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ASSESSMENT AND PLANNING OF SURFACE TRANSPORTATION SYSTEM IN MEHSANA CITY

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Abstract: Road Networks are used to move people and transport goods. Mehsana city in Mehsana district of Gujarat state requires detailed network analysis for the development of communication system including roads connecting within the district and with other area adjacent to the Mehsana city with industries, hospitals, Education centers, airport (training base), railway station and bus terminal etc. Inefficient road network system will disrupt the transportation movement, environment and affect efficiency of traffic movement and quality of life. The main objective of this study is to develop a surface transport network system to reduce travel time and cost. In research work prepare an existing route with a station in Google Earth then after completed O-D survey concluded for route extension of Route number 8, the including station ONGC Office, GPERI College and Shanku Water Park. Existing routes of Mehsana City have been studied and alternative routes have been suggested for proper planning of road network system using Google Earth and GIS. Network analysis is being carried out to solve the problems pertaining to spatial networks including the most efficient travel route, generating travel directions, locating the closest facility, and defining service areas based on travel time and distance covered using geo-informatics technology.

Index Terms: **Road network system, public transportation, GIS, Google earth analysis**

I. INTRODUCTION

Indian states are becoming more and more urban and has witnessed urbanization rate of 35% in the year 2020. This increase in the population put burden on demand and supply of the primary infrastructure in urban areas. Also, at the same time changing lifestyle of the urbanisms stressed on basic infrastructure. On the other side, under developed or undeveloped rural, small and medium town's population try to push themselves in search of employment and better infrastructure which tends to end up as the migrants of developed urban areas. The villages or towns neighbouring to the metros may rely on those metros for their needs, but in absence of such metros in regional context, they are migrating to the other developed region. The migrated population, due to the industrialization and more urbanized region, try to settle in the developed region which results into the requirement of more infrastructure provision. This unexpected migration will create false estimation of demand in cities after 20-30 years down the line. In the above context, it is also observed that the areas/region developed as the industrial area in absence of basic amenities and lack of infrastructure are not accepted by the workers or employees as the residential location choice and hence, they select residential area in nearby metros.

As an urban planner, it is difficult to measure the demand and supply due to the unexpected growth of migration and is also difficult to predict the choice behavior of the workers or employees. These challenges are taken up by developing better regional balanced area planning. Second issue in the small and medium towns, urbanization scenario changes as we go from core city to outer peripheral area. These changes are observed in land use, density, economic activity, etc. because of the time gap in implementation of the plans. In order to propose the development plan of an area, it is Essential to study its existing condition and its future need which was lacking in the past plans along with the time frame of its completion.

Road network system is important for any city as it provides the means for people movement transportation of goods and other emergency services like ambulances. Inefficient road network system will disrupt the transportation movement, environment and affect human movement and quality of life. A good road network can improve and generate many things into improvements of town and its surroundings.

Mehsana city is the administrative headquarters of this district. The district has a population of over 1.8 million and an area of over 4,500 km2. There are over 608 villages in this district with a population of 2,035,064 of which 22.40% were urban as of

2011.Mehsana district borders with Banaskantha district in the north, Patan and Surendranagar districts in west, Gandhinagar and Ahmedabad districts in south and Sabarkantha district in the east.

Major towns of the district are Mehsana, Vijapur, Bahucharaji, Satlasana, Modhera, Unjha, Vadnagar, Kalol, Kadi, Visnagar, Kherva, Jotana and Kheralu.

Mehsana (23º35'N 72º22'E) is a part of Mehsana district in Gujarat state having total area of 31.8 km2. Population of Mehsana city is1, 84,991 as per the census of 2011. The city of Mehsana is located on the Ahmedabad-Delhi highway at a distance of 35 km from Ahmedabad at an altitude of 35 feet above sea level. Literacy of city is 89.64%. Hinduism is majority religion in Mehsana city with 88.18 % followers. Islam is second most popular religion in city of Mehsana with approximately 9.26 % following it.

