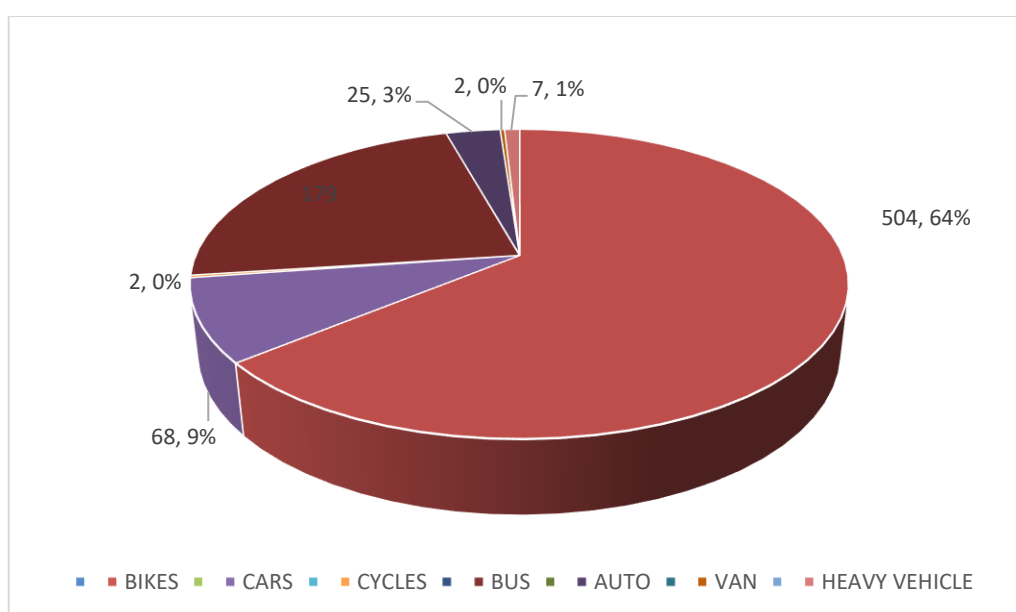


Fig. 4.1: Number of Vehicles Entries from 8 AM To 9.30 AM (Day 1)

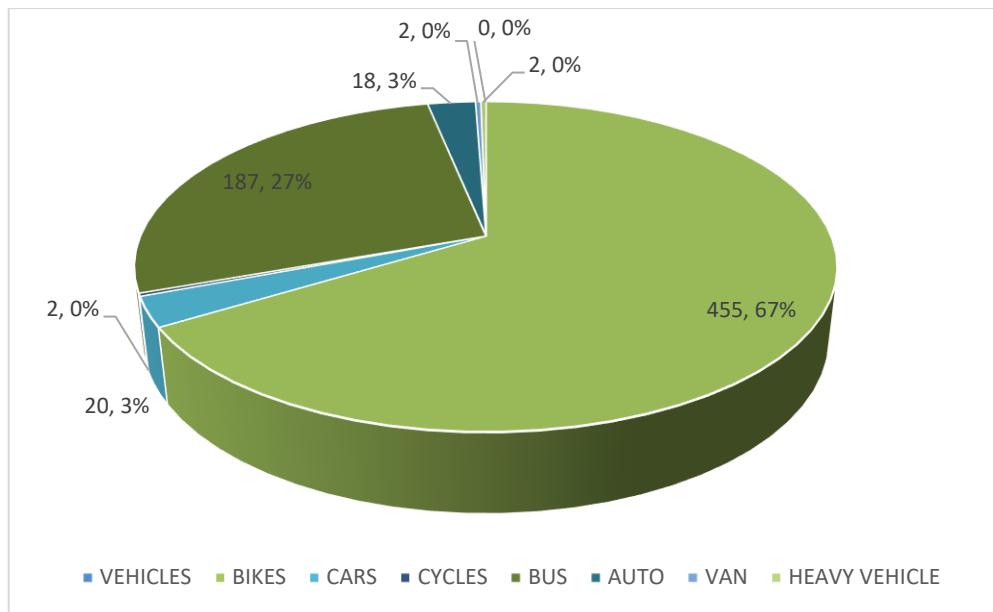


Fig. 4.2: Number of Vehicles Entries from 3 PM TO 4.30 PM (Day 1)

Figure 4.1 and 4.2 shows the vehicle volume counts entering and leaving the University during peak hour period from 8 AM to 9.30 AM and 3 PM to 4.30 PM respectively. On an average, 65 percent of Two wheelers contributes towards the trip generation at Rajiv Gandhi Salai on day 1, Tuesday.

DAY 2 :

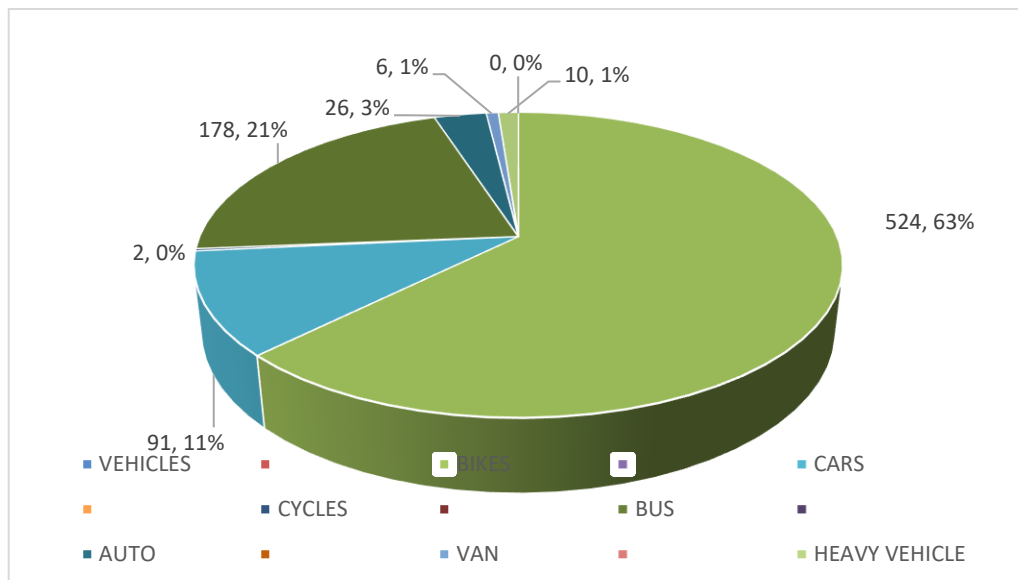


Fig. 4.3: Number of Vehicles Entries from 8 AM To 9.30 AM (Day 2)

