Course Project Report

ANALYSIS OF TRAFFIC CONGESTION AT MUKKAM JUNCTION

by

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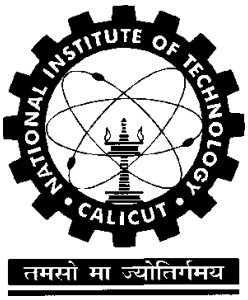

UNDER THE GUIDANCE OF
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Department of Mechanical Engineering

M.TECH. Industrial Engineering and Management

MONSOON SEMESTER 2023-24

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to our course faculty Dr. Vinay V. Panicker and Dr. Pradeepmon TG for their invaluable support and guidance throughout our course.

Their expertise in the subjects significantly shaped our project's direction and enriching our learning experience.

We also take the opportunity to acknowledge the contribution of Dr. M.L. Joy, Head of Department (Mechanical Engineering), for his full support and assistance during the development of the project. We also do not like to miss the opportunity to acknowledge the contribution of all faculty members of the department for their kind assistance and cooperation during the course of our project. Last but not the least, we acknowledge our seniors and friends for their contribution in the completion of the project.

DECLARATION

We hereby declare that except where specific reference is made to the work of others, the contents of this course project are original and have not been submitted in whole or in part for consideration for any other degree or qualification in this, or other university. This course project is our own work and contains nothing which is the outcome of the work done in collaboration with others, except as specified in the text and Acknowledgements.

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11-12-2023

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Certificate

This is to certify that the Project entitled '**ANALYSIS OF TRAFFIC CONGESTION AT MUKKAM JUNCTION'** is Bonafide record of the project done **Aditya Kumar Singh (M230592ME)**, **Rakesh Manawat (M230835ME)**, under my supervision, in partial fulfilment of the requirements for the award of the degree of **Master of Technology** in **Industrial Engineering and Management** from **National Institute of Technology Calicut**, and his work has not been submitted elsewhere for the award of a degree.

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Date: 11-12-2023

ABSTRACT

Traffic congestion has been an area of major bother across the globe. Lots of other reason are there that are responsible for traffic like parking of vehicles in the lane, overcrowding due to stalls, heavy rush due to almost same office and school timings, resulting in less space in a lane.

The project focuses on analysing the traffic congestion, peak hours and in the end working towards the reduction of average waiting time of the vehicles. Real time data had been collected for analysis purpose. Our observation is restricted to a one lane traffic congestion process for a day.

The Python programming language has been used for constructing histogram to show the pattern of vehicle distribution over the duration. The report provides results of all analysis done by the Python which was needed for the verification and validation of model.

The report discusses more about the trend vehicles follow on a particular day from the start till its termination, how the no. of vehicles is changing which family of distribution it is following and the statistical parameters.

Overall this report contributes to the understanding of Simulation and system modelling. Data visualization was done by Python programming. We were able to know the peak hours, PCU for a particular vehicle including cars, bikes, trucks buses.

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CHAPTER 1

INTRODUCTION

1.1. Description

Traffic congestion is a pervasive and pressing issue that affects urban areas worldwide, posing significant challenges to transportation systems, economic productivity, and overall quality of life defined as the condition where the demand for transportation exceeds the available capacity, traffic congestion occurs when the volume of vehicles on a roadway surpasses its optimal flow, resulting in slower speeds, increased travel times, and decreased overall efficiency.

Figure 1.1 Traffic congestion in Kozhikode district

Problem Statement

Our problem statement is “Analysis of traffic congestion at Mukkam junction”. Study involves the trends of vehicle distribution over a day, peak hours, PCU of different vehicles in a day.

