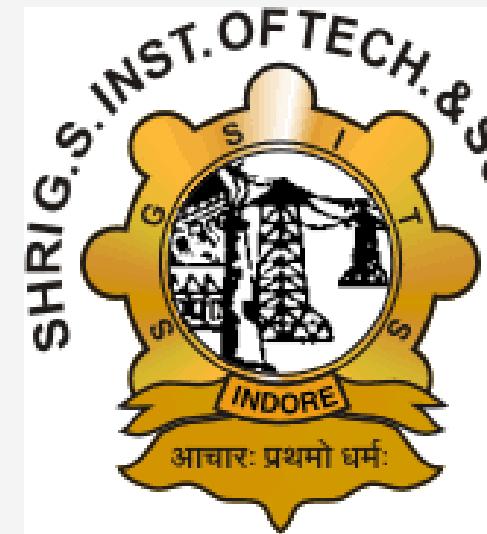


CO44498 : MAJOR PROJECT PHASE- II CITY BUS PASSENGER DATA VISUALISATION TOOL



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Problem Statement

To develop a comprehensive dashboard tool tailored for city bus administrators, aimed at providing dynamic data visualization of city bus routes and passenger data on Google Maps

Objectives

- 1. Enhanced Data Visualization:** Develop geographical maps to visually represent bus routes and related data to improve comprehension and analysis.
- 2. Solving Real-World Transport Problems:** Address challenges faced by transport authorities by providing tools to plan and execute a more efficient transport system.
- 3. Efficiency Improvement:** Enable transport authorities to optimize routes and schedules through spatial analysis, leading to reduced congestion, shorter travel times, and improved service reliability.
- 4. Dynamic Visualization:** Create interactive maps that can adapt to real-time data, allowing for dynamic representation of bus routes, stops, and operational information.
- 5. Readability:** Design maps that are easily readable and understandable for transport authorities , facilitating effective decision-making and route planning.

6. Spatial Analysis: Utilize spatial analysis techniques to identify patterns, trends, and areas of improvement within the transport network, aiding in strategic planning and resource allocation.

7. Admin Friendly Interface: Develop a user-friendly interface that allows transport authorities to input data, perform analysis, and visualize results intuitively, without requiring specialized technical skills.

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8. Continuous Improvement: Establish a framework for ongoing updates and enhancements to the visualization platform, ensuring that it remains relevant and effective in addressing evolving transport challenges.

OBJECTIVE :

To analyse and visualize the number of passengers boarding at various stops for different routes.

- There are multiple routes that connect with single stop.

We analyzed the bus ridership data for various bus routes and tried to determine the passenger density at different stops.

EXAMPLE

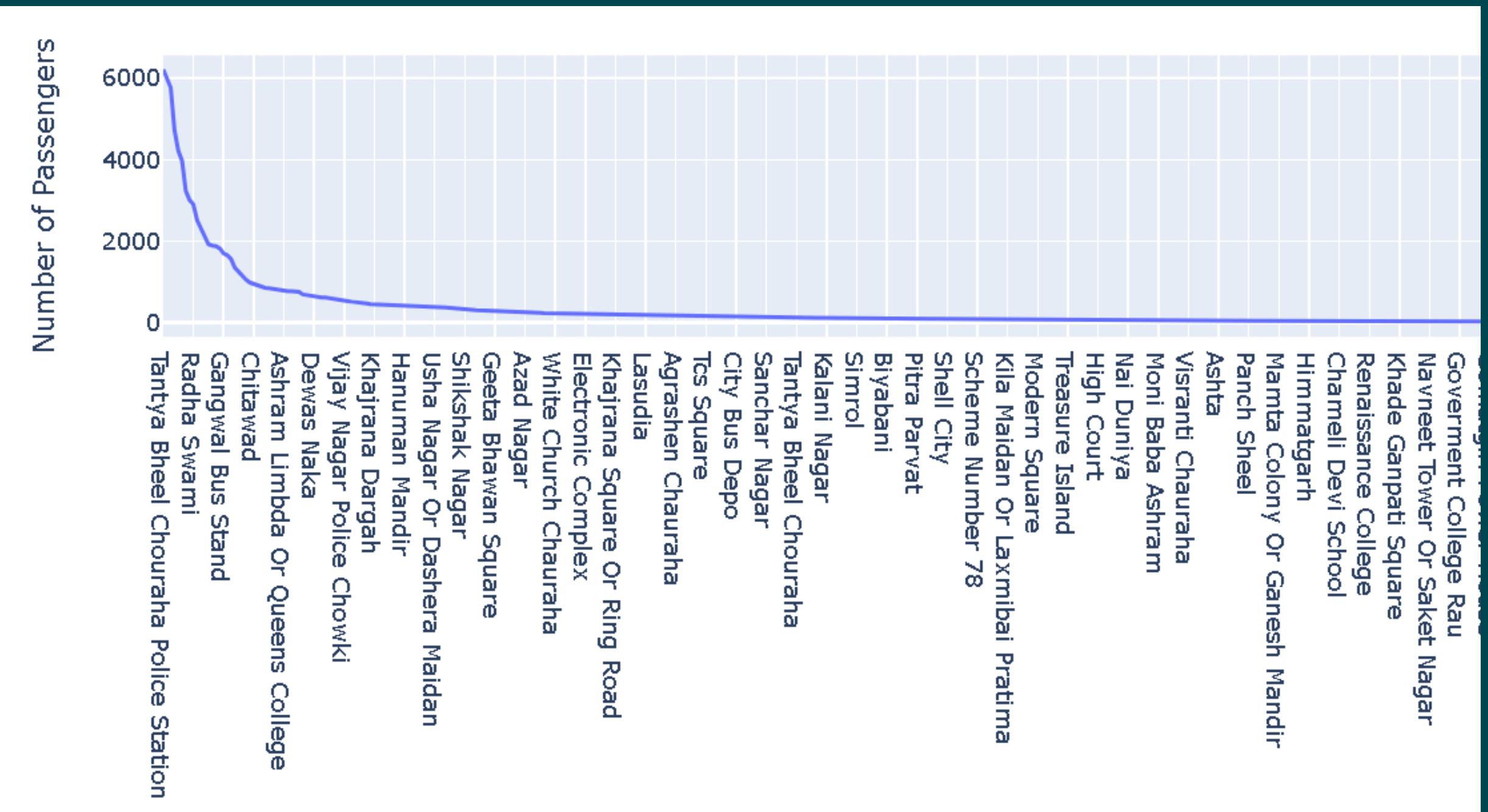
We have performed an analysis of the data for all stops on the date 14/11/2022.

There were certain stops with a passenger count exceeding 5000, while others had counts lower than 2.

Number of passengers on different stops

Maximum number of passengers
are on Tantya Bheel Choraha = 6881

Minimum number of passengers
are on Gotiya Aam Road -1,
Hoshangabad = 1



Maximum Stop density



Minimum Stop density



OBJECTIVE :

To analyse and visualize total no of passengers on boarding the buses at each station in time interval of one hour .

- Visualizing passenger numbers by hour helps pinpoint peak travel times, enabling transit agencies to allocate more resources and optimize services during periods of high demand, reducing overcrowding and improving service quality.
- Identifying busy stations and time intervals allows for targeted route adjustments, such as adding extra buses or optimizing routes to accommodate higher passenger loads.

Stop wise Data Analysis

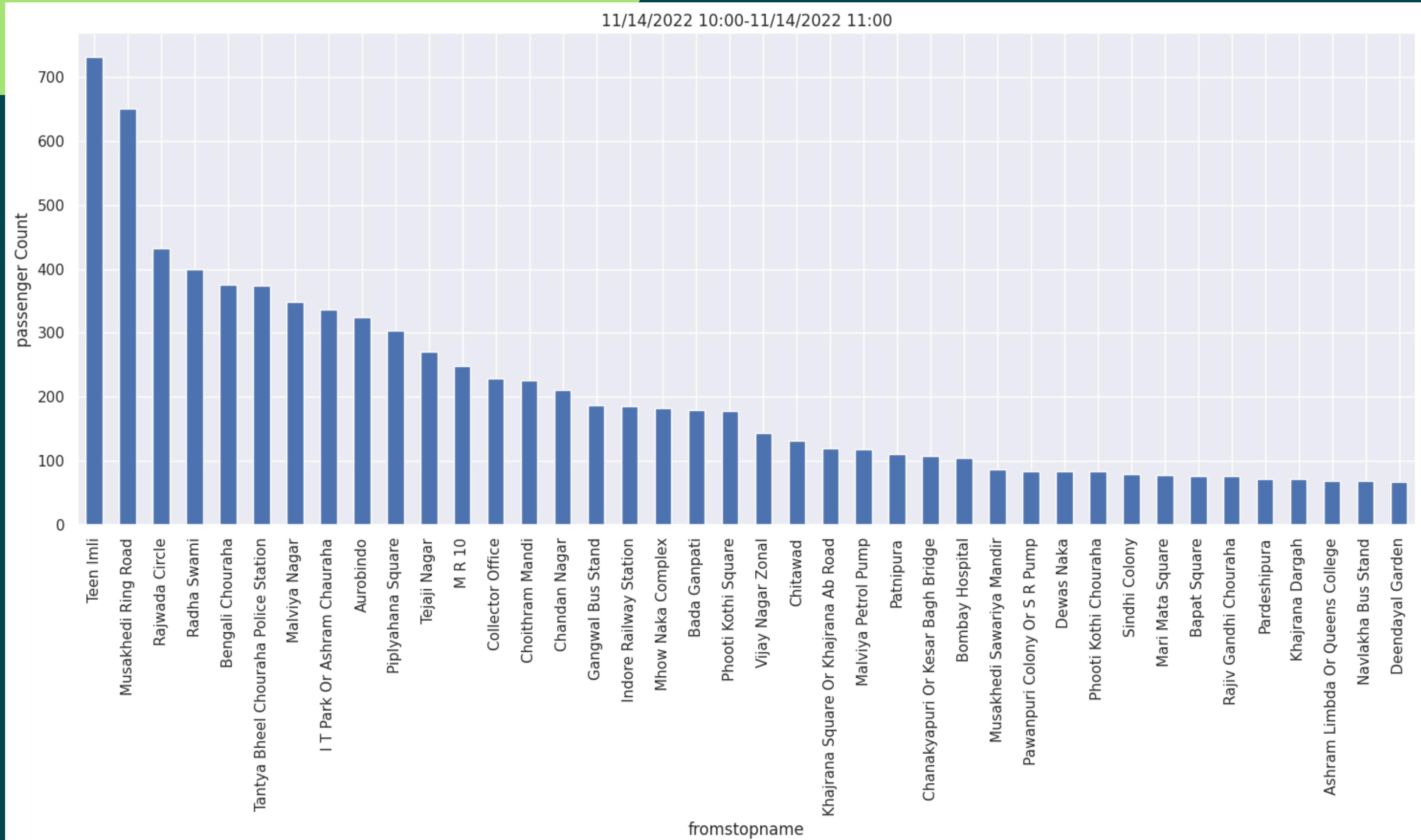
From the initial dataset, 3 features are required for this analysis:

- fromStopName
- Passengers
- ticket_time

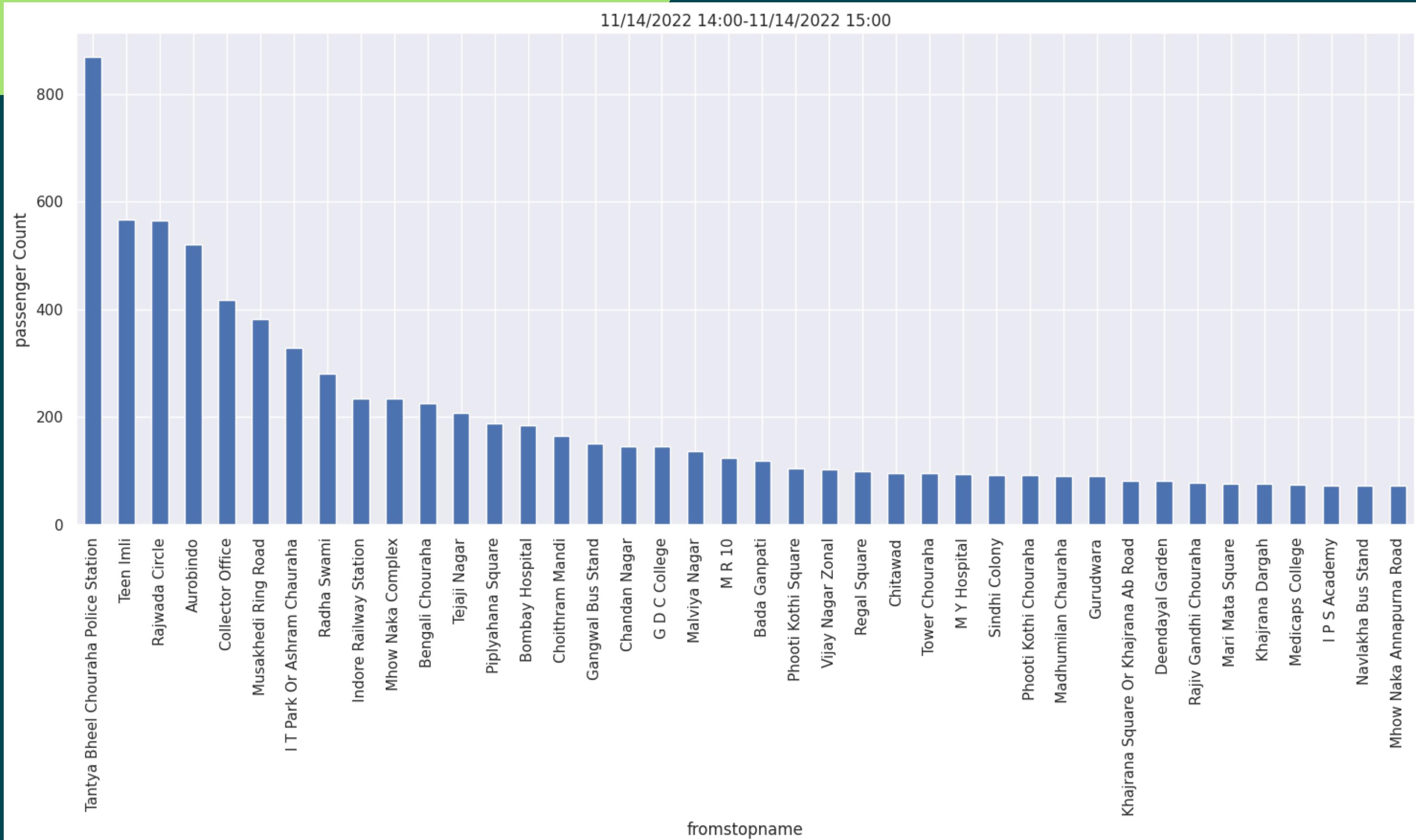
Using these features, data conversion process is performed to get hourly data of passengers onboarding from each stop.

fromstopname	passengers
Teen Imli	732
Musakhedi Ring Road	651
Rajwada Circle	433
Radha Swami	399
Bengali Chouraha	376
Tantya Bheel Chouraha Poli	374
Malviya Nagar	348
I T Park Or Ashram Chaurah	336
Aurobindo	324
Piplyahana Square	304
Tejaji Nagar	271
M R 10	249
Collector Office	229
Choithram Mandi	226
Chandan Nagar	211
Gangwal Bus Stand	187
Indore Railway Station	185
Mhow Naka Complex	183
Bada Ganpati	180
Phooti Kothi Square	178
Vijay Nagar Zonal	144

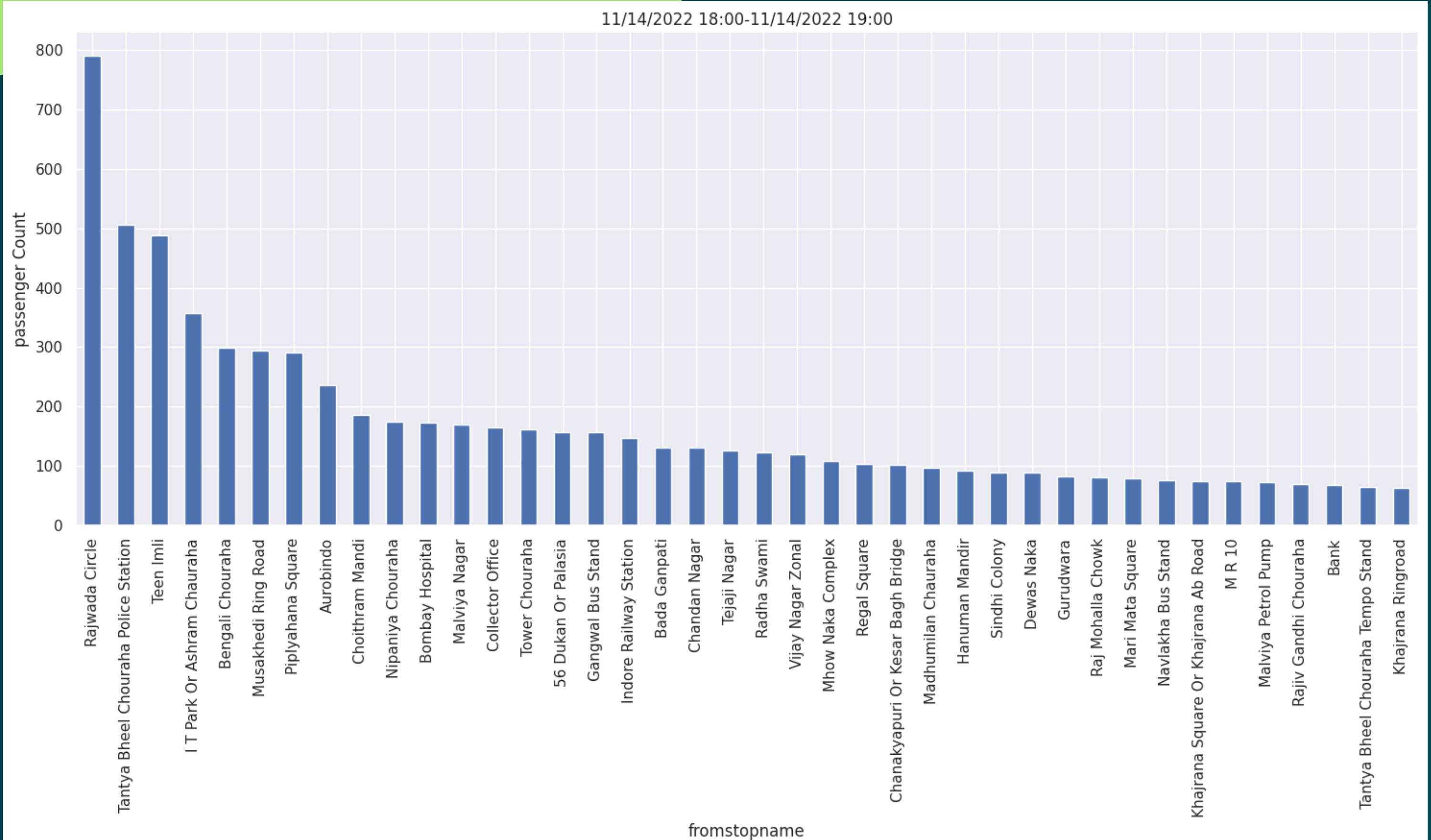
Graph Based Visualization



Graph Based Visualization



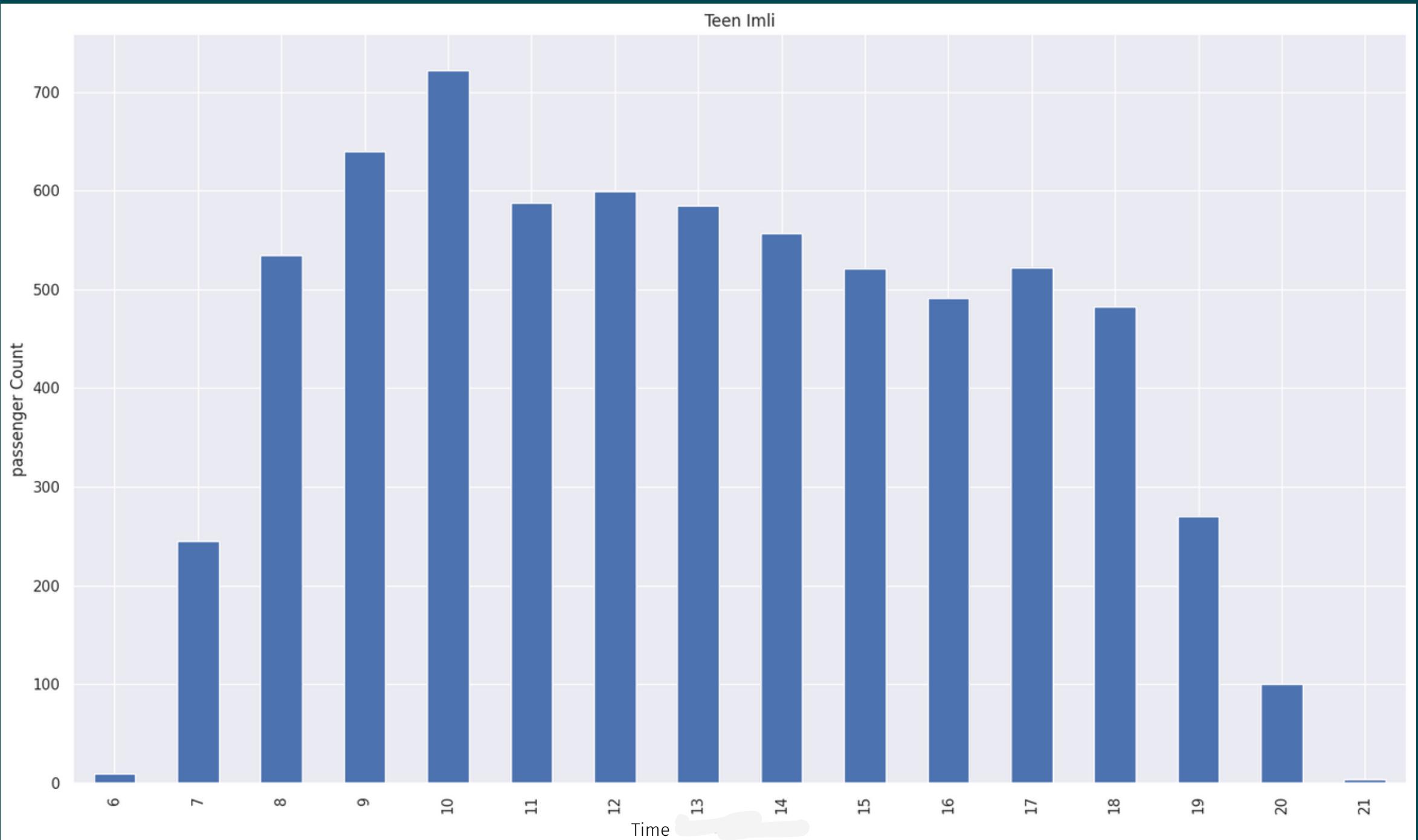
Graph Based Visualization



Graph Based Visualization

We have generated a graph illustrating the passenger boarding trend at a specific station over the course of the entire day. This visual represents flow of passenger activity at this particular location as the hours progress

Teen Imli Bus Station



Conclusions :

- Some of the bus stops had higher passenger frequency during morning hours and lesser during evening hours.
- Some bus stops such as Rajwada, Teen Imli have high frequency of passengers throughout the daytime

Based on the insights from this data analysis, a bus route can be replanned by eliminating the bus stops which have very less number of passenger throughout the day.

Also, the frequency of buses can be increased for the routes having many stops with high number of passenger counts, thus preventing overcrowding in buses.

OBJECTIVE :

To analyse and visualize the number of passengers for different routes from each bus stop.

- Analyzing the number of passengers for different routes from each bus stop for the entire day helps us to get a comprehensive understanding of travel patterns and demand trends.
- By understanding the demand for different routes from each bus stop, transportation authorities can optimize the routes to ensure that buses are assigned based on passenger demand. This helps reduce overcrowding and ensures efficient utilization of resources.