To Date, most development theory and practice have focused on either "urban" or "rural" issues with little consideration of the interrelations between the two. By contrast, several empirical studies show that the linkages between urban centers and the countryside, including movement of people, goods, capital and other social transactions, play an important role in processes of rural and urban change. Within the economic sphere, many urban enterprises rely on demand from rural consumers, and access to urban markets and services is often crucial for agricultural producers. In addition, a large number of households in both urban and rural areas rely on the combination of agricultural and non-agricultural income sources for their livelihoods.

II. LITERATURE SURVEY

Access to urban parks: Comparing spatial accessibility measures using three GIS-based approaches by Wang, S., Wang, M., & Liu, Y., Elsevier 90 2021[1]. Urban Road Network Analysis Using GIS Software: A Review by Kasahun, T., Juremalani, J., & Gupte, Journal of Emerging Technologies and Innovative Research (JETIR), April 2018[2]. Transportation Planning through GIS and Multicriteria Analysis: Case Study of Beijing and XiongAn by Farooq, A., Xie, M., Stoilova, S., Ahmad, F., Guo, M., Williams, E. J. . . . Issa, A. M., Journal of Advanced Transportation Volume 2018[3]. Planning of Transport Network of Nadiad City Using Geo-Informatics Technology by Doshi, R., Juremalani, J., & Prakash, I., International Research Journal of Engineering and Technology (IRJET), Apr -2017[4]. An Evaluating Method of Public Transit Accessibility for Urban Areas Based on GIS by Yan-yan, C., Pan-yi, W., Jian-hui, L., Guo-chen, F., Xin, L., & Yi, G., Elsevier, 2016[5]. The Easy Accessibility and Reliability to Passengers: A Case Study of Anand City by Patel, D., & Dave, K., International Journal of Innovative Research in Science, engineering And Technology, April 2015[6]. Transportation Network Analysis by Using Remote Sensing and GIS A Review by Nagne, A. D., & Gawali, D. W., International Journal of Engineering Research and Applications (IJERA), May-Jun 2013[7]. Road Network Analysis Using Geoinformatics Technique for Akola City, Maharashtra State, India by Kakade, R. R. (2013). International Journal of Engineering Research & Technology (IJERT), August – 2013[8]. Accessibility Analyst: An Integrated GIS Tool for Accessibility by Liu, S., & Zhu, X., Environment and Planning B: Planning and Design, 2004[9].

III. STUDY AREA AND METHODOLOGY

Mehsana district lies between 72.29`-73.49` East (Longitude) to 23.39`-24.9` North (Latitude) on the World Map. Geographical area of the district is 4484.10 sq. km. Mehsana city (23.35°N 72.22°E) is a part of Mehsana district in Gujarat state and having a total area of 45.09 km2. Population of Mehsana is 184991 as per the census of 2011. Mehsana city connect to northern part of Gujarat and Ahmedabad so we said easy its located center of North Gujarat. The city lies in the Northern side of district in Mehsana district but important for the ceramic business, agriculture product and Dairy product. Mehsana city is a head quarter of a district and district included 10 talukas and 614 villages. It has an average elevation of 35 meters (114 feet). The area is occupied by mainly three types of soil alluvial, well-drained calcareous and coarse loam.

A research methodology gives research legitimacy and provides scientifically sound findings. It also provides a detailed plan that helps to keep researchers on track, making the process smooth, effective and manageable in our research work after completed literature Study and make a methodology for transportation planning in first step is field survey and Network analysis. In second step finding a route which has a problem then for the improvement take an O-D survey and analyses data of O-D survey. After complete analysis of Data and arrange all data in various category and questionnaire and take suggestion from Travelers and agencies of city bus management. In third Stage with help of GIs carried out buffering of Area and find maximum people use a public transport service and prepare route or Modified route with schedule and provide better service to people of City.