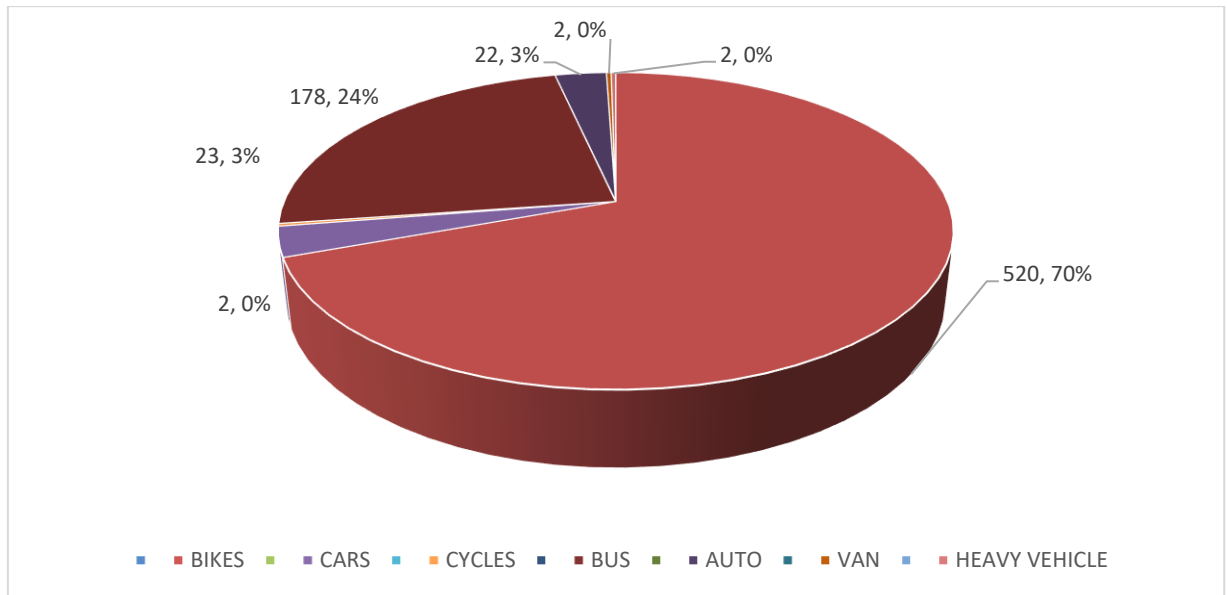


Fig. 4.4: Number of Vehicles Entries from 3 PM TO 4.30 PM (Day 2)

Figure 4.3 and 4.4 shows the vehicle volume counts entering and leaving the University during peak hour period from 8 AM to 9.30 AM and 3 PM to 4.30 PM respectively. On an average, 66 percent of Two wheelers contributes towards the trip generation at Rajiv Gandhi Salai on day 2, Wednesday.

4.2 VEHICLE-WISE VOLUME ANALYSIS

From the observations of Peak hour vehicle volume count, the vehicle categories Car, Two wheelers and Buses are found to be higher than other categories of vehicles. Hence the analysis for the mentioned categories are done to understand the time line variation among all the vehicles.