Stop wise Data Analysis

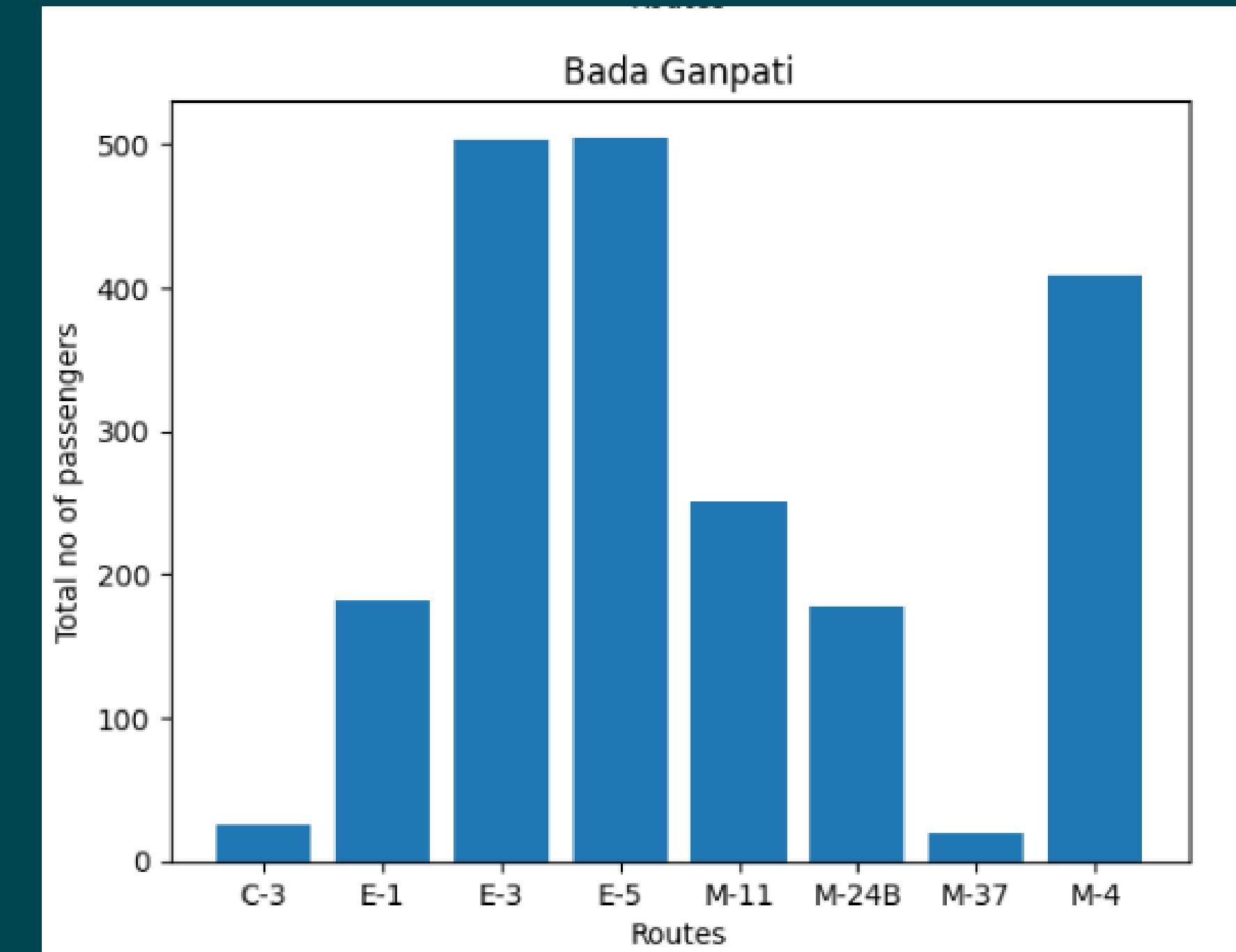
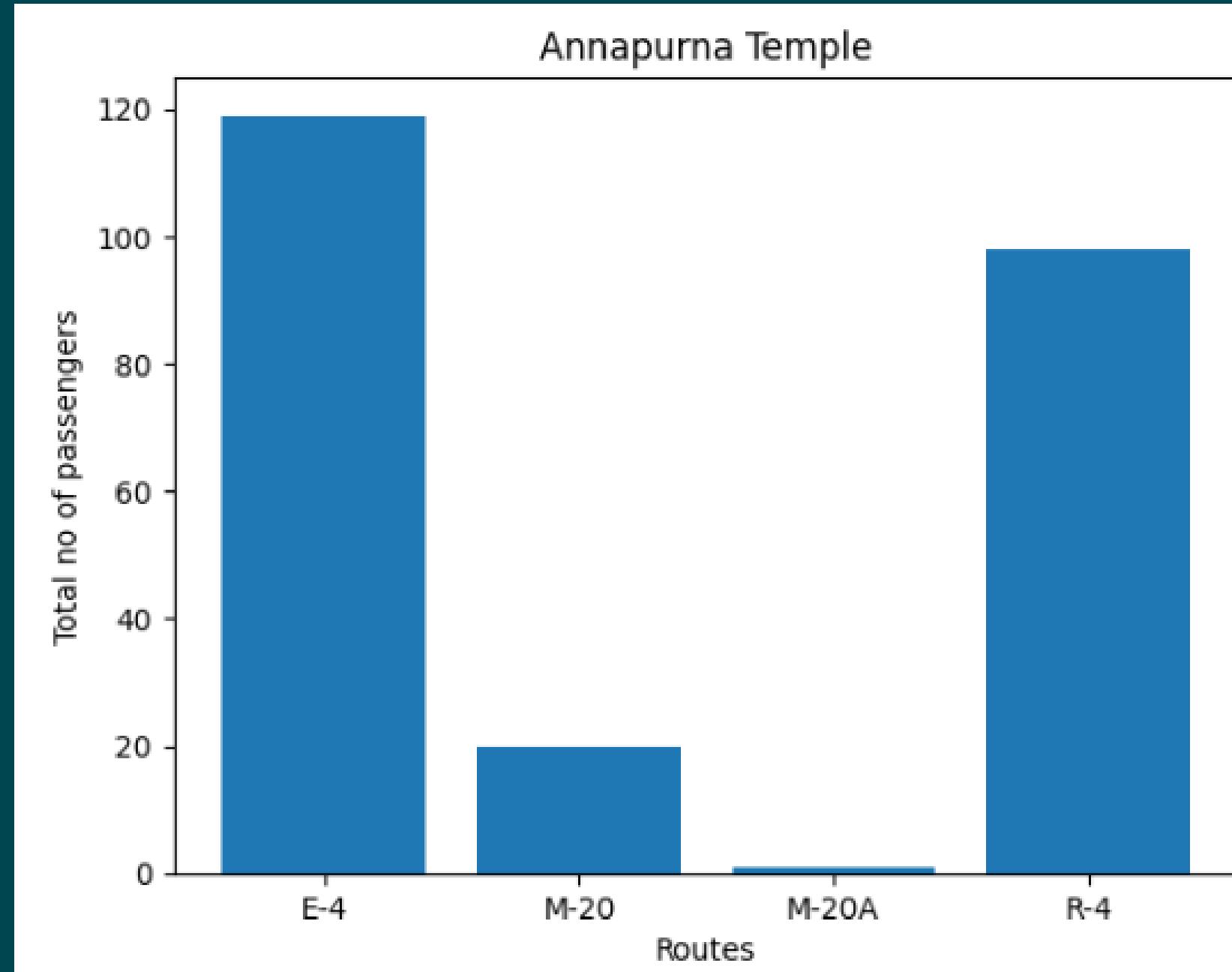
From the initial dataset, 3 features are required for this analysis:

- fromStopName
- Passengers
- route_name

Using these features, data conversion process is performed to get the stop wise data of count of total passengers for each route.

	A	B	C
1	fromstopname	route_name	Count of total passengers
2	56 Dukan	C-1	28
3	56 Dukan Or Palasia	E-3	289
4	56 Dukan Or Palasia	R-9	406
5	7 Meel	M-22	23
6	8 Meel	M-22	65
7	9 Mile	M-19	363
8	Aastha Talkies	R-17	47
9	Abhinandan Pump	C2-(16)	32
10	Abhvaj Udyan Or Choi	R-5	278
11	Advanced Academy	C-1	12
12	Agarwal Public School	M-29	27
13	Agrashen Chauraha	E-4	189
14	Agrawal Toll Kanta	M-17	41
15	Agrawal Toll Kanta	M-26	17
16	Agrawal Toll Kanta	M-26A	1
17	Agrawal Toll Kanta	N-5	8
18	Agrawal Toll Kanta	R-4	13
19	Ahilya Ashram	M-29	12
20	Airport	E-1	108
21	Airport	M-24B	38
22	Airport Gate	E-1	20

Graph Based Visualization



Conclusions :

- Many of the bus stops have some routes for which the count of passengers is very less as compared to the other routes.
- Only a few bus stops had an almost equal amount of passengers distribution among all their routes.

Based on the insights from this data analysis, a bus route can be replanned by eliminating the bus stops which have very less number of passenger counts.

Also, the frequency of buses can be increased for the routes having many stops with high number of passenger counts.

OBJECTIVE :

To analyze and visualize the number of passengers on a particular route with respect to time

- We studied the ticket sales volume for a specific route across various time intervals, aiming to depict the variation in passenger numbers corresponding to different times of the day.
- Then we compared the data of multiple routes to analyze the demand difference at various times of a day.

Example :

We analyzed the passenger count corresponding to time data for 3 bus routes on hourly time interval :

- M-6
- R-9
- M-36

We studied these Indore city bus routes and compared them to put in context the variations of time and passengers.