Various steps:

Step 1: Define Study area and Methodology
Step 2: Data collection
Step 3: Data analysis
Step 4: Proposal and Conclusion

IV. DATA COLLECTION

The present study aims at generating the future forecast scenario which is useful for deciding the demand of future public transportation. So, data was collected in terms of population, density, census, Geo-spatial data, satellite images, public demand survey, O-D survey and remote sensing images which are used for forecasting the population and demand which will be needed in 2021. The type of data collected are as follows:

1. Primary data

Site visit, Observations and Informal Questioning to the head of authorities.

2. Secondary data

This includes data collected in the form of existing reports, census data, annual progress reports, case study and city development plan.

3. GIS data

This involves collection of Satellite images, maps and other related GIS data useful for the analysis purpose.

- For the purpose of understanding the area and fixing the parameters upon which it can be planned, site visit was carried and based on observation following notes are made.

1) The Railway station, New Bus station, Radhanpur chokdi, Modhera chokdi are the busiest area with congestion and mix traffic ranging from bicycles, auto, private vehicles.
2) Mass transport is less preferable due to less frequency.
3) Vegetable and shopping market are present.
4) Industries attracting population of Visnagar, Unjha, Kadi and with dependency on private vehicles and company buses.
5) Dried out water ponds.
6) New townships and apartments being developed.
7) Kalol, Vijapur, Unjha, Kadi and Visnagar are the nearby growth centers.
8) Presence of recreational areas.

- With the use of satellite images and software, the base map of Mehsana is generated. This base map is used at later stage for the site location and selection.