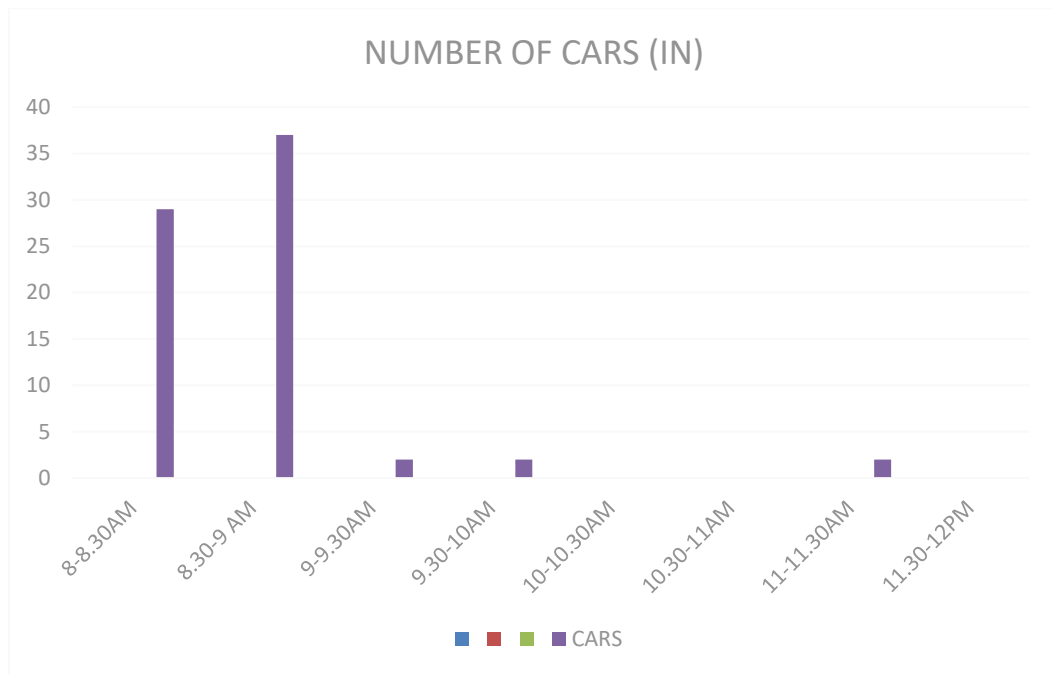


Fig. 4.5: Count of Car entering to University Parking

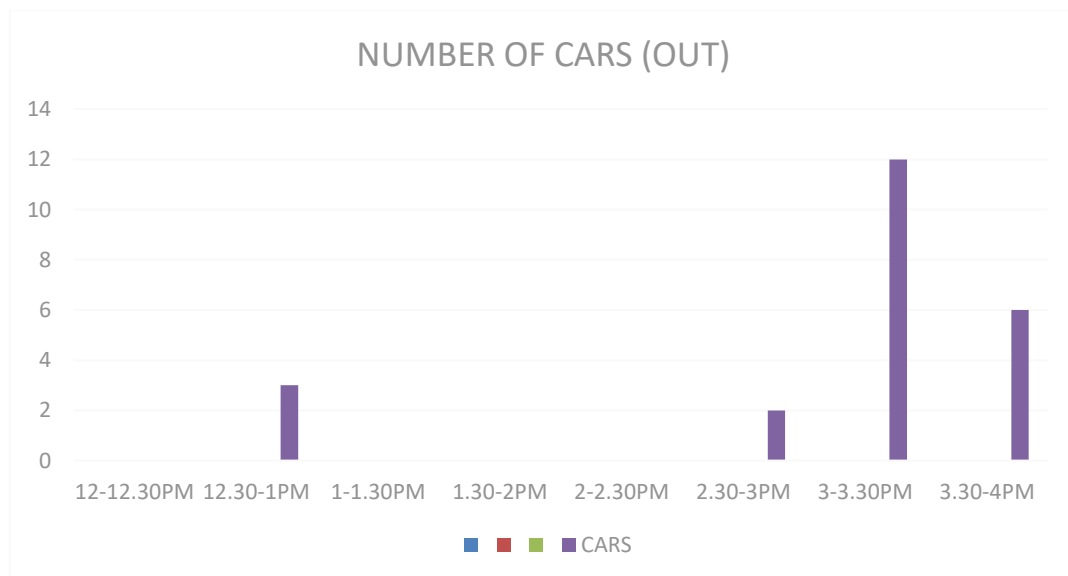


Fig. 4.6: Count of Car leaving from University Parking

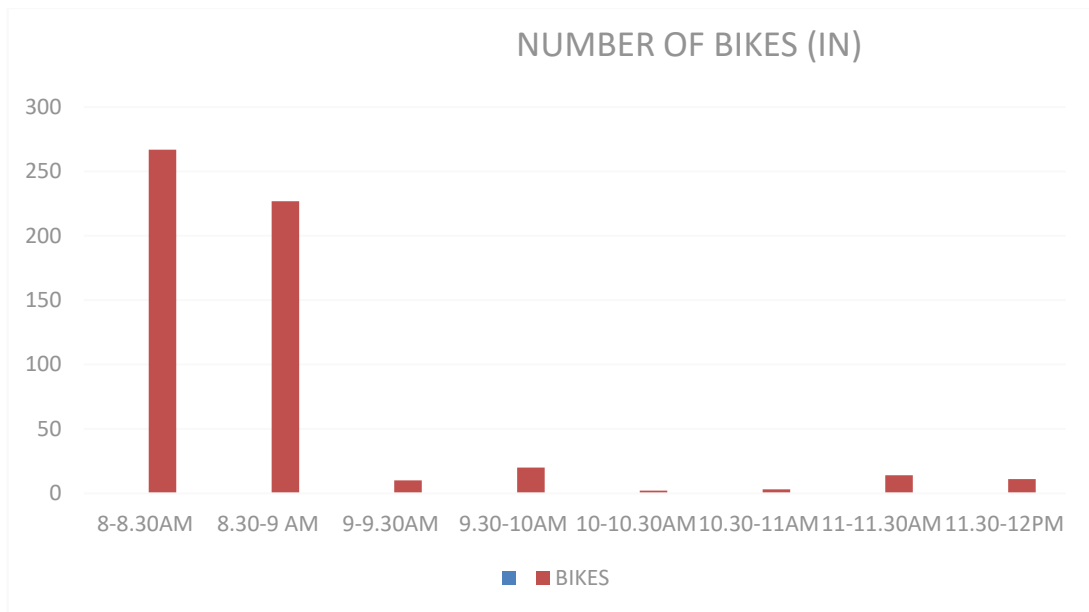


Fig. 4.7: Count of Bikes entering to University Parking

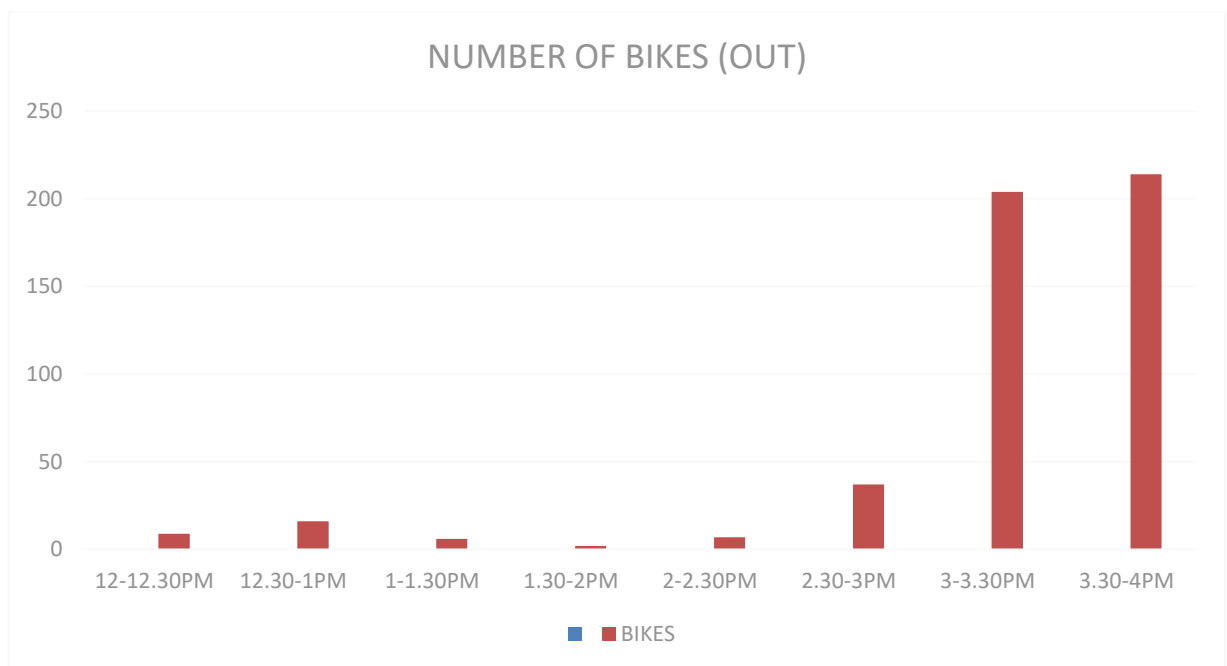