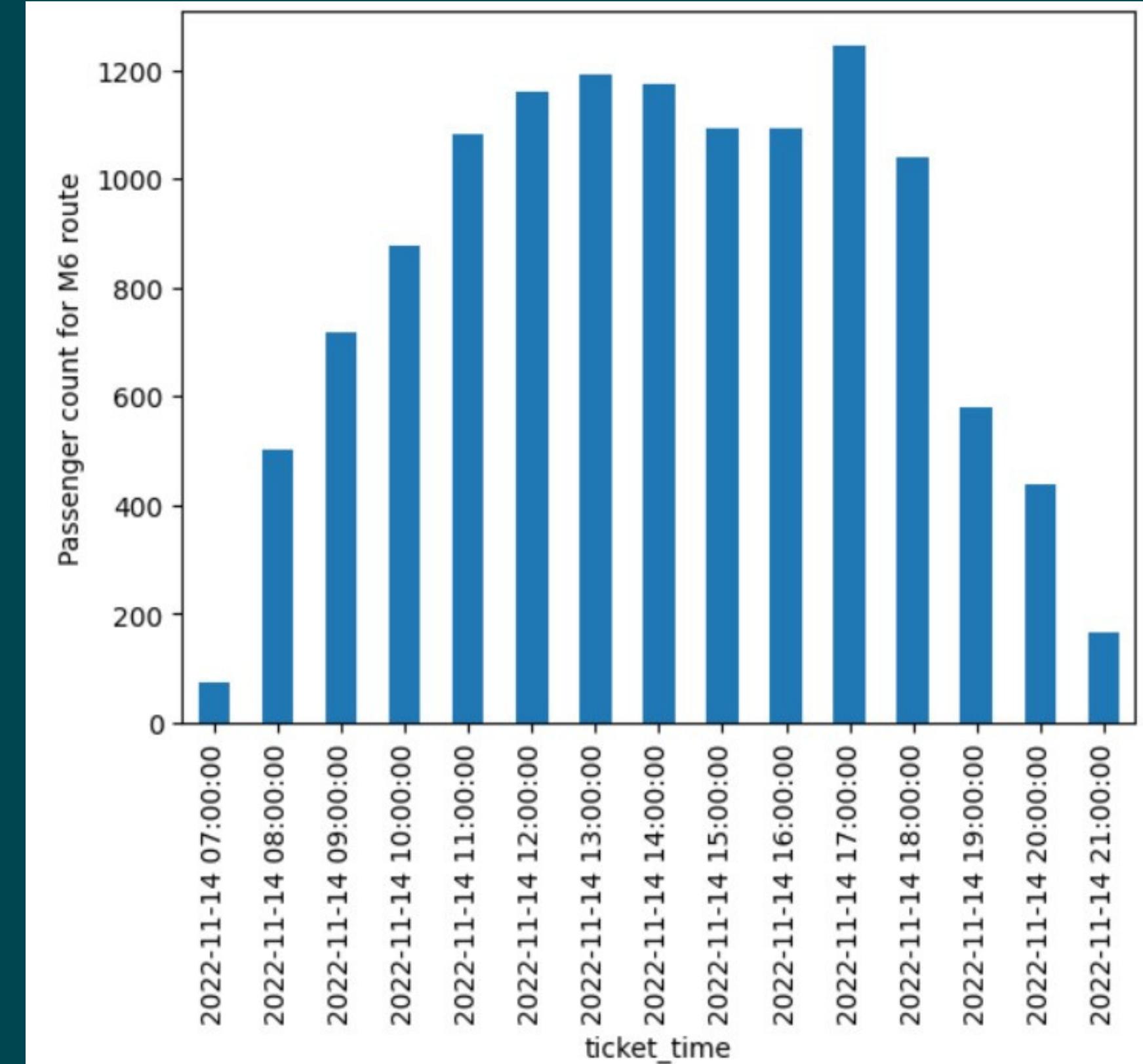
Bus Route M-6 data analysis

Route : Tejaji nagar to Rajwada

Distance : 10.5 Kms

Number of Buses : 8

Peak Passenger Count at : 5 PM



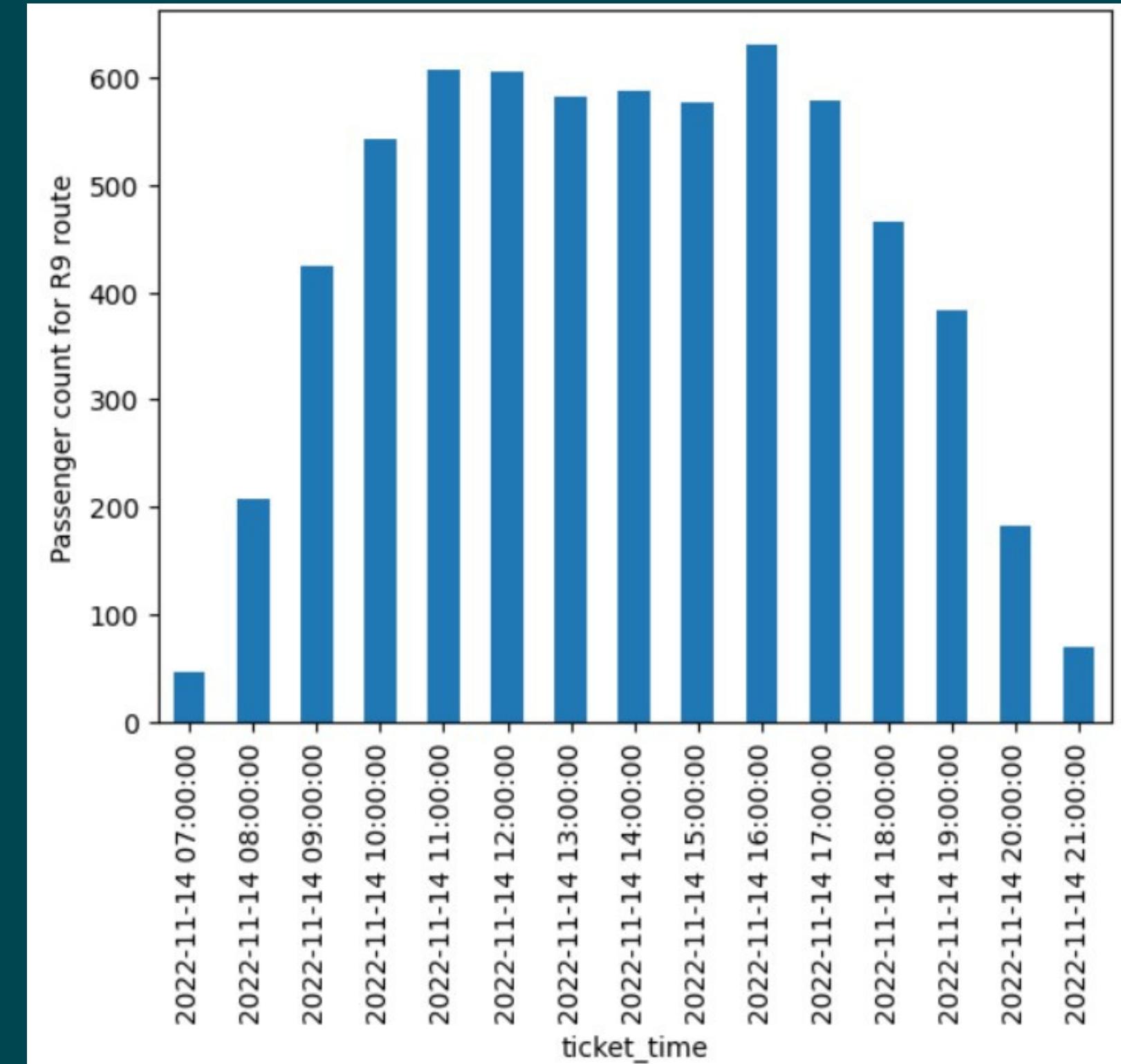
Bus Route R-9 data analysis

Route : Suryadev Nagar to By pass

Distance : 15.5 Kms

Number of Buses : 13

Peak Passenger Count at : 4 PM



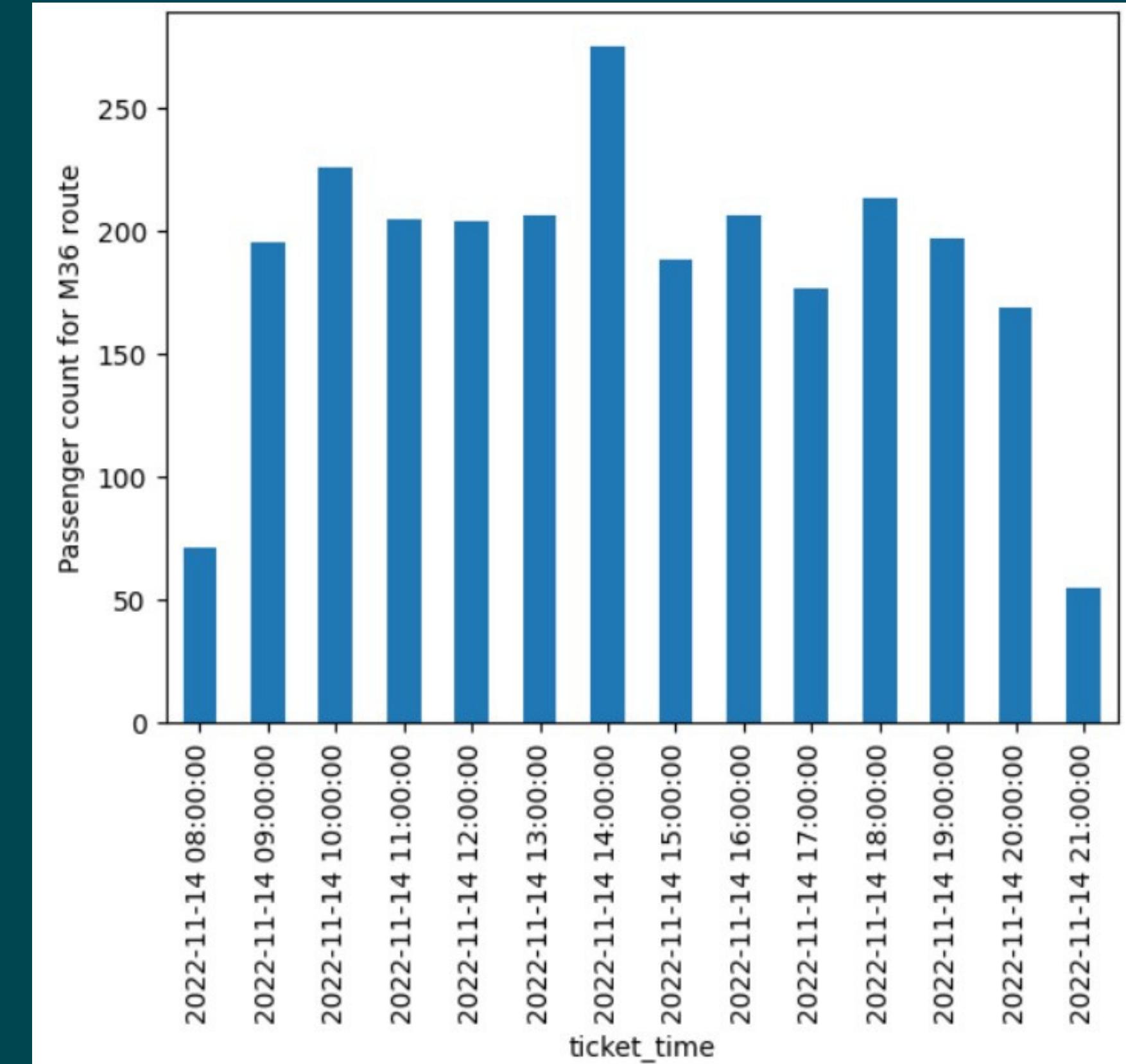
Bus Route M-36 data analysis

Route : MR-10 To Rajwada

Distance : 7.2 Kms

Number of Buses : 5

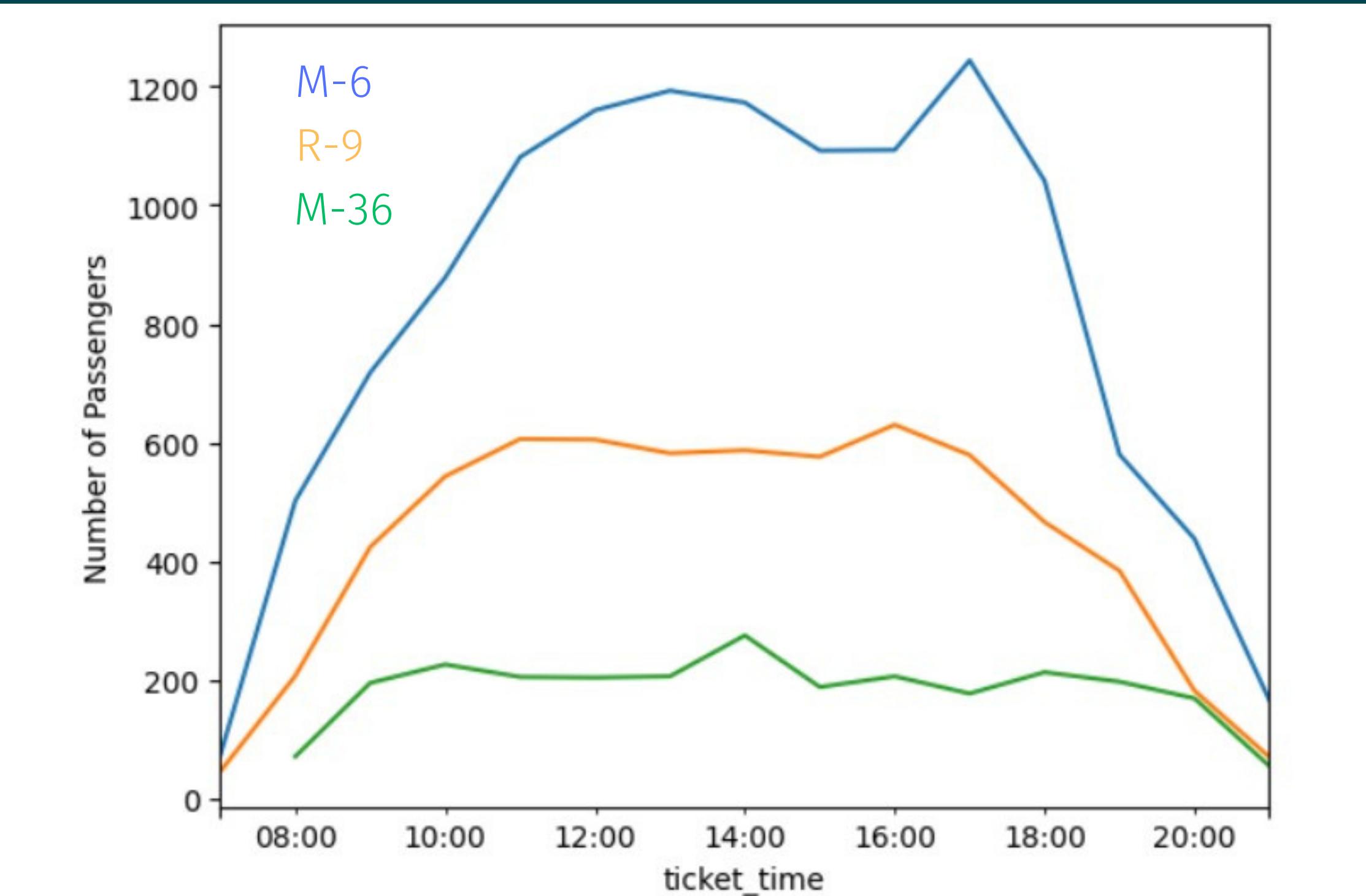
Peak Passenger Count at : 2 PM



Comparing M-6, R-9 and M-36 Bus Routes

Analysis

- M-6 routes has way more passengers than R-9 and M-36.
- All the three routes have a peak passenger demand at different times in a day.
- M-6 and R-9 bus routes have longer ticket sale times i.e. tickets sell even before 8:00 AM unlike M-36 route.



Conclusion :

- We got insights into how passenger numbers fluctuate over different time periods, offering a comprehensive view of the route's temporal passenger trends.
- We deduce that the buses can be efficiently used if the bus frequency and distribution is done corresponding to the passenger count variations with respect to time.
- Bus frequency should not be fixed for a route and be dynamic instead, depending on various factors, one of them being time.

OBJECTIVE :

To analyze and visualize the number of passengers travelling through different routes in a given time interval.

- Identify the routes with maximum passengers.
- identify the routes with minimum passengers.