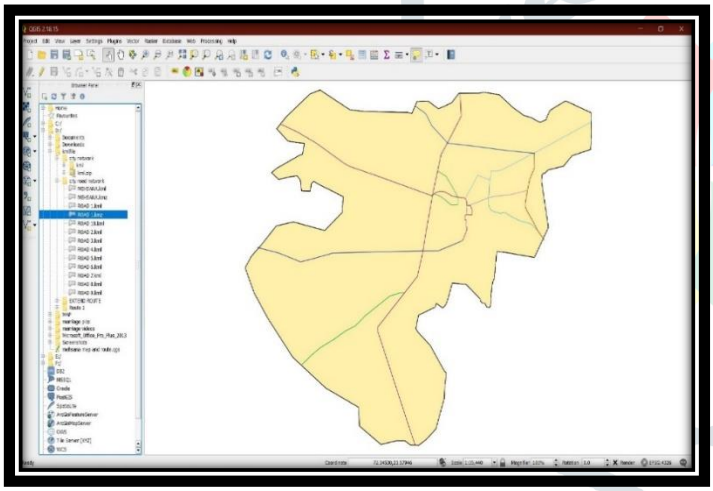


Figure 1: Mehsana City Road Network in GIS

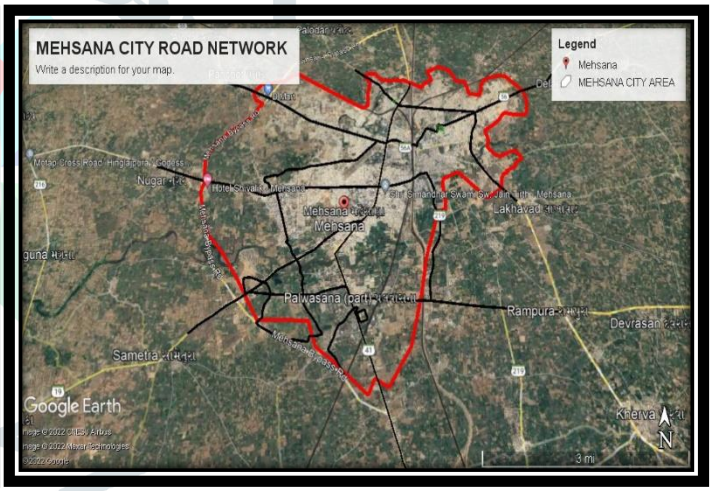
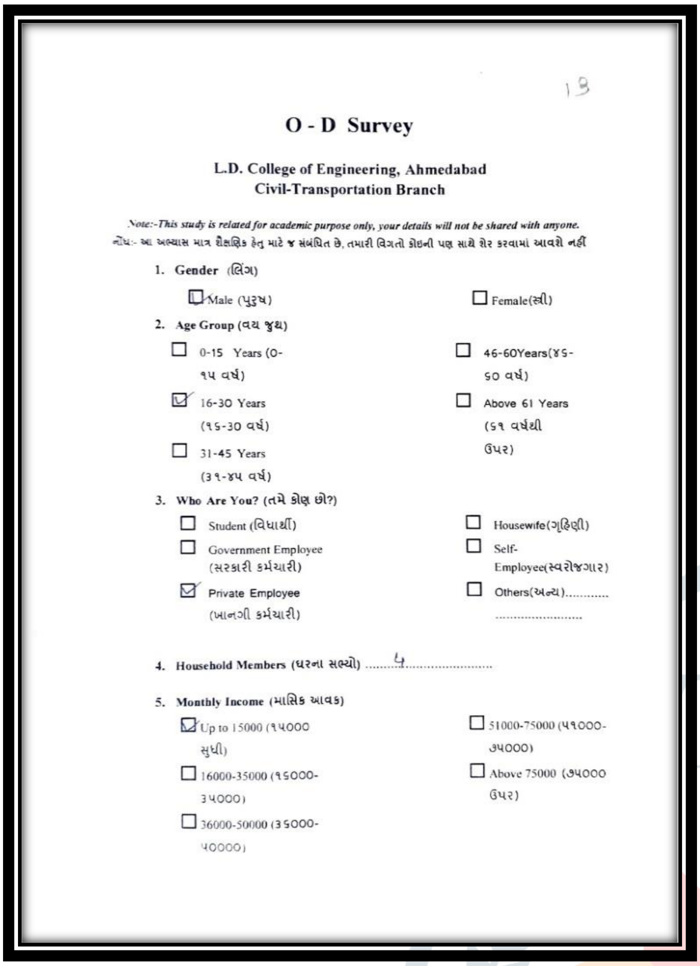


Figure 2: Satellite Image of Road Network of Mehsana City



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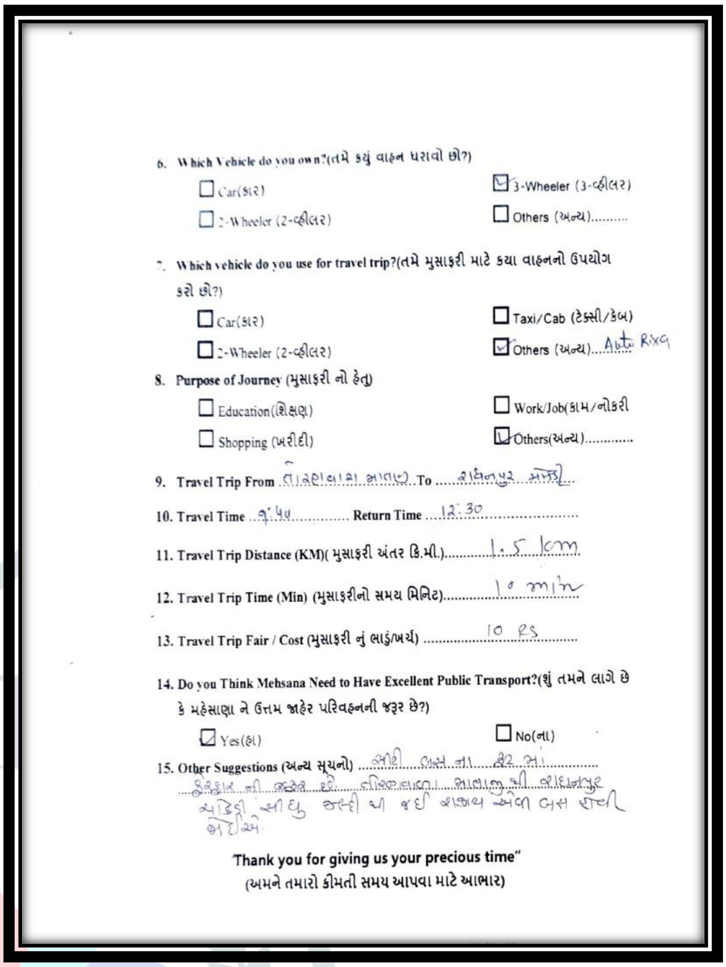
O - D Survey