Fig. 4.8: Count of Bikes leaving from University Parking

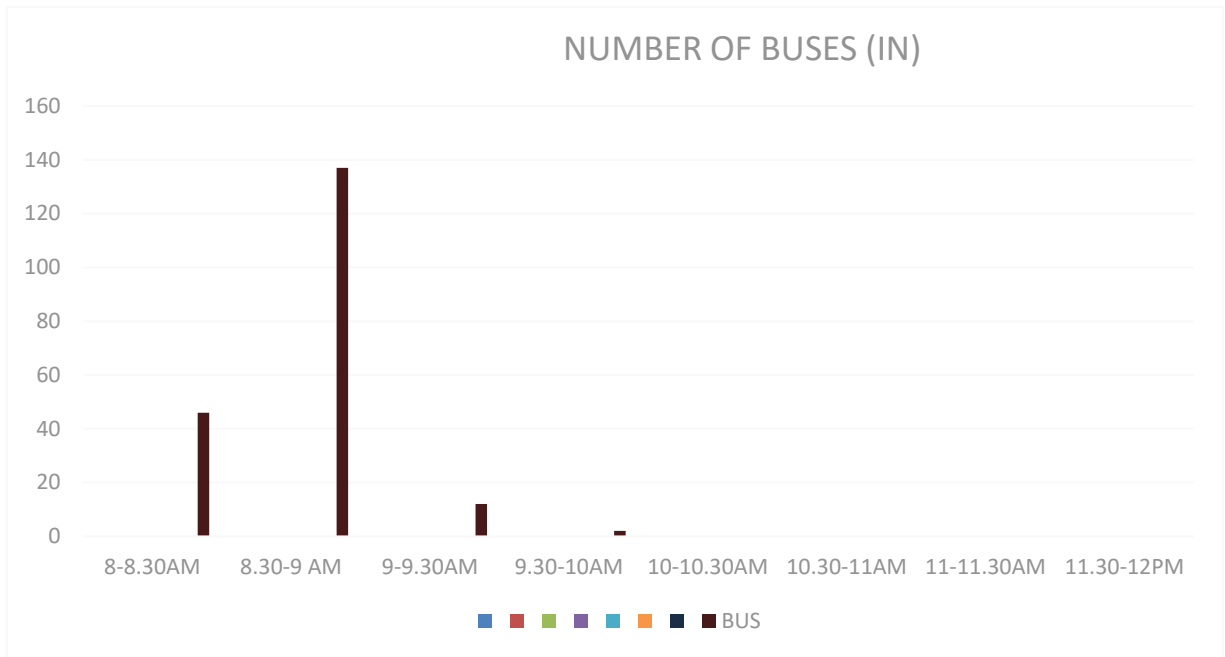


Fig. 4.9: Count of Buses entering to University Parking

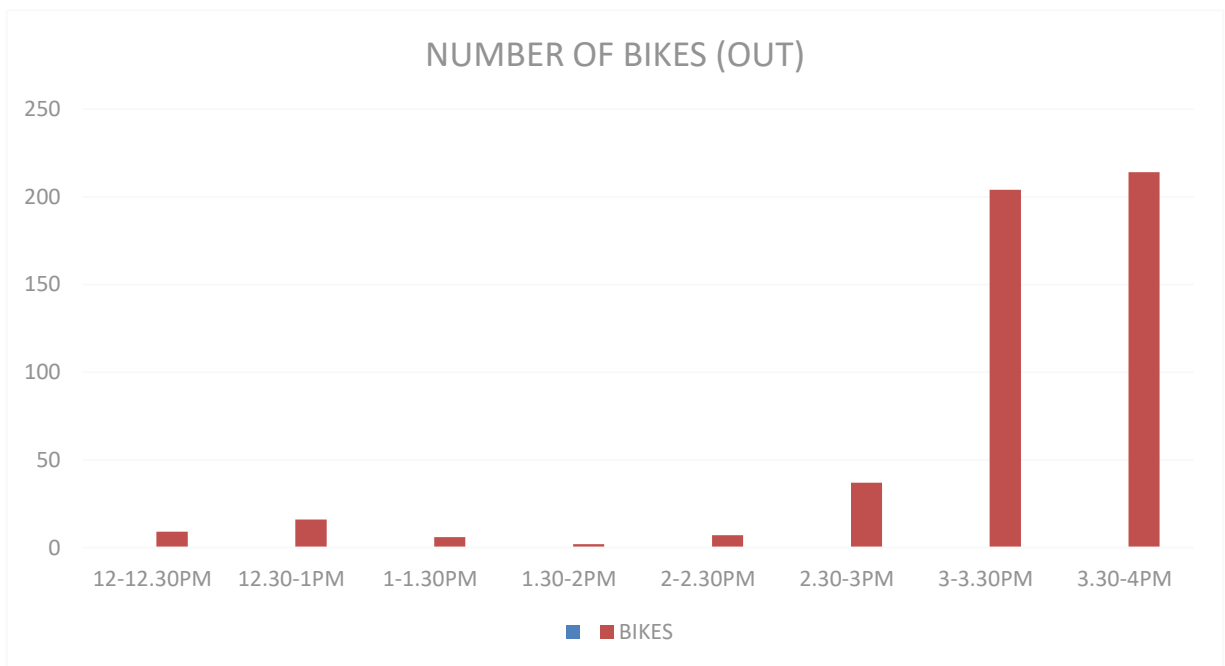


Fig. 4.10: Count of Buses leaving from University Parking

Figure 4.5 to 4.10 presents the count of Cars, Two wheelers and Buses generated and distributed in Rajiv Gandhi Salai during peak hours.