EXAMPLE

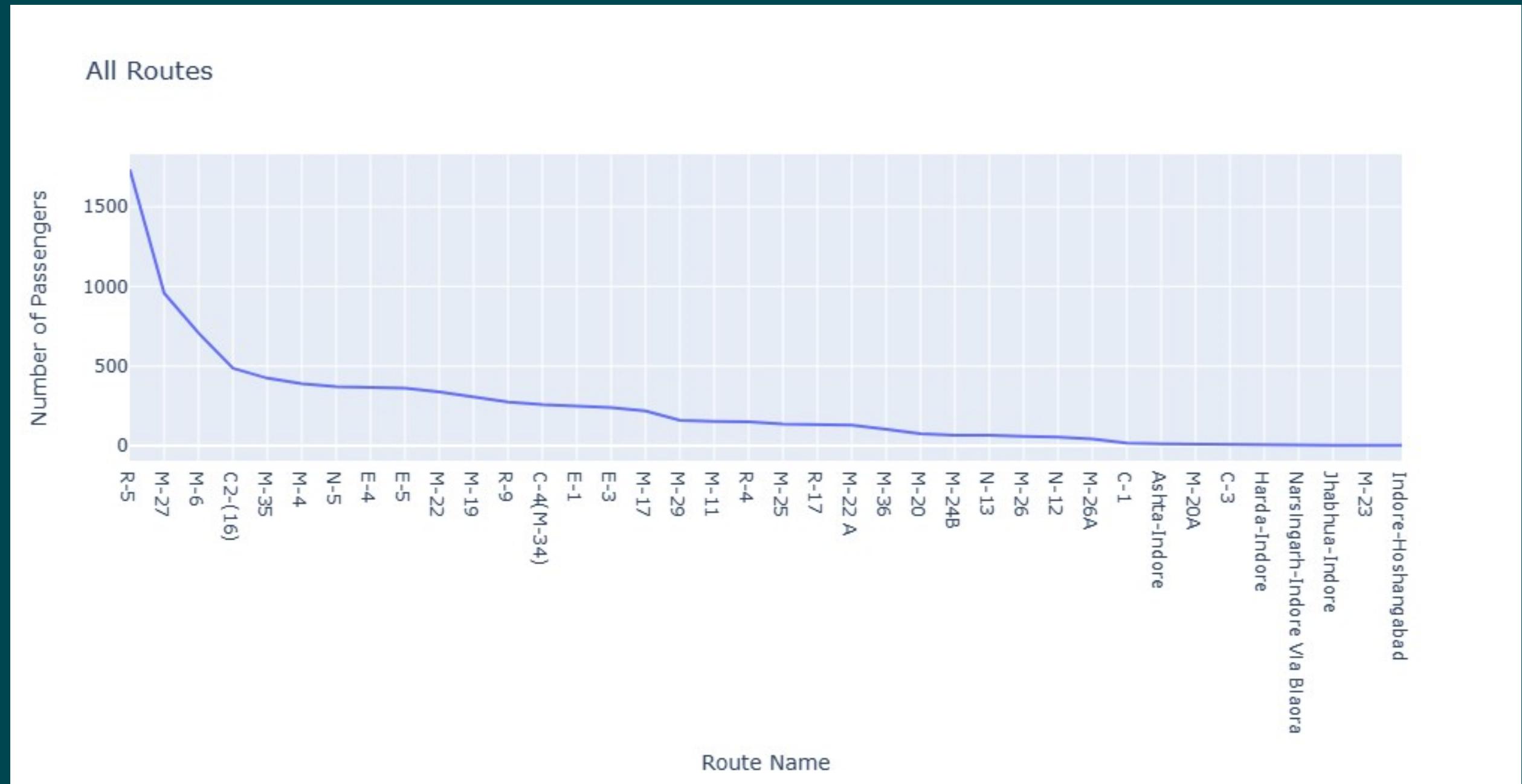
We have conducted an analysis of the data for all the routes in a time interval of 8AM-9AM.

There were some routes which were over-utilized and some routes which were under-utilized.

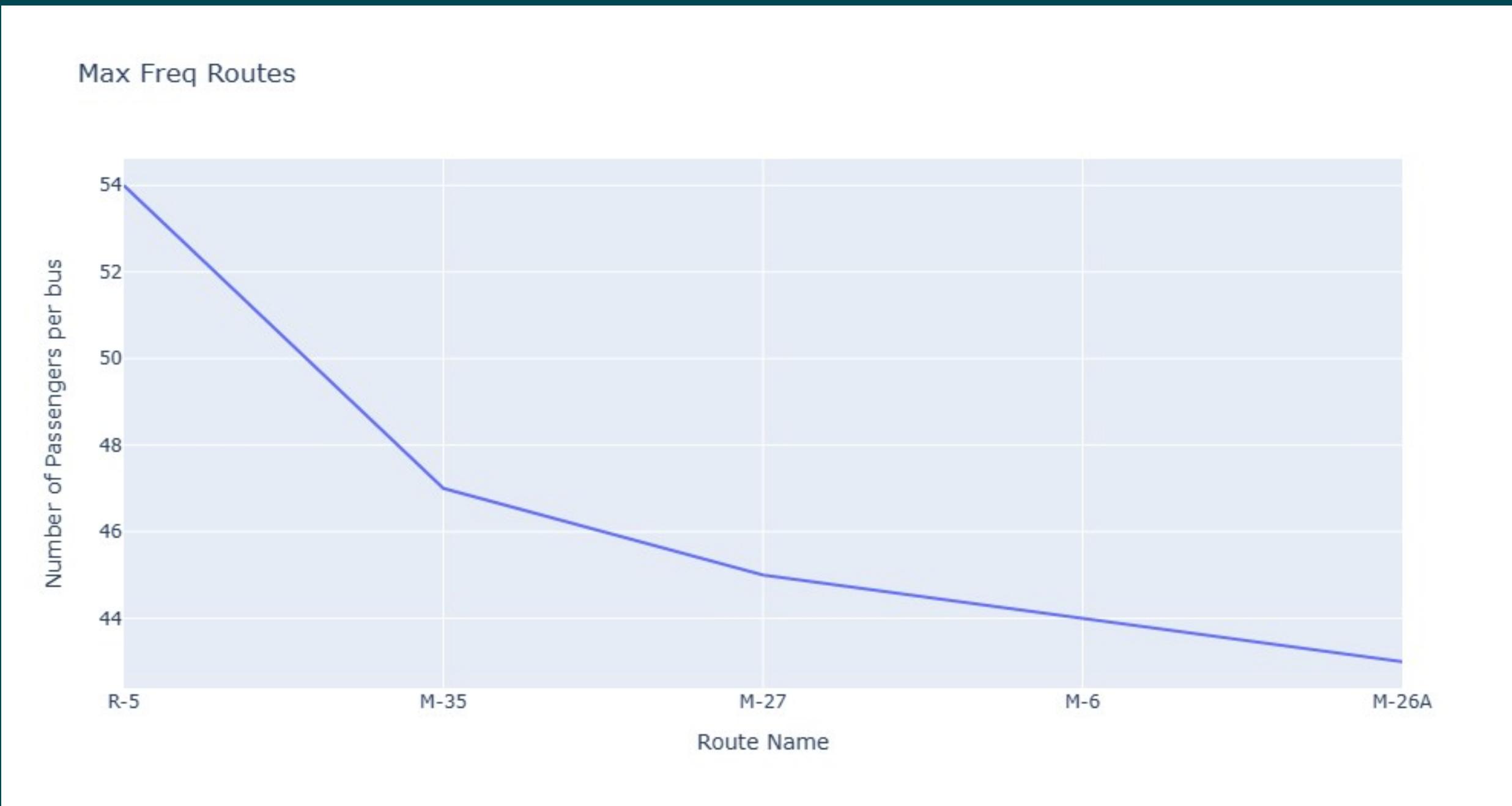
Number of passengers on different routes

Maximum number of passengers
are on route R-5 = 1733

Minimum number of passengers
are on route Indore-
Hoshangabad = 3



Maximum number of passengers per bus on different routes



Minimum number of passengers per bus on different routes



Conclusion :

- We got insights into how passenger numbers fluctuate over different routes
- We can conclude that some routes are under-utilized while others are over-utilized which can be handled by changing the frequency of buses

OBJECTIVE :

To analyse and visualize the number of passengers in a bus at each stops for different trips of buses.

- There are multiple routes with several buses operating on each route.
- The buses undertake multiple trips throughout the day.

We analyzed the bus ridership data for various bus routes and tried to determine the current passenger count on the bus for multiple trips throughout the day.

EXAMPLE

We have conducted an analysis of the data related to bus number **MP09FA6080** across its multiple trips on Route M-6.

- To determine the passenger count at each stop.
- When the bus has the highest number of passengers.