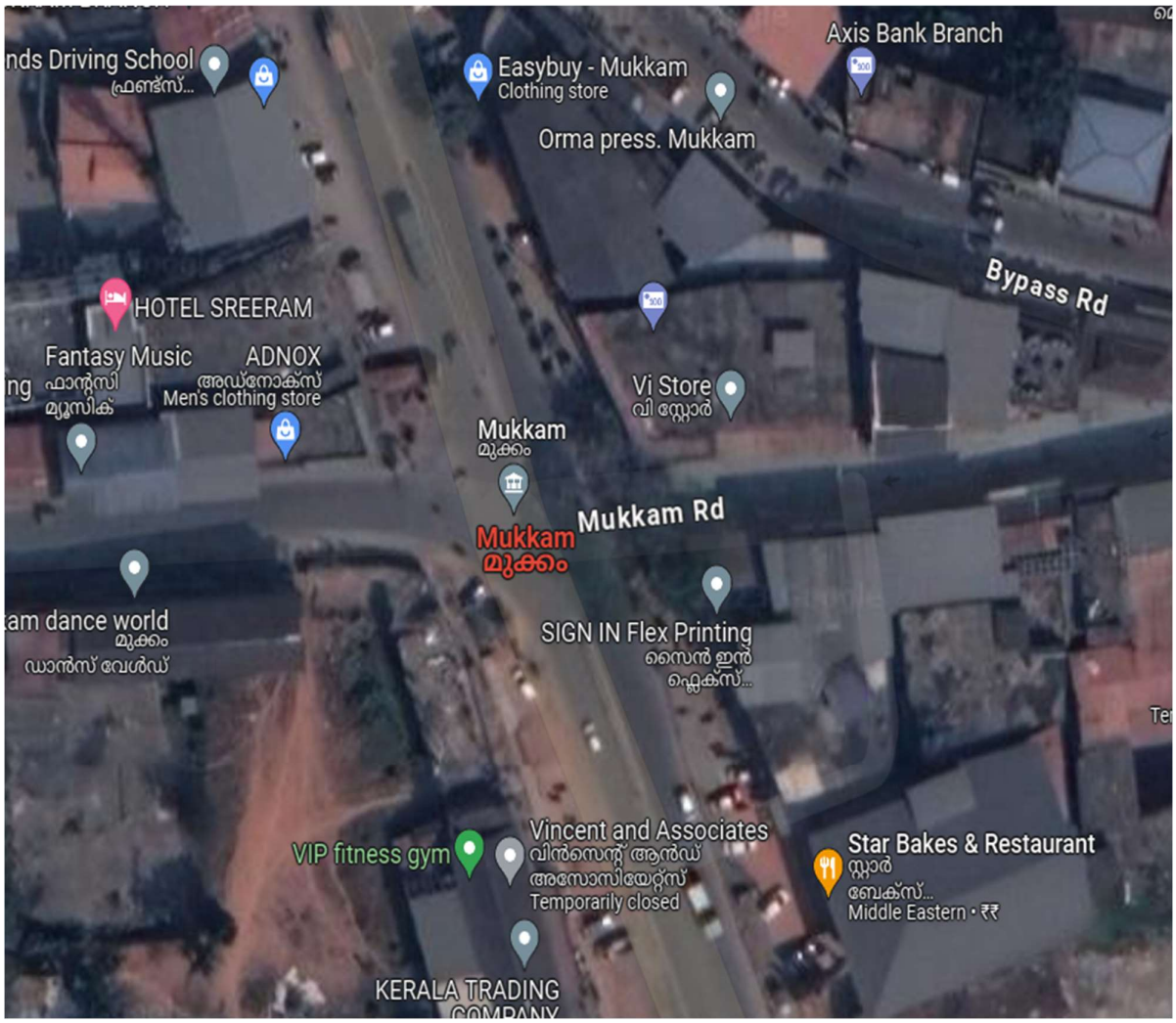

Figure 1.2 Satellite image of Mukkam Junction

CHAPTER 2

Project Concept

1. Project Overview: By collecting the real data of an urban traffic junction we created the simulated data sets so to see the change in overall change in count of no of vehicles in terms of PCU, peak hours.