L.D. College of Engineering, Ahmedabad
Civil-Transportation Branch

Note:-This study is related for academic purpose only, your details will not be shared with anyone.
નોંધ:- આ અભ્યાસ માત્ર શૈક્ષણિક હેતુ માટે જ સંબંધિત છે, તમારી વિગતો કોઇની પણ સાથે શેર કરવામાં આવશે નહીં

1. Gender (લિંગ)
   - ☑ Male (પુરુષ)
   - ☐ Female(સ્ત્રી)
2. Age Group (વય જુથ)
   - ☐ 0-15 Years (૦-૧૫ વર્ષ)
   - ☑ 16-30 Years (૧૬-30 વર્ષ)
   - ☐ 31-45 Years (૩૧-૪૫ વર્ષ)
   - ☐ 46-60Years(૪૬-૬૦ વર્ષ)
   - ☐ Above 61 Years (૬૧ વર્ષથી ઉપર)
3. Who Are You? (તમે કોણ છો?)
   - ☐ Student (વિધાર્થી)
   - ☐ Government Employee (સરકારી કર્મચારી)
   - ☑ Private Employee (ખાનગી કર્મચારી)
   - ☐ Housewife(ગૃહિણી)
   - ☐ Self-Employee(સ્વરોજગાર)
   - ☐ Others(અન્ય)...........
4. Household Members (ઘરના સભ્યો) ....4....
5. Monthly Income (માસિક આવક)
   - ☑ Up to 15000 (૧૫૦૦૦ સુધી)
   - ☐ 16000-35000 (૧૬૦૦૦-૩૫૦૦૦)
   - ☐ 36000-50000 (૩૬૦૦૦-૫૦૦૦૦)
   - ☐ 51000-75000 (૫૧૦૦૦-૭૫૦૦૦)
   - ☐ Above 75000 (૭૫૦૦૦ ઉપર)

Figure 3: Filled sample of Questionnaire Page.1



6. Which Vehicle do you own?(તમે કયું વાહન ધરાવો છો?)
   - ☐ Car(કાર)
   - ☐ 2-Wheeler (2-વ્હીલર)
   - ☑ 3-Wheeler (3-વ્હીલર)
   - ☐ Others (અન્ય)..........
7. Which vehicle do you use for travel trip?(તમે મુસાફરી માટે કયા વાહનનો ઉપયોગ કરો છો?)
   - ☐ Car(કાર)
   - ☐ 2-Wheeler (2-વ્હીલર)
   - ☐ Taxi/Cab (ટેક્સી/કેબ)
   - ☑ Others (અન્ય)...Auto Rixa
8. Purpose of Journey (મુસાફરી નો હેતુ)
   - ☐ Education(શિક્ષણ)
   - ☐ Shopping (ખરીદી)
   - ☐ Work/Job(કામ/નોકરી
   - ☑ Others(અન્ય)............
9. Travel Trip From ...[illegible]... To ...[illegible]...
10. Travel Time ...9:45...... Return Time ...12:30......
11. Travel Trip Distance (KM)(મુસાફરી અંતર કિ.મી.).......1.5 km
12. Travel Trip Time (Min) (મુસાફરીનો સમય મિનિટ).......10 min
13. Travel Trip Fair / Cost (મુસાફરી નું ભાડું/ખર્ચ) ....10 RS
14. Do you Think Mehsana Need to Have Excellent Public Transport?(શું તમને લાગે છે કે મહેસાણા ને ઉત્તમ જાહેર પરિવહનની જરૂર છે?)
   - ☑ Yes(હા)
   - ☐ No(ના)
15. Other Suggestions (અન્ય સૂચનો) ...[illegible]...