Bus number MP09FA6080

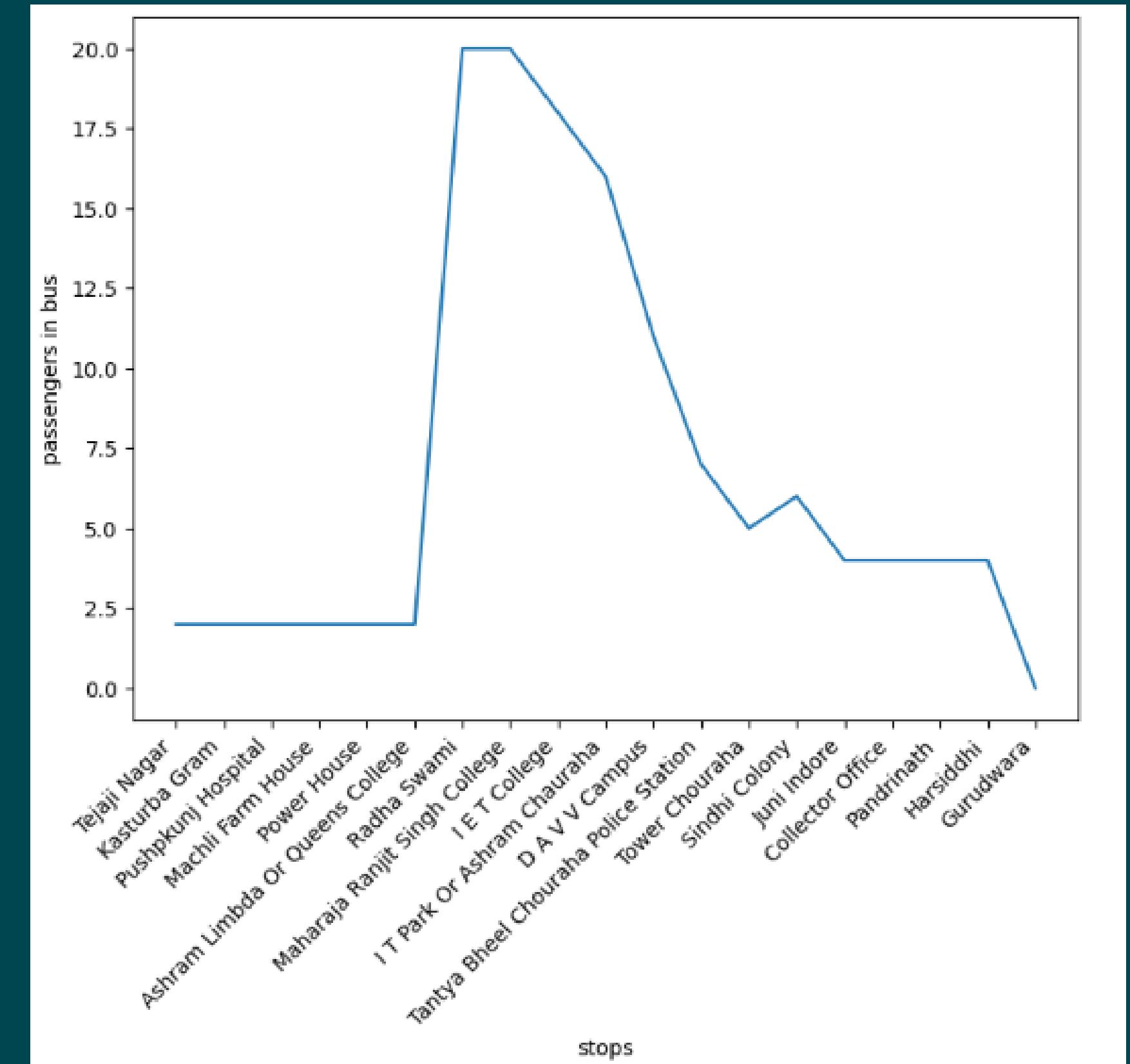
Trip 1

Route : Tejaji nagar to Rajwada

Distance : 10.5 Kms

Trip number : 1

Number of Buses : 8



Bus number MP09FA6080

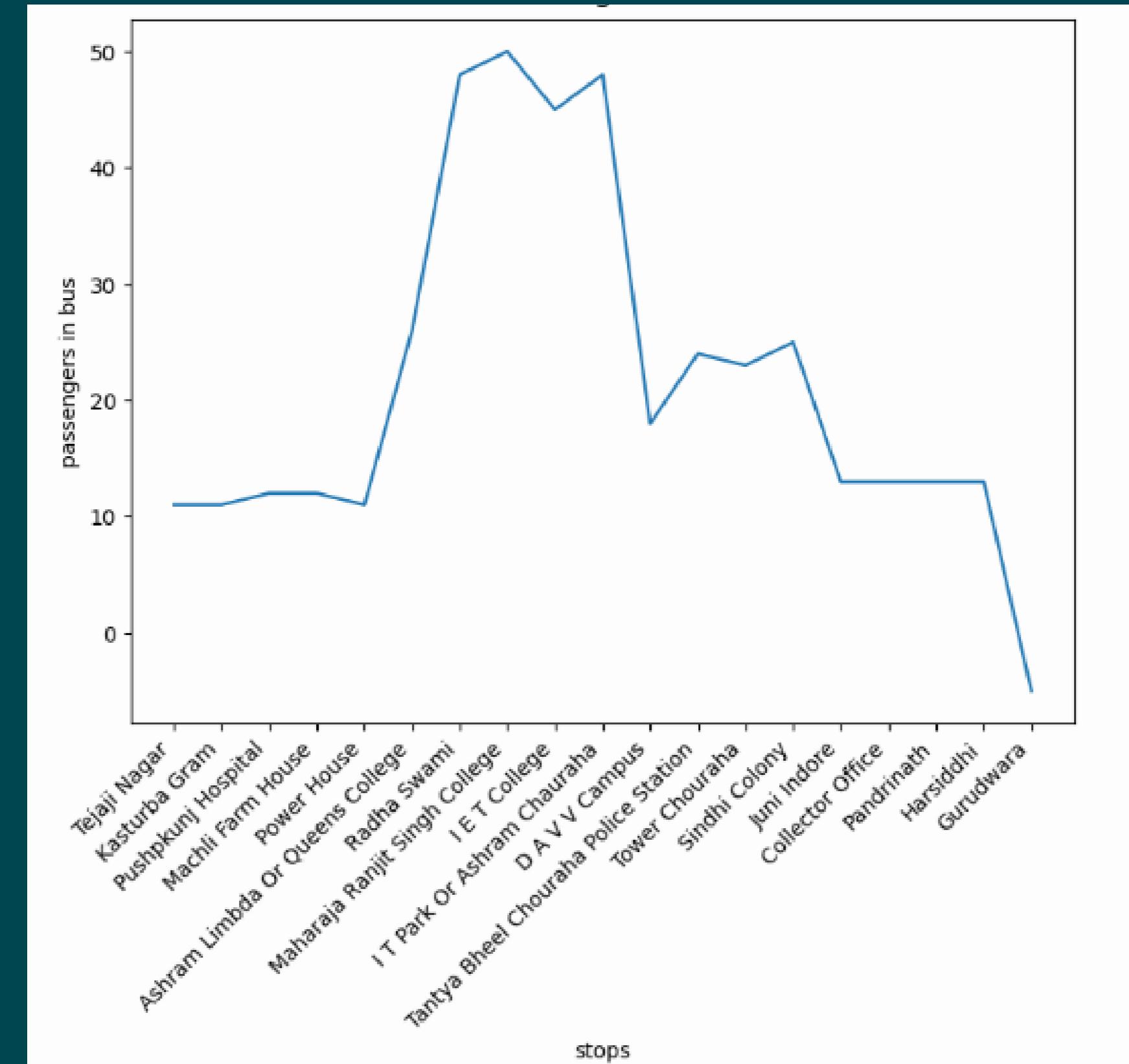
Route **M-6**

Route : Tejaji nagar to Rajwada

Distance : 10.5 Kms

Trip number : 3

Bus Number : MP09FA6080



Bus number MP09FA6080

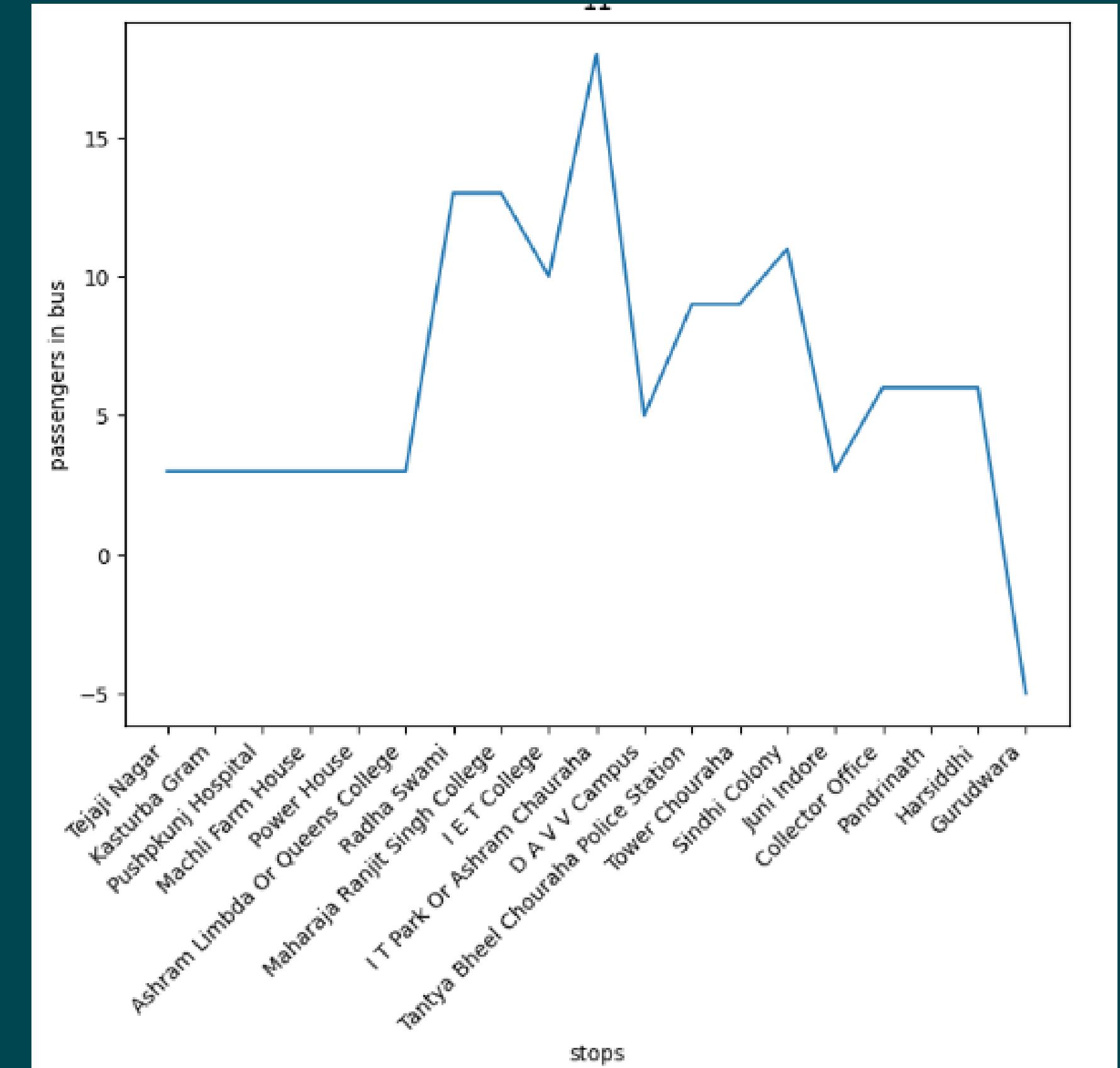
Route **M-6**

Route : Tejaji nagar to Rajwada

Distance : 10.5 Kms

Trip number : 5

Bus Number : MP09FA6080



Conclusion

- **Peak Passenger Count:** Trip 3, which typically begins around 11:15 AM, consistently registers the highest passenger count among all trips throughout the day.
- **Passenger Patterns:** Certain stops along Route M-6 exhibit higher passenger activity compared to others. The region stretches from Radha Swami to Tantya Bheel Choraha.
- **Variation:** The passenger count on bus no. MP09FA6080 varies across different trips and times of the day.

Maps for Visualization

- Density Map illustrating the traffic on each bus route through the number of passengers travelling in a particular time interval.
- Map illustrating ratio of frequency of passengers to frequency of buses for each route during a particular time interval.
- Heat Map representing how busy a stop is through the number of tickets sold in a particular time interval

Passenger Density Map

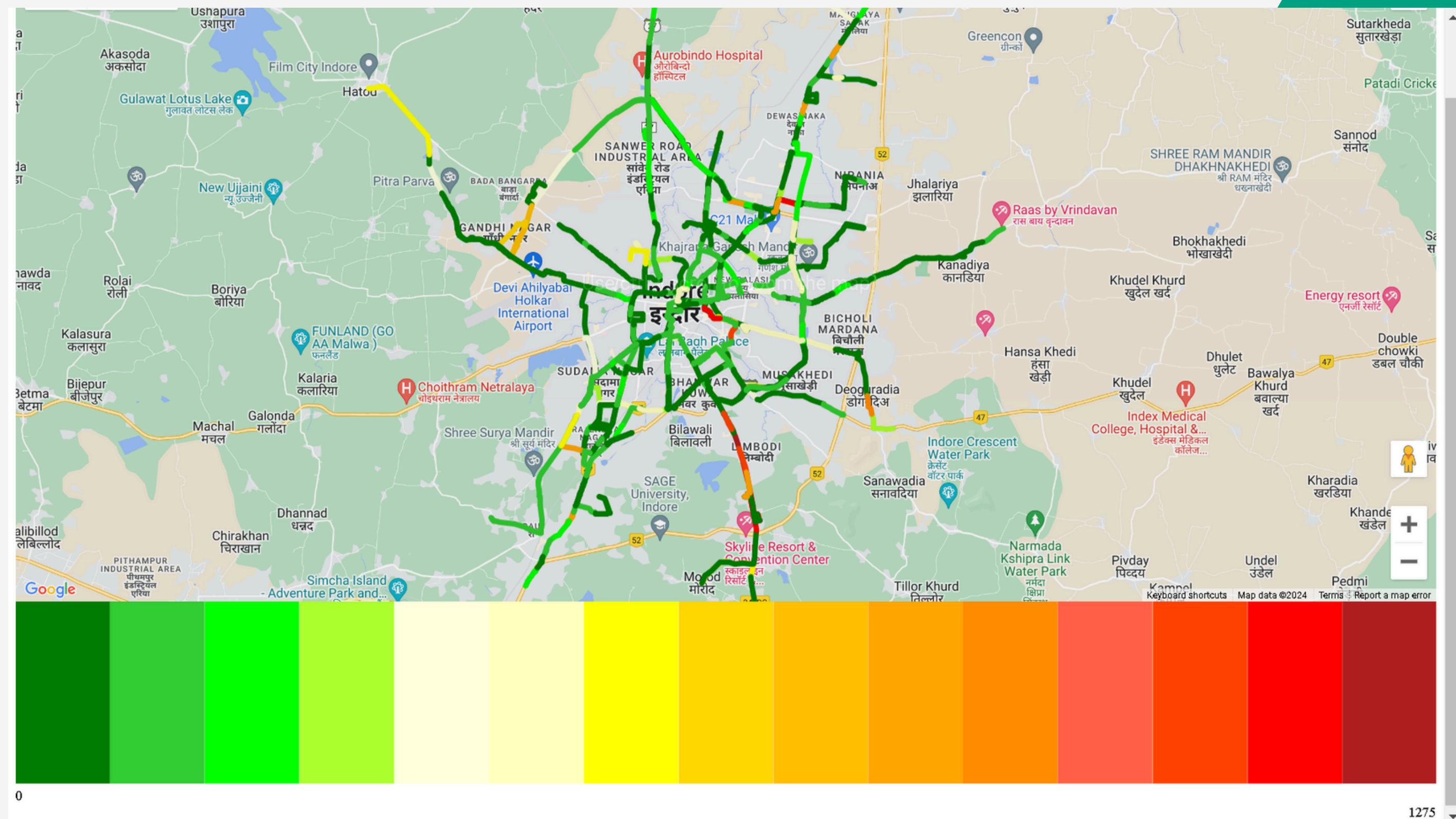
- This map shows the traffic on routes between various bus stops in the city.
- This map helps visualize which routes are busier at what times of a day.
- Colors range from green to red, with the former showing low density and the latter showing high density.

Usage

- Monitoring passenger density can help city bus administrators ensure that buses are not overcrowded, which can improve safety and passenger comfort. It can also help in identifying areas where additional buses or services are needed to reduce overcrowding.
- The map can help in planning services more effectively by identifying routes or time intervals with high passenger demand. This information can be used to adjust schedules, routes, or bus capacities to better serve passengers.
- The map enables administrators to make data-driven decisions to improve bus service quality and efficiency.