2. System Description: Our system is a no. of vehicle including buses, cars, bikes at Mukkam Junction. The junction we considered is a cross road, we restricted to a single lane.

3.Data Collection and Inputs: Data is collected as the count of vehicle type that includes buses/trucks, cars, bikes in 5-minute time stamps. Further they are classified as red and green which says vehicles that have to wait in 5-minute time stamps, green are those which pass freely without waiting in 5-minute interval from 10 AM in the morning till 5 PM in the evening for a single day.

	A	B	C	D	E	F	G
1	Road Traffic Data						
2		Bus/Truck		Bikes		Cars	
3	TIME	RED	GREEN	RED	GREEN	RED	GREEN
4	10:00-10:05	4	2	5	16	5	10
5	10:05-10:10	3	4	11	13	8	5
6	10:10-10:15	5	3	30	8	6	10
7	10:15-10:20	0	2	4	9	8	10
8	10:20-10:25	2	0	12	10	10	9
9	10:25-10:30	5	6	14	9	3	8
10	10:30-10:35	1	2	3	12	4	18

Figure 2.1 Road Traffic data

4. Modelling Approach: We considered only the no. of vehicles, Hence it was a discrete simulation event. For better understanding of the distribution histogram was plotted which shows the frequency of vehicles across certain range and it appeared symmetrical, which warranted the normal distribution. Further chi square test was performed to validate the family of distribution is normal.

```
In [16]: import matplotlib.pyplot as plt
         import seaborn as sns

In [17]: sns.displot(traffic1['Total_Bus/Truck'],kde=True, rug=True)

Out[17]: <seaborn.axisgrid.FacetGrid at 0x1262b5dd0>
```

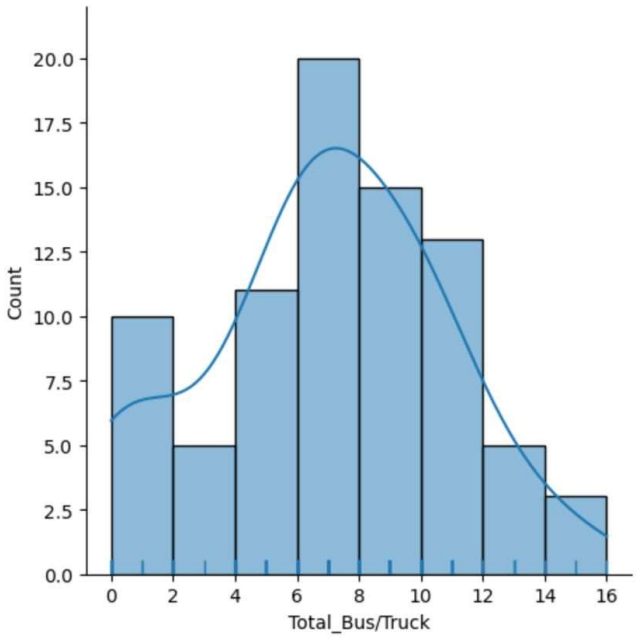

Figure 2.2 Histogram

Verification:

GOODNESS OF FIT TEST

K-S Test

In [149…
```
from scipy.stats import kstest, norm
```

In [150…
```
df = pd.read_excel('data.xlsx')
```

In [152…
```
data = df['SumPCUTotal'].tolist()    #  'SumPCU' column data taken
```

In [153…
```
mean, std_dev = norm.fit(data)    # normal distribution fitting
```

In [154…
```
ks_statistic, ks_p_value = kstest(data, 'norm', args=(mean, std_dev))    # K-S Test
```

In [155…
```
print("K-S statistic:", ks_statistic)     # Result
print("p-value:", ks_p_value)
```

```
K-S statistic: 0.051379684423658256
p-value: 0.9713737576551905
```

In [156…
```
alpha = 0.05
if ks_p_value < alpha:
    print("Reject the null hypothesis. The data does not follow a normal distribution.")
else:
    print("Fail to reject the null hypothesis. The data follows a normal distribution.")
```

```
Fail to reject the null hypothesis. The data follows a normal distribution.
```