Thank you for giving us your precious time"
(અમને તમારો કીમતી સમય આપવા માટે આભાર)

Figure 4: Filled sample of Questionnaire Page.2

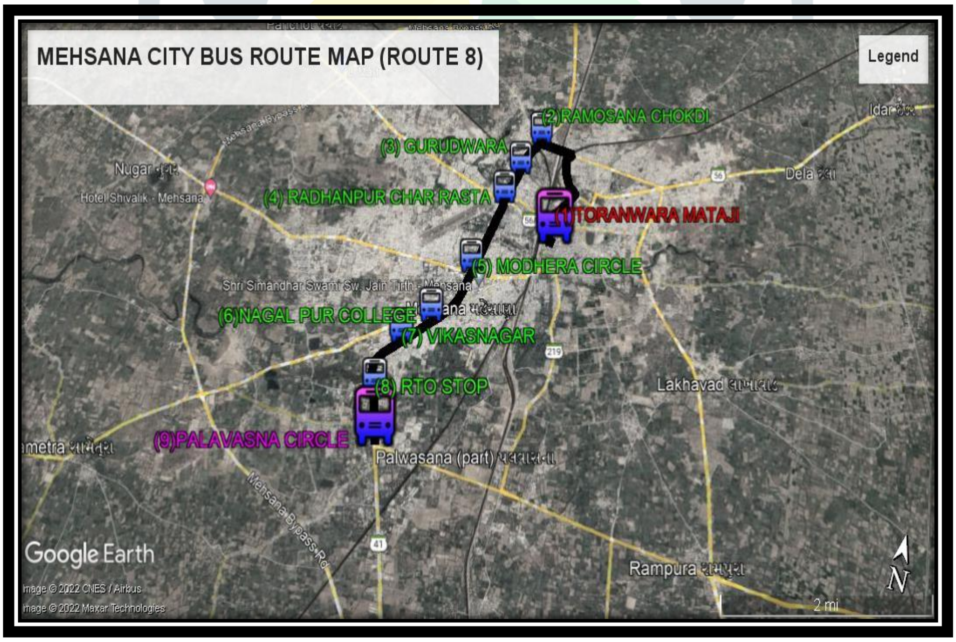


Figure 5: Existing Route of City Bus for Route No.8

V. DATA ANALYSIS

Radhanpur chokdi is meeting point of the Chanasma Road, Ramosana road, Dairy Road and Gurudwara road. It is a last stop of private vehicle which comes from Palanpur, Patan, Deesa, Dhanera and Radhanpur and rural traveler of Mehsana district who's live in northern side of district.

Table 1: Analysis of Traveller Movement Direction from Radhanpur Chokdi

From	To	No of Traveler
Radhanpur Chokdi	**Ahmedabad side**	113
Radhanpur Chokdi	**Himmatnagar side**	81
Radhanpur Chokdi	**Becharaji side**	57
Radhanpur Chokdi	**Upto Palavasna Chokdi**	114
Radhanpur Chokdi	**Palavasna Chokdi to Saffrony**	85