12:00 PM TO 1:00 PM

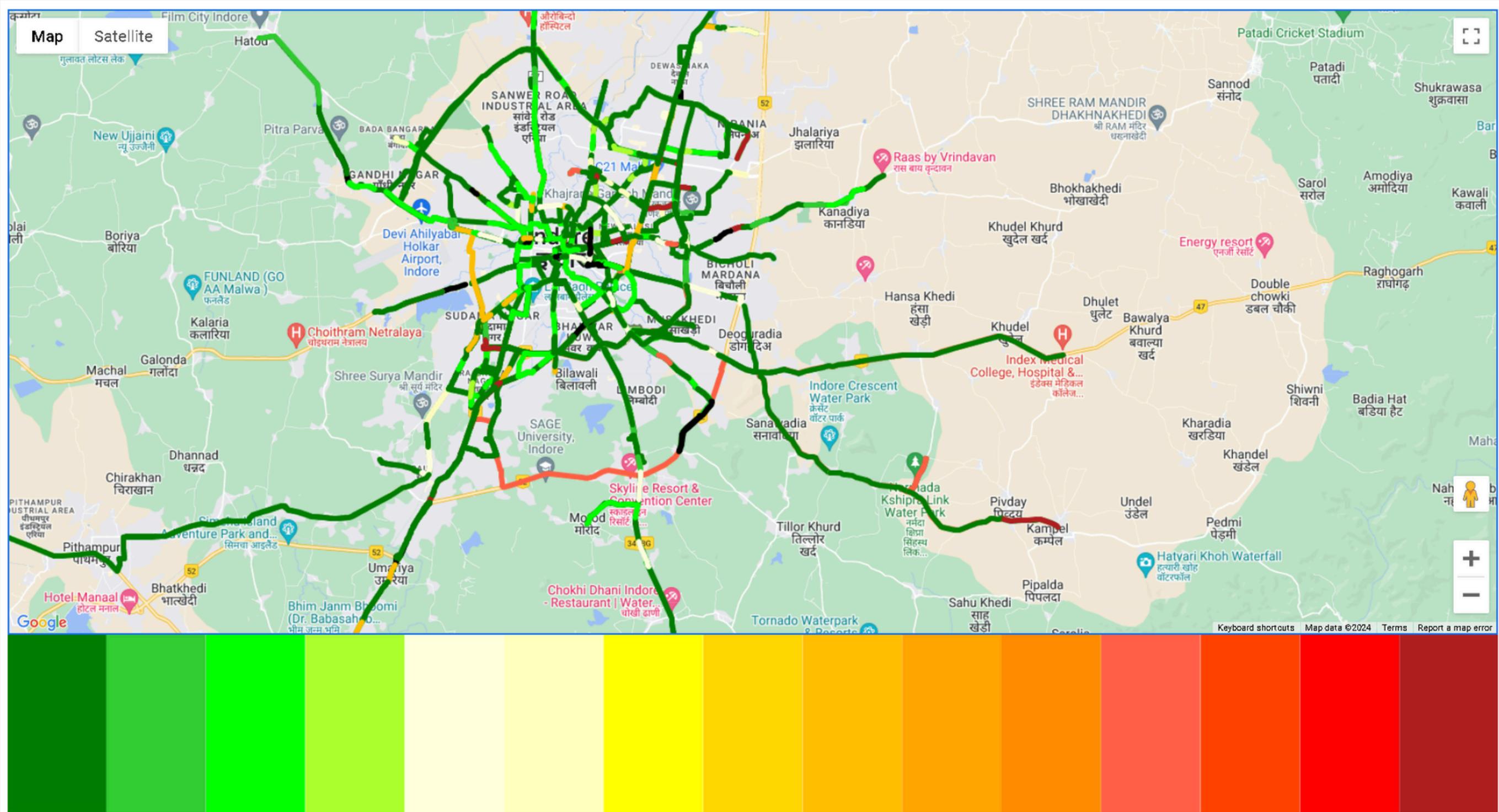
INDORE



Passenger Density

Bus Density : By analyzing the number of buses on each route during different time intervals, administrators can optimize bus deployment to match passenger demand.

12:00 PM TO 1:00 PM



Passenger to bus ratio

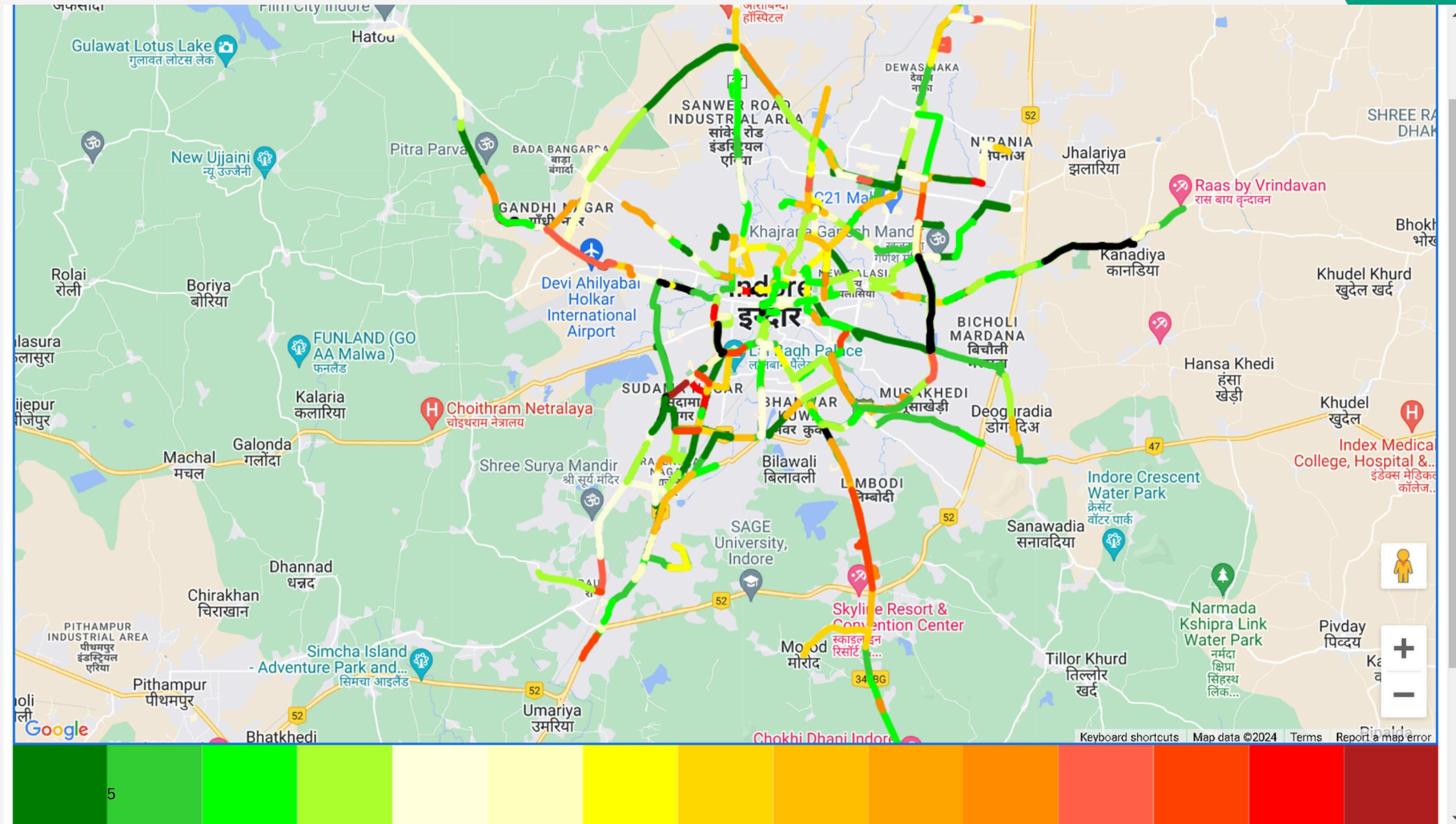
- This map shows the ratio of no of passengers to no of buses on routes between various bus stops in the city.
- This map helps visualize which routes are having heavy passenger load on buses.
- Colors range from green to red, with the former showing low density and the later showing high density.

Usage

- **Identifying High-Density Routes:** The map allows administrators to quickly identify routes with high passenger-to-bus ratios, indicating potential overcrowding issues. This insight enables them to prioritize resources and interventions where they are most needed
- **Efficient Resource Allocation:** By pinpointing routes with heavy passenger loads, administrators can allocate resources more efficiently. This might include deploying additional buses, adjusting schedules, or implementing route changes to better accommodate demand

12:00 PM TO 1:00 PM

INDORE



Passenger to bus ratio during particular time interval

12:00 PM TO 1:00 PM

INDORE

127.0.0.1:5501 says

Route City Centre / High Court_1 to Regal Square has exceeded passenger limit → passenger count 43,

Route Rajmohalla to Malganj has exceeded passenger limit → passenger count 52,

Route Ramchandra Pump / APTC to Badaganpati has exceeded passenger limit → passenger count 70,

Route Badaganpati to Antim Chauraha has exceeded passenger limit → passenger count 52,

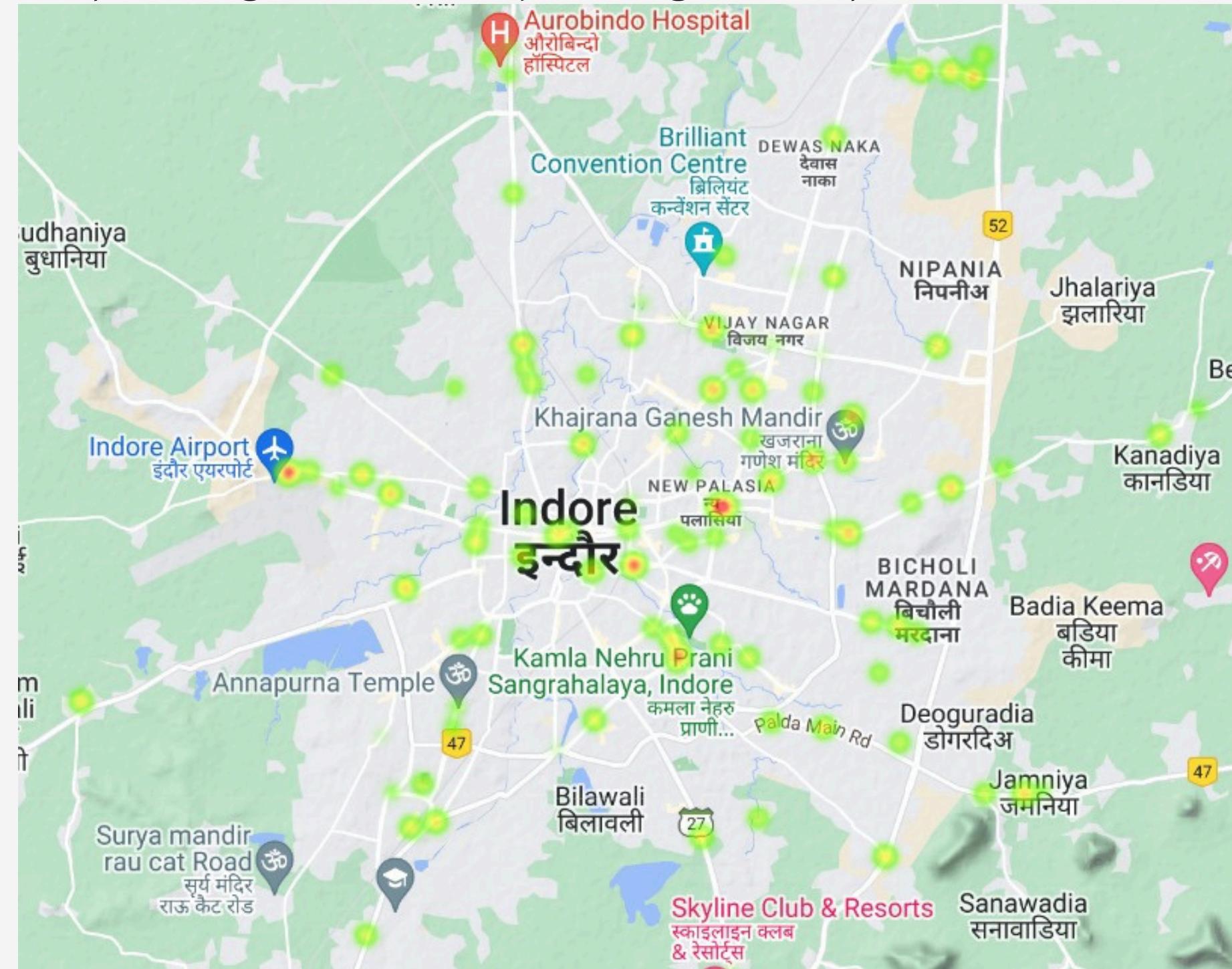
Route Antim Chauraha to Rajmohalla has exceeded passenger

OK

List of routes that exceeds the threshold

Heat Map

- The given map shows how busy various bus stops in the city are at various times of a day.
- This is calculated through the amount of tickets sold per stop in that particular time interval.
- The red color scheme depicts high sales, and yellow-green depicts lower sales.