4.3 STATISTICAL ANALYSIS USING ANOVA

ANOVA, or analysis of variance, was developed by sir Ronald a. fisher, a british statistician, in the 1920s. fisher introduced ANOVA as a method to compare means between multiple groups simultaneously, providing a robust statistical framework for analyzing variance and identifying differences among group means is a statistical method crucial for analyzing trip generation patterns. in transportation planning, ANOVA aids in discerning variations in trip generation rates among different zones, land use types, or demographic groups. by comparing mean trip rates across these categories, ANOVA helps identify significant differences, shedding light on factors influencing travel behavior. this method enables planners to understand whether land use mix, socio-economic factors, or infrastructure play pivotal roles in shaping trip generation. moreover, anova can uncover interaction effects, revealing how various factors might combine to influence travel patterns.

Table 4.1: Interpretation of Volume Count using ANOVA Hypothesis

Day 1	Day 2	Day 3	Day 4	Day 5 .
554	494	447	411	444
72	23	27	54	39
2	2	3	2	21
181	188	187	185	85
26	24	22	26	26
2	2	2	6	6
12	2	2	10	10

Table 4.1 depicts the interpretation of volume data using ANOVA hyperthesis for the next 3 days from the collected data of traffic volume of 2 days.

Table 4.2 : Summary of Volume Count for testing hypothesis

Summary of Data						
	<i>Treatments</i>					
	1	2	3	4	5	Total
N	7	7	7	7	7	35
$\sum X$	849	735	690	694	631	3599
Mean	121.2857	105	98.5714	99.1429	90.1429	102.829
$\sum X^2$	345689	280497	236008	206878	207135	1276207
Std.Dev.	201.1291	184.0842	167.3289	151.6975	158.2481	163.2507

Table 4.3 : Testing the 0.05% significance level of Hypothesis

Result Details				
<i>Source</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	
Between-treatments	3766.1143	4	941.5286	<i>F</i> = 0.0313
Within-treatments	902360.8571	30	30078.6952	
Total	906126.9714	34		

The *F*-ratio value is 0.0313. The *p*-value is .998006. The result is *not* significant at *p* < .05.

Table 4.4 : Turkey's HSD

Pairwise Comparisons		HSD _{.05} = 268.8975 HSD _{.01} = 330.8761	Q _{.05} = 4.1021 Q _{.01} = 5.0476
T ₁ :T ₂	M ₁ = 121.29 M ₂ = 105.00	16.29	Q = 0.25 (p = .99977)
T ₁ :T ₃	M ₁ = 121.29 M ₃ = 98.57	22.71	Q = 0.35 (p = .99916)
T ₁ :T ₄	M ₁ = 121.29 M ₄ = 99.14	22.14	Q = 0.34 (p = .99924)
T ₁ :T ₅	M ₁ = 121.29 M ₅ = 90.14	31.14	Q = 0.48 (p = .99710)
T ₂ :T ₃	M ₂ = 105.00 M ₃ = 98.57	6.43	Q = 0.10 (p = .99999)
T ₂ :T ₄	M ₂ = 105.00 M ₄ = 99.14	5.86	Q = 0.09 (p = .00000)
T ₂ :T ₅	M ₂ = 105.00 M ₅ = 90.14	14.86	Q = 0.23 (p = .99984)
T ₃ :T ₄	M ₃ = 98.57 M ₄ = 99.14	0.57	Q = 0.01 (p = .00000)
T ₃ :T ₅	M ₃ = 98.57 M ₅ = 90.14	8.43	Q = 0.13 (p = .99998)
T ₄ :T ₅	M ₄ = 99.14 M ₅ = 90.14	9.00	Q = 0.14 (p = .99998)

The significance level of testing hypothesis for 0.05 % for the predicted value of volume count with respect to primary data are done using ANOVA are shown in Table 4.2, 4.3 and 4.4.

The p-value represents the probability of obtaining the observed results (or more extreme) if the null hypothesis is true. A p-value greater than 0.05 suggests that the observed differences between groups could reasonably occur due to random variability alone, rather than a true difference in the population means.

With a p-value greater than 0.05, there is insufficient evidence to reject the null hypothesis, which typically states that there is no significant difference between the groups being compared. Therefore, it is concluded that there is no significant effect of the independent variable(s) on the dependent variable.

4.4 VEHICLE EMISSION ANALYSIS USING JAVASCRIPT

Building a vehicle entry checking web application using the MERN (MongoDB, Express.js, React.js, Node.js) stack along with integrating analytics for emissions using AWS QuickSight involves several steps. Below is an outline of approach this:

Set Up the MERN Stack:

MongoDB: Setting up a MongoDB database to store information about vehicles, their emissions data, and other relevant details.

Express.js: Creating a RESTful API using Express.js to handle CRUD operations for vehicle entry data.

React.js: Developing a front-end application using React.js for the user interface of the web application.

Node.js: Using Node.js to run the server-side logic and interact with the MongoDB database.

Implementing Vehicle Entry Checking Functionality: Developing a form or interface where users can input vehicle details such as license plate number, vehicle type, etc

Developing a form or interface where users can input vehicle details such as license plate number, vehicle type, etc.

Implementing backend APIs to store and retrieve vehicle entry data in MongoDB.

Designing frontend components to display the entered vehicle data and any relevant information.