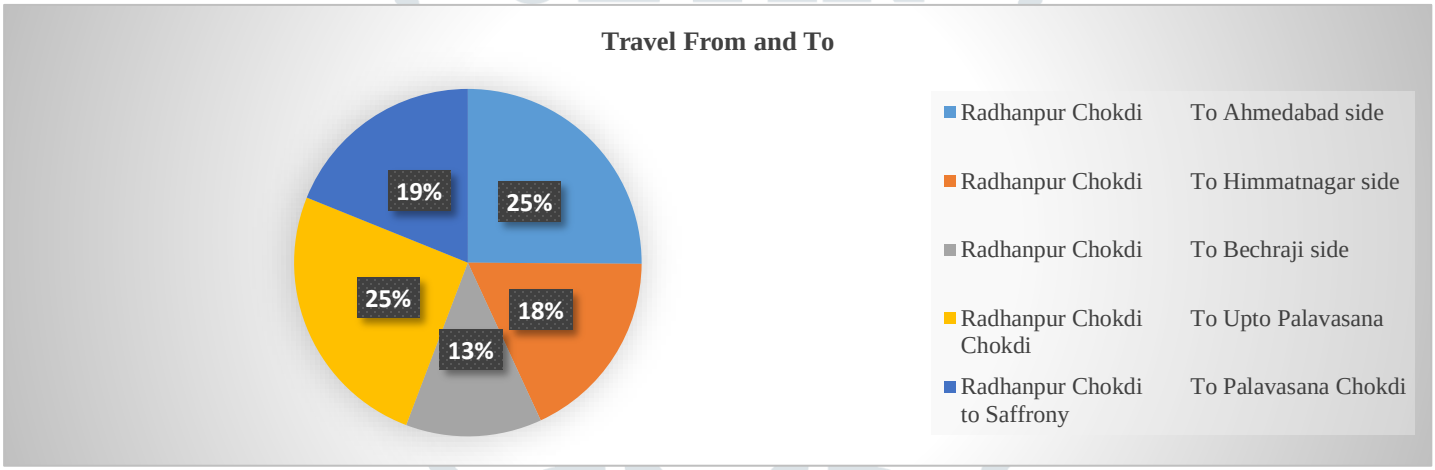


Figure 6: Pie Chart of Travel Movement Direction of Traveller

- **O-D Analysis**

Table 2 Analysis of Vehicle Use for Travel Trip

Type of Vehicle	Frequency	Percentage
CAR	58	12.88
2-WHEELER	86	19.12
3-WHEELER(RICKSHAW)	174	38.67
CITY BUS	132	29.33
Total	450	100.0