Algorithm Used For Density Map

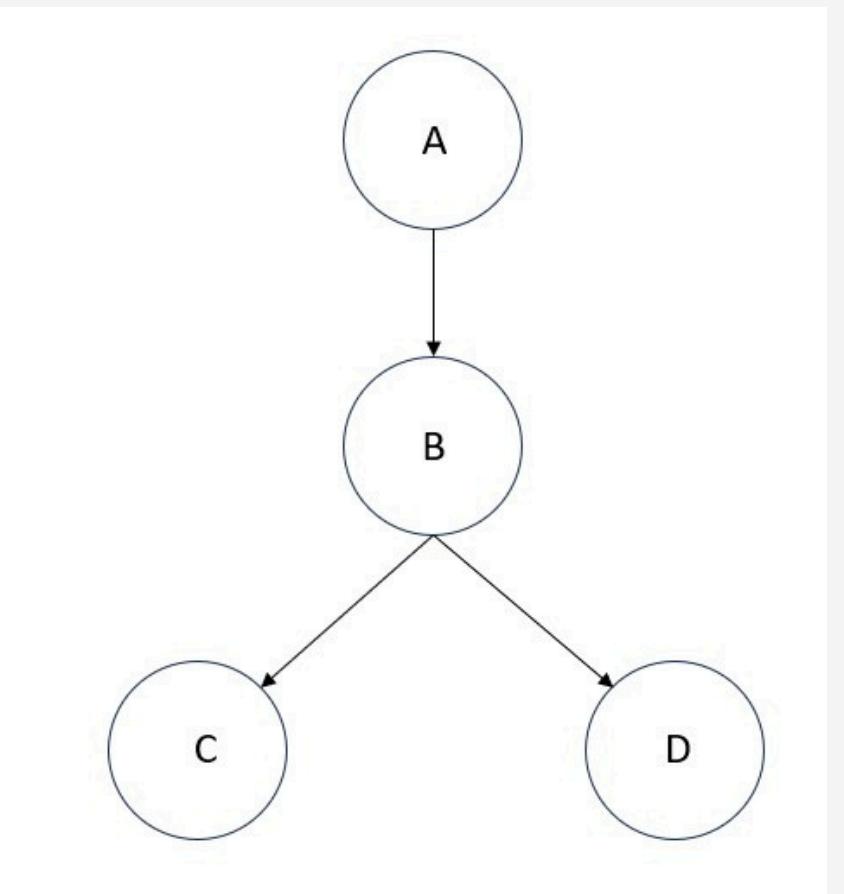
- First we made a function which gives us all the permutations between every two bus stops for each route
- Then as we had the data of various routes and the data of tickets sold on each bus stop, we could calculate the number of passengers in a route.

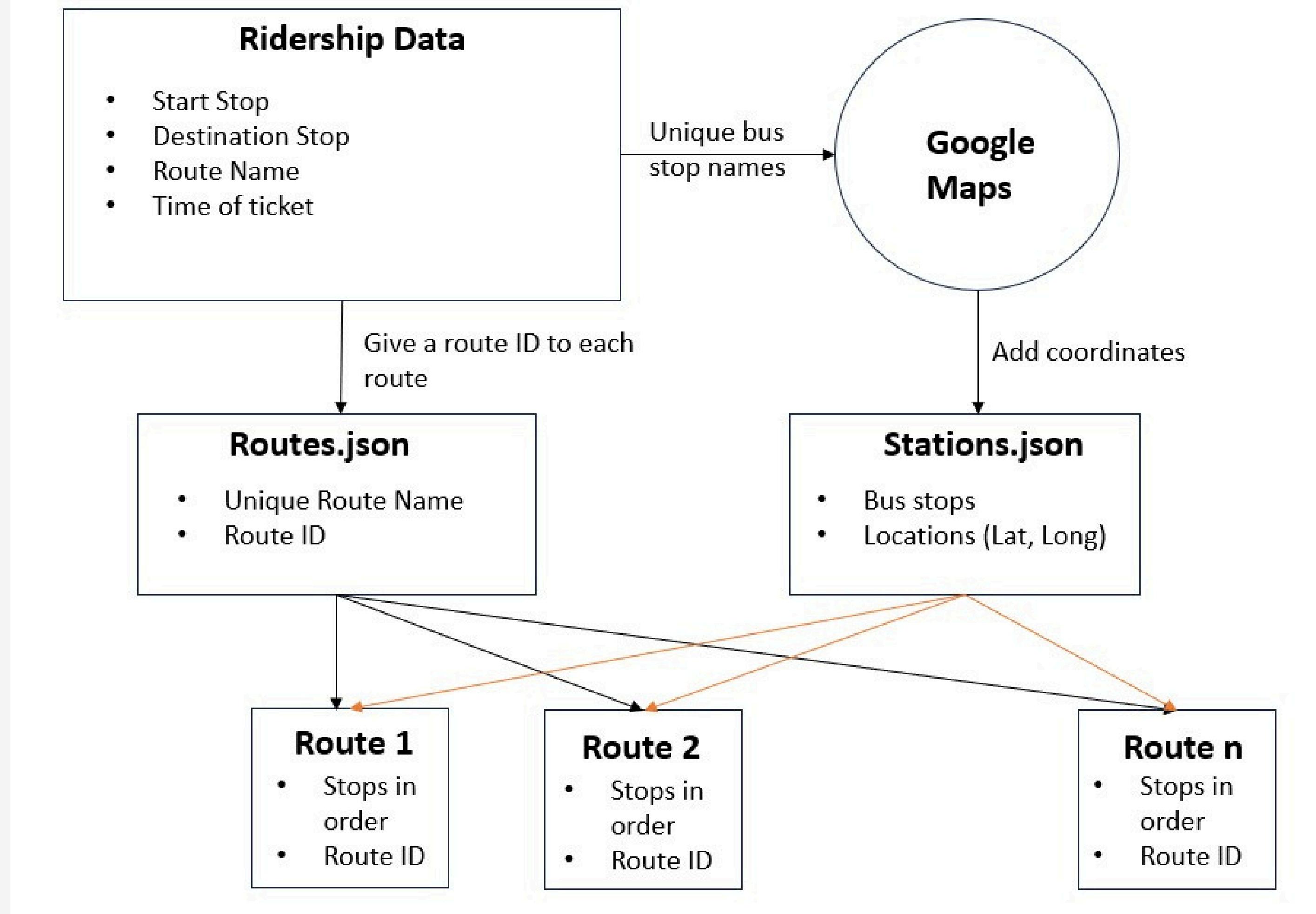
Data Extraction

- We had ridership Data in which we had Start stop and destination stop and its route name along with the time.
- So we took all the unique stop names from this list and then with the help of Google maps, we found out the coordinates of that stops. This is our file number one all stations.Json
- Then we took all the unique roots from the ridership Data and placed them in a separate file all routes.json and gave every root a unique ID.
- Then we made a separate file of every route ID and placed all the stations in the respective order inside every route file.

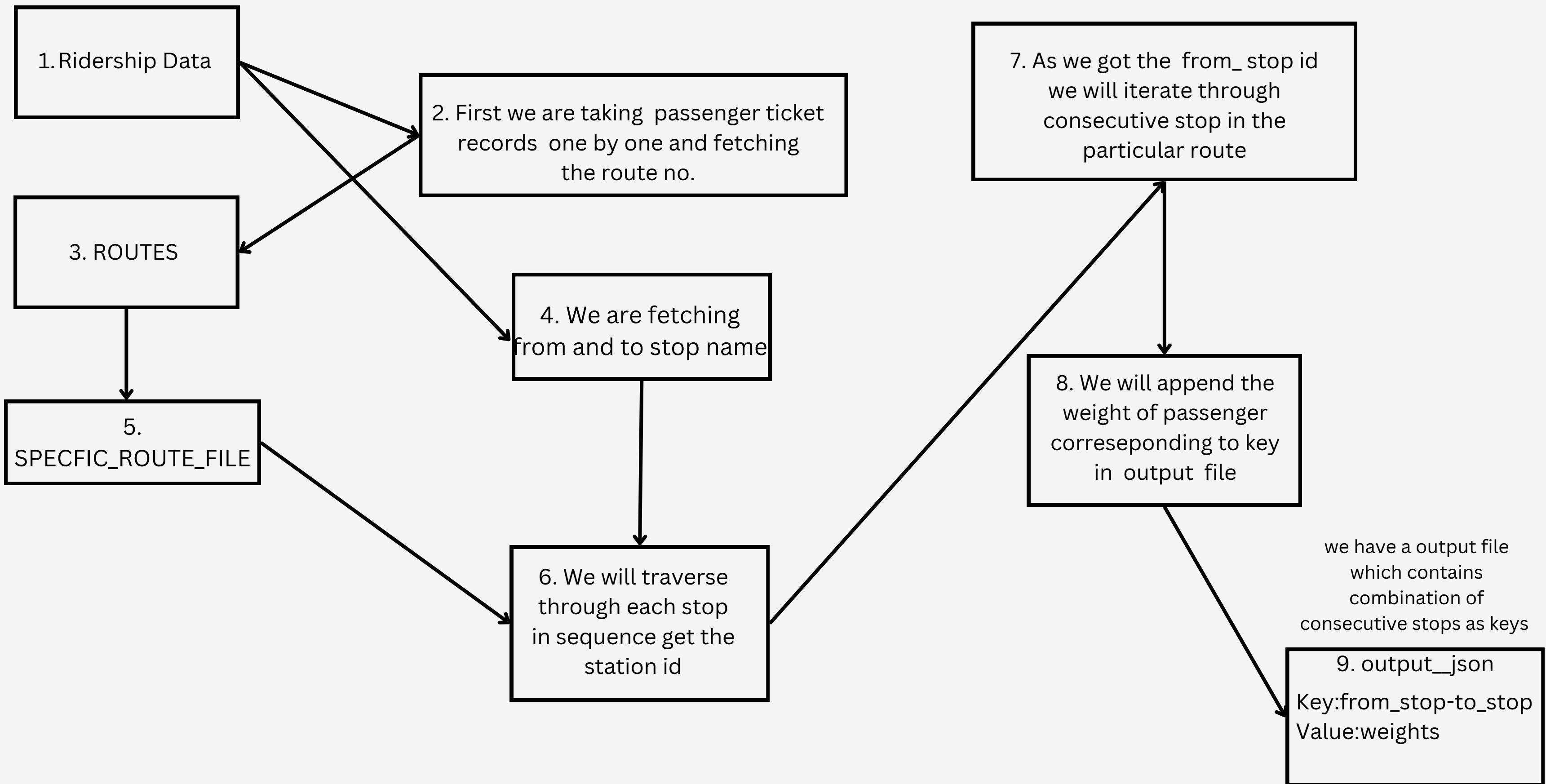
For Example

- Let us consider there are 4 stops - A,B,C,D.
- The paths we see in the given diagram are - AB, BC, BD.
- Now the route can be AC as well as AD.
- To calculate the passengers travelling between two stops, we first calculate the number of tickets bought at bus stop A.
- Let the tickets bought are 50 for AB, we append 50 passengers at AB.
- Let the tickets bought for AC are 30, we append 30 passengers at AB as well as BC.
- Let the tickets bought for AD are 40, we append 40 passengers at AB as well as BD.
- Similarly now we calculate the number of tickets bought at stop B for BC and BD, let them be 20 and 10 respectively.
- Therefore at this given interval of time, we can conclude that a total of 120 passengers are travelling from A to B, while 50 will travel from B to C and 50 will travel from B to D.
- Hence, we calculate the passenger density between each stop. We can do this for any time interval in a day as well as for any route.





Flow for Weight Updation



Action Suggestions

Our proposed approach involves a comprehensive analysis of passenger distribution per bus between each stop. Subsequently, our project provides an alert if a route is exceeding the capacity of passengers-to-bus ratio which helps ensure an equitable spread, effectively maintaining the balance between supply and demand.

How is this solution helpful to the AiCTSL?

The above-mentioned solution offers significant benefits to AiCTSL by providing them with an analysis of the existing passenger-to-bus ratio data. Moreover, it sends an alert to them when capacity of bus increases and helps them take action and provide potential enhancements to system efficiency, along with potential improvements in passenger experience, contingent upon the implementation of recommended measures. Our project endeavours to empower the bus transport authority with actionable insights, enabling them to make informed decisions and undertake appropriate measures based on our assistance.

Our Algorithm

Our algorithm employs a multi-step process to optimize bus routes effectively:

- Segmentation: We begin by dividing the map and routes into the smallest feasible segments, typically the paths between consecutive stops. For instance, if the route AE includes intermediate stops B, C, and D (in sequence), we segment it into AB, BC, CD, and DE segments to facilitate more streamlined analysis.
- Passenger Analysis: Next, we compute the number of passengers traveling between each pair of stops along these segments.
- Bus Allocation: Subsequently, we determine the number of buses currently operating along each segment.

- Ratio Calculation and Current Status Map Generation: Utilizing the passenger and bus data, we calculate the ratio of passengers per bus for each segment, thereby generating a comprehensive map reflecting the current status of the system.
- Redistribution Strategy: At this stage, we send alerts if the passenger-to-bus ratio increases the threshold value which is set at 40 (passengers per bus) to guide the redistribution process.
- Transport authority takes action: This allows for the transport authority to take action accordingly and ensure better utilization of resources.

Technology Used

- JavaScript
- Heatmap API
- Google Maps Route



THANK YOU