Integrating Emissions Analytics Using AWS QuickSight: Set up AWS services:

AWS QuickSight: Creating a QuickSight account and set up datasets for emissions data.

AWS Lambda: Creating Lambda functions to fetch emissions data from your database or other sources and prepare it for QuickSight.

AWS IAM: Configuring IAM roles and permissions for Lambda functions to access data.

Preparing emissions data: Retrieve emissions data from vehicles. This might involve integrating with external APIs or sensors. Transform and prepare the data in a format suitable for analysis.

Connecting QuickSight to your data sources: Create a dataset in QuickSight using the prepared emissions data. Define relationships and formats for your data.

Creating visualizations and dashboards: Design visualizations to represent emissions data, such as charts showing emissions trends over time, comparison between different vehicle types, etc.

Creating dashboards to display these visualizations and insights.

Embedding QuickSight dashboards into your web application: Using QuickSight's embedding feature to embed dashboards into your React.js application. Customize the embedding to fit seamlessly into your application's UI.

Security and Access Control: Implementing authentication and authorization mechanisms to secure access to your web application and emissions analytics. Ensure that users can only access the data and features that they are authorized to.

Testing and Deployment: Testing the web application thoroughly to ensure that all features work as expected. Deploys your application and AWS resources to a production environment. Monitor the performance and usage of your application and analytics dashboard.

Maintenance and Updates: Regularly update and maintain your web application and analytics infrastructure to ensure security, performance, and usability. Incorporates user feedback and feature requests to improve the application over time. By following these steps, you can develop a vehicle entry checking web application using the MERN stack and integrate emissions analytics using AWS QuickSight.

Project Overview: Vehicle Entry Checking Web App with Emissions Analytics

1. **Introduction:** The project aims to develop a comprehensive web application that allows users to check vehicle entry into a campus or specific area while also providing analytics on vehicle emissions.

The web application will be built using the MERN (MongoDB, Express.js, React.js, Node.js) stack for its backend and frontend development.

Analytics on vehicle emissions will be integrated using AWS QuickSight, providing insights into environmental impact and trends.

2. **Features:** **Vehicle Entry Checking:** Users can input vehicle details such as license plate number, vehicle type, and purpose of entry. Upon submission, the system records the entry details in a MongoDB database. Users can view the history of vehicle entries and associated information.

Emissions Analytics: Emissions data from vehicles will be collected and stored in the database. AWS Lambda functions will fetch and prepare emissions data for analysis. QuickSight dashboards will visualize emissions trends, comparisons between vehicle types, and other relevant insights. The web application will embed QuickSight dashboards, allowing users to access emissions analytics seamlessly.

User Authentication and Access Control: Secure user authentication and authorization mechanisms will be implemented to control access to the web application and analytics. Administrators can manage user roles and permissions.

Notifications and Alerts: Implement notifications or alerts for administrators based on predefined criteria such as high emissions levels or unauthorized vehicle entries.

Data Export and Reporting: Users can export data and generate reports for further analysis or compliance purposes.

3. Architecture:

Backend: Node.js and Express.js will handle server-side logic and API development. MongoDB will serve as the database for storing vehicle entry data and emissions information.

Frontend: React.js will be used to create a responsive and interactive user interface. The frontend will communicate with the backend APIs to fetch and display data.

Analytics Integration: AWS services such as QuickSight and Lambda will be integrated to provide emissions analytics. QuickSight will generate visualizations and dashboards based on emissions data stored in the MongoDB database.

4. Deployment and Maintenance: The web application and associated AWS resources will be deployed to a production environment. Regular maintenance and updates will be performed to ensure the security, performance, and usability of the application. Continuous monitoring will be implemented to track application performance and usage metrics.

5. Conclusion: The Vehicle Entry Checking Web App with Emissions Analytics aims to provide a comprehensive solution for managing vehicle entry into a campus or designated area while offering insights into emissions impact.

By leveraging the MERN stack and AWS services, the project aims to deliver a scalable, secure, and user-friendly application that addresses both operational and environmental concerns.