In [157…
```
print("Estimated Mean:", mean)
print("Estimated Standard Deviation:", std_dev)
```

```
Estimated Mean: 63.39880952380953
Estimated Standard Deviation: 14.377859914661276
```

Chi-square Test

In [158…
```
import numpy as np
from scipy.stats import chisquare, norm
```

In [159…
```
df = pd.read_excel('data.xlsx')
```

In [161…
```
data = df['SumPCUTotal'].tolist()     #'SumPCU' column  data taken
```

In [162…
```
mean, std_dev = norm.fit(data)    # normal distribution fitting
```

In [163…
```
observed_frequencies, bins = np.histogram(data, bins='auto')   # Create bins and observed frequencies
```

In [164…
```
bin_centers = (bins[:-1] + bins[1:]) / 2
expected_frequencies = norm.pdf(bin_centers, mean, std_dev) * len(data)    # Calculate expected frequencies based on the normal di
```

In [165…
```
# Normalize expected values to match the sum of observed values
expected_frequencies = expected_frequencies / expected_frequencies.sum() * observed_frequencies.sum()
```

In [166…
```
chisqu_stat, chisqu_p_value = chisquare(f_obs=observed_values, f_exp=expected_values)  # chi-square goodness-of-fit test
```

In [167…
```
print("Chi-square statistic:", chisqu_stat)   # Result
print("p-value:", chisqu_p_value)
```

```
Chi-square statistic: 1.8146259715561033
p-value: 0.9861769432455396
```

In [168…
```
alpha = 0.05
if chi2_p_value < alpha:
    print("Reject the null hypothesis. The data does not follow a normal distribution.")
else:
    print("Fail to reject the null hypothesis. The data follows a normal distribution.")
```

```
Fail to reject the null hypothesis. The data follows a normal distribution.
```

Anaconda-Navigator

5. Simulation Parameters: The real data follows normal distribution.

Mean value = 63.398

Standard deviation = 14.377

6. Simulated data generation: Using Excel we have generate random data with mean and standard deviation. Formula for generation we used is =NORM.INV(rand(), mean, standard deviation).

Date	Time	Red signal duration / Cycle	Green signal duration / Cycle		Total vehicles waiting	Total no.of vehicles not waiting	Total no of vehicles	Waiting time	New waiting time		simulated vehicles count(waiting)	Waiting time	New waiting time
11/11/23	10:00-10:05	171	129		24	29	53	7	7		31	6	5
11/11/23	10:05-10:10	171	129		27	30	57	6	6		50	3	3
11/11/23	10:10-10:15	171	129		47	27	74	4	3		29	6	6
11/11/23	10:15-10:20	171	129		11	24	35	16	15		24	7	7
11/11/23	10:20-10:25	171	129		26	17	43	6	6		31	6	5
11/11/23	10:25-10:30	171	129		32	37	69	5	5		27	6	6
11/11/23	10:30-10:35	171	129		10	34	44	17	16		27	6	6
11/11/23	10:35-10:40	171	129		24	32	57	7	7		42	4	4

CHAPTER 3

METHODOLOGY

3.1 Data Collection and Analysis:

The data collected shows the vehicle flow rate at a particular time interval. The total data sets recorded are 84 in number as a five minutes time interval was taken.

3.2 Categorization of Traffic:

The engine driven vehicles were categorized into various heads viz. Trucks/Bus, Light Carriage Vehicles (LCV), Car/Jeep, Multi Axle Vehicles, Two/Three Wheelers and Cycles/others. The results of vehicle count are converted into Passenger Car Units (PCU) as per the equivalent PCUs prescribed by IRC guidelines.