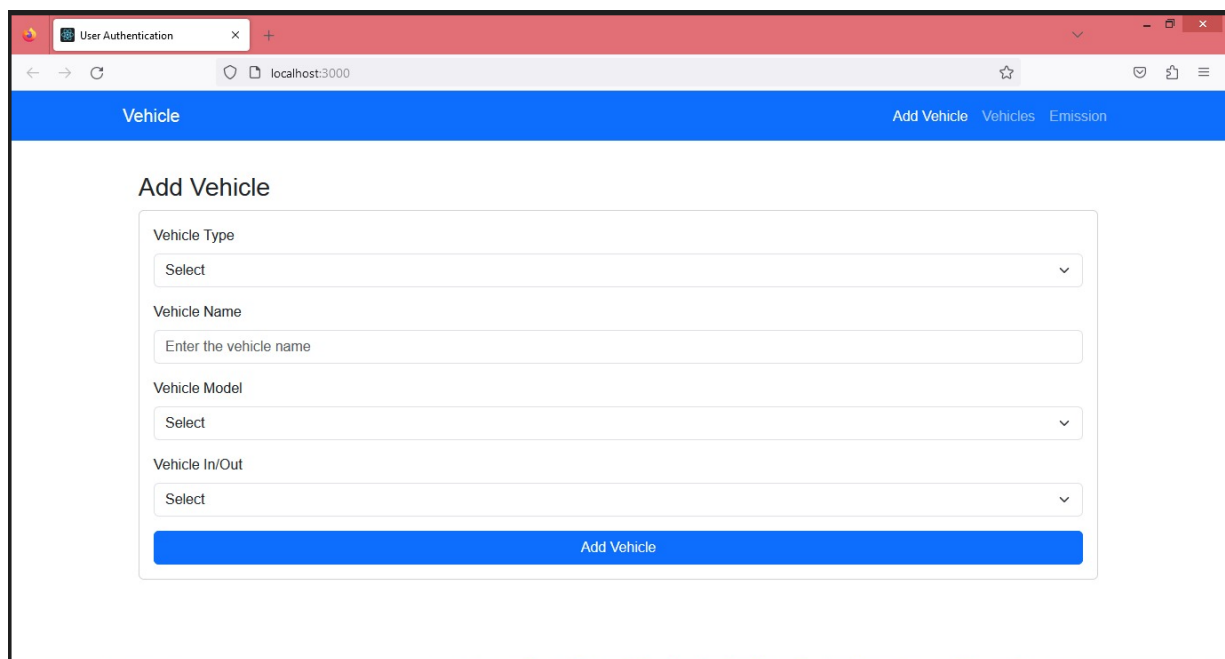
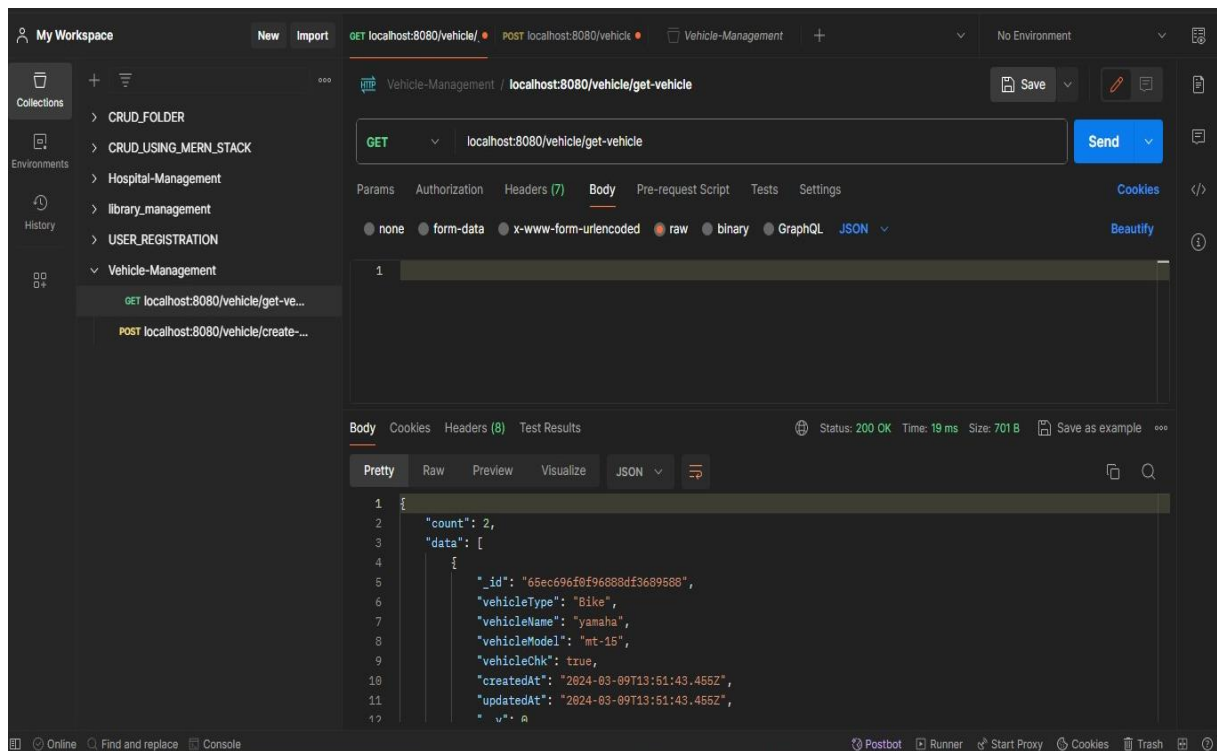
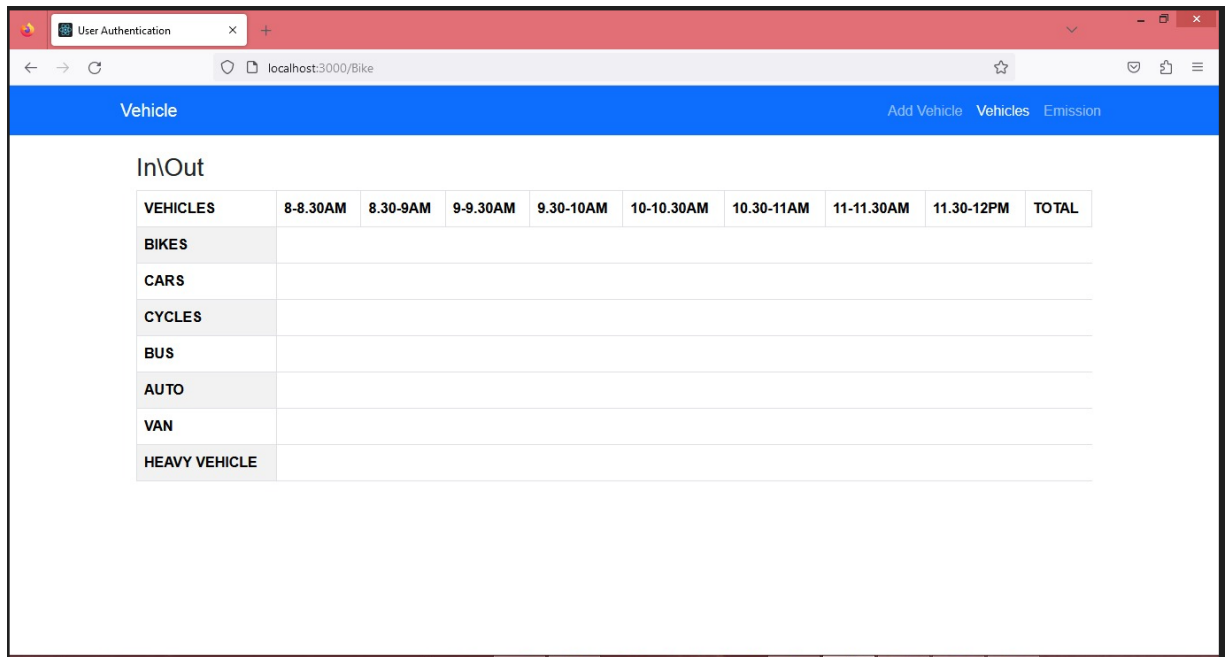


Fig. 4.11: Vehicle Parameters in Vehicle Emission Analysis using JAVA script



Database filter Table filter Host: 13.55.240.192 Database: vehicle_data_table Table: vehicle_schedule Data Query

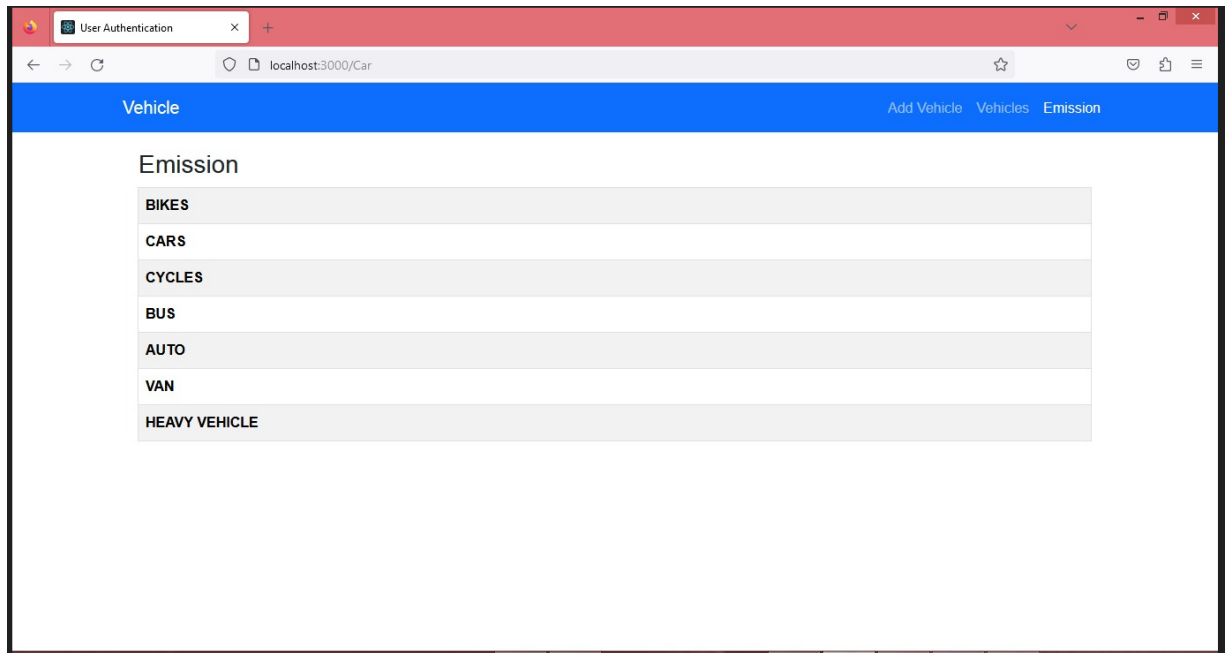
VehicleDB

- information_schema
- mysql
- performance_schema
- sys
- vehicle_data_table
- emission
- vehicle_schedule
- vehicle_emission

vehicle_data_table.vehicle_schedule: 7 rows total (exact)

#	id	VEHICLES	8AM_8_30AM	8_30AM_9AM	9AM_9_30AM	9_30AM_10AM	10AM_10_30AM	10_30AM_11AM	11_AM_11_30AM	11_30AM_12PM	TOTAL
1	1	BIKES	244	221	15	18	0	5	7	14	524
2	2	CARS	32	29	14	12	0	0	4	0	91
3	3	CYCLES	2	0	0	0	0	0	0	0	2
4	4	BUS	47	111	9	4	0	0	0	7	178
5	5	AUTO	4	21	0	1	0	0	0	0	26
6	6	VAN	2	4	0	0	0	0	0	0	6
7	7	HEAVY VEHICLE	4	2	1	2	1	0	0	0	10

Fig. 4.12: Traffic Volume Input in Vehicle Emission Analysis using JAVA script



The screenshot shows a MySQL database interface. The left sidebar displays the database structure, including 'VehicleDB' and its tables: 'information_schema', 'mysql', 'performance_schema', 'sys', 'vehicle_data_table', 'emission', 'vehicle_schedule', and 'vehicle_emission'. The 'emission' table is selected, showing 7 rows of data. The table has two columns: 'VEHICLES' and 'EMISSION'.

#	VEHICLES	EMISSION
1	AUTO	1.9
2	BIKES	0.5
3	BUS	5.7
4	CARS	2.3
5	CYCLES	0.1
6	HEAVY VEHICLE	6.5
7	VAN	3.2

Fig. 4.13: Prediction of Vehicle Emission using JAVA script

Figure 4.11 and 4.12 shows the Vehicle parameters and volume data in vehicle emission analysis using JAVA script. Figure 4.13 presents the Pollution Emission factors of each type of vehicle and model.

CHAPTER 5

SUMMARY AND CONCLUSION

5.1 SUMMARY

The trip generation study conducted at Sathyabama Institute of Science and Technology, Chennai likely involves analysing the patterns and volume of trips generated by various activities or land uses from the University campus. The key elements includes the methodology employed, data collection and analysis tools, the findings regarding modes of transportation used, and factors influencing trip generation.

5.2 CONCLUSION

Based on the trip generation study conducted at Sathyabama Institute of Science and Technology, Chennai, it can be concluded that the primary factors influencing trip generation, patterns of transportation usage among students and staff,etc. These findings provide valuable insights for urban planners, transportation authorities, and campus administrators to develop effective strategies for managing transportation infrastructure, promoting sustainable commuting options, and enhancing overall mobility within the university campus. Additionally, recommendations for future research or policy interventions may include mention any suggestions for further investigation or action. Overall, this study contributes to the understanding of transportation dynamics in academic settings and underscores the importance of mass transportation planning solutions for Rajiv Gandhi Salai as a whole to the society in minimizing the vehicle emission based on their modes.

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