TABLE 3.1 - Equivalency Factors for Various Types of Vehicles On Urban Roads

Sl. No.	Vehicle Class	Equivalency Factor	
		Percentage composition of vehicle type in traffic stream	
Fast Vehicles		**5%**	**10% & Above**
1	Two wheelers - motor cycle, scooter, etc.	0.5	0.8
2	Passenger car, Pick-up van	1.0	1.0
3	Auto-rickshaw	1.2	2.0
4	Light Commercial vehicle	1.4	2.0
5	Truck or Bus	2.2	3.7
6	Agricultural Tractor - trailor	4.0	5.0
Slow Vehicles			
7	Pedal cycle	0.4	0.5
8	Cycle rickshaw	1.5	2.0
9	Tonga (Horse drawn vehicle)	1.5	2.0
10	Hand cart	2.0	3.0

Above shown is the PCU (Passenger Car Unit) Table. PCU is used to measure the rate of traffic flow on highway. In other words, PCU is a measure of number of vehicles moving on a highway at a given point of time. To describe the entire traffic flow on a highway per unit time, the flow of various vehicle classes must be converted into a single standard vehicle type, such as passenger car. As a result, equivalency

factor known as passenger car unit is allotted to each vehicle type.

We again verify the PCU data, for which distribution it follows. For this we make histogram and find that it follows normal distribution.

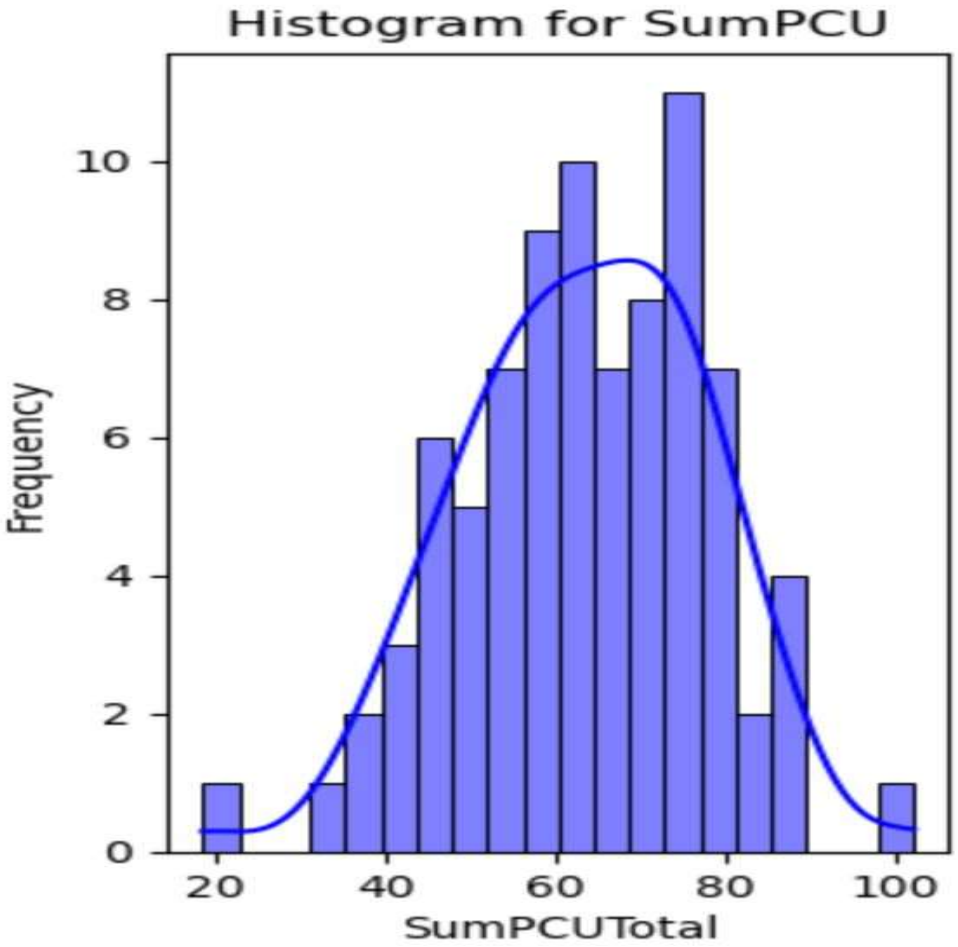

Figure 3.1 Histogram of PCU data

CHAPTER 4

Result & Analysis

4.1 Result and Findings:

The daily vehicular traffic densities for continuous normal day at each location observed during the study period and the same are presented in below mentioned in the following Tables and Figures.

TABLE 4.1 - SUMMARY OF REAL AND PCUS OBSERVED ON MUKKAM JUNCTION

Category	Real Count	PCU Count
Buse/ Truck	620	2279
Bikes	1986	1480
Cars	1542	1542
Average	1382	1767

Below bar graph is constructed for total vehicles and total PCU count. By this we find peak hour at 4pm – 5pm.

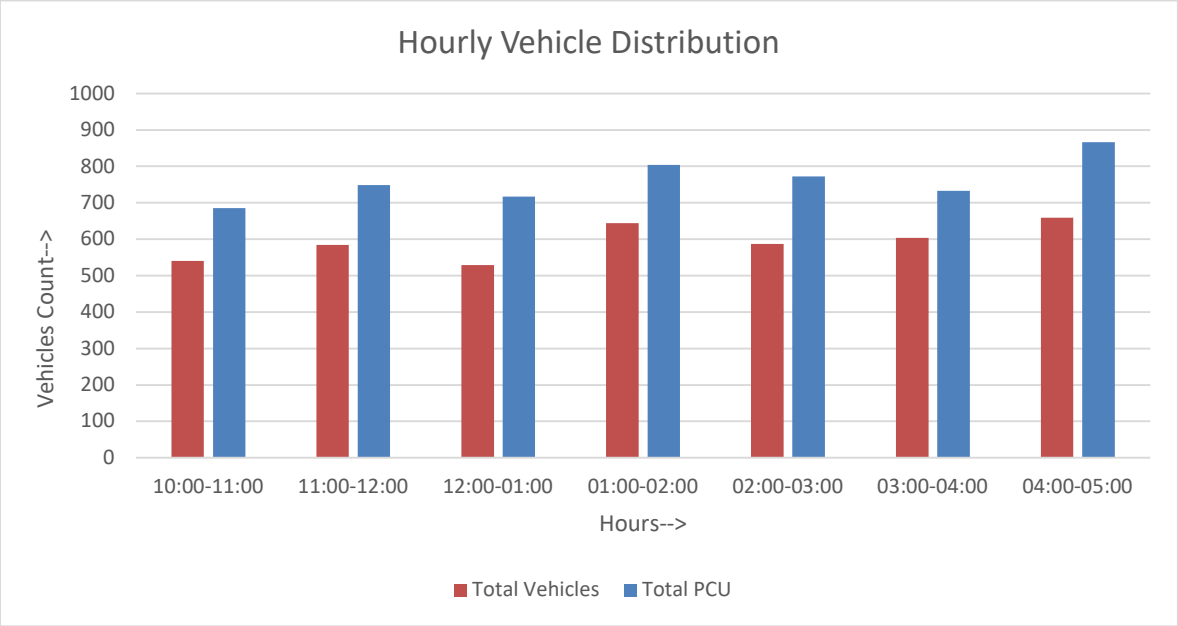

Figure 4.1 Hourly Vehicle Distribution

Traffic Flow Patterns:

The traffic study was conducted Mukkam junction road. The average traffic on Mukkam junction road is observed as 1767 PCUs/hr (Passenger Car Units / hour). The peak traffic is observed 866 PCU/hr (Passenger Car Units / hour) from 04:00pm – 05:00pm.

REFERENCES

- Banks, J., Carson, J.S., Nelson, B. L., and Nicol, D. M., 2014, Discrete-Event System Simulation, Pearson Education.

- **https://civilyard.com/what is passenger-car-unit-pcu /** Accessed on 11-12-2023.