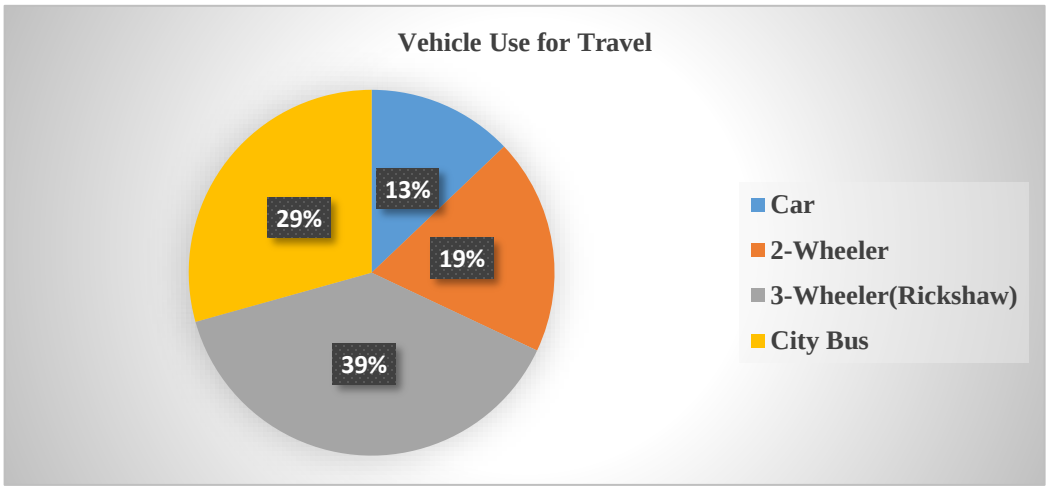


Figure 7: Pie Chart of Use of Vehicle for Travel

Table 3: Analysis of Need of Public Transport

Response	Frequency	Percentage
YES	431	95.78
NO	19	4.22
Total	450	100.0

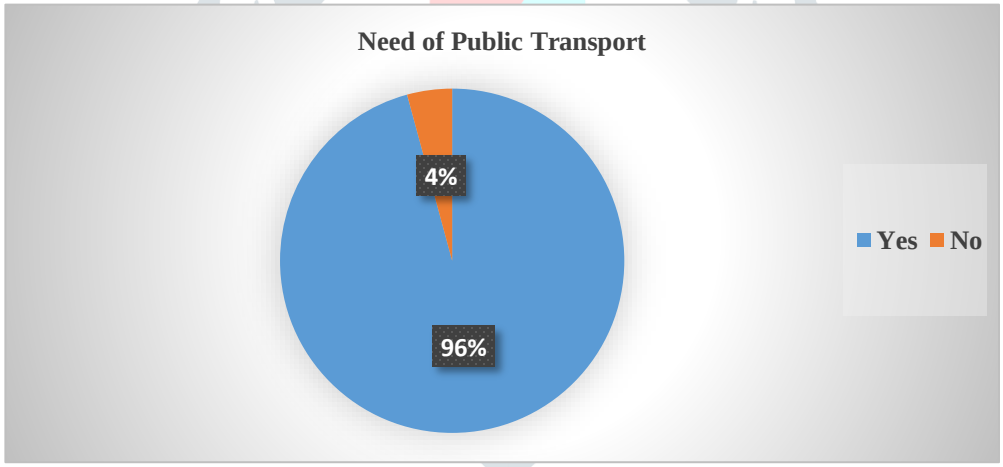


Figure 8: Pie Chart for Need of Public Transport

DATA INTERPRETATION

- Likewise, different charts can be made on the basis of Gender, Age Group, Occupation, No. of Household Members, Income Group, Vehicle Ownership, Purpose of Journey, Journey travel time and cost etc. which will give the overall idea of the current situation in Mehsana City.
- Origin-Destination (O-D) surveys provide a detailed picture of the trip patterns and travel choices. An O-D survey carried out for transportation planning of Mehsana city. In a first step meet to transport officer of public transport service Mehsana city. The detail

of all route provides by officer. Analyse all data and finalized that some modification, improvement in route and new route for citizen better service provision.

- A data analysis of O-D Survey of Mehsana town summary is below:

  - A data sample 450 there is 65.10% male travel for various purpose on day time and female 34.90% travelling. Among 34.9 percentage only 18.80 lady travel for job and business purpose.
  - The age group 16-30 travel more than another group. Senior citizen not feel comfort during travel in city but most senior choose the city bus for the travelling.
  - In our data 134 private employs out of 450 whose travel by 2 wheelers, 3 wheeler and 4-wheeler. But 83 employees use a private transportation facility and paid more than city bus ticket.
  - A student use a private transportation service in morning for reach at time in institute.
  - 31 travelers destination is Ahmedabad, for reduce a travel time and for reduce travel time pick up a private vehicle. Many travelers want to go at Palavasna chokdi for pick private transportation.
  - The total 102 student travel -41 student of GPERI and 26 Student study in Saffrony campus.76 private employees who destination between Palavansa chokdi and Saffrony college and return time of all between 4-30 to 5-00 PM.

VI. PROPOSAL AND CONCLUSION

Important institutions outside the Mehsana city area such as Saffrony education campus, GPERI College as well as the industrial area have seen good development in the area towards Ahmedabad as well as the animal feed plant and research unit of Dudh Sagar Dairy.

In a city area Route number 8 starting from the Toranvala mataji chowk to Palavasna Chokdi, in that route many passengers choose the auto rickshaw and private transport because of lengthy route for bus station and Radhanpur chokdi and it consume more time than rickshaw and private transport. A modified route is proposed for reach at Radhanpur chokdi, Mehsana new bus stop at Modhera chokdi and Palavasana Chokdi from Toranvala mataji chowk which is Located in Heart of City area.

Due to stop at Gurudwara and Ramosana Chokdi station in Route No.8 delay to reach at Radhanpur chokdi, Mehsana new bus stop at Modhera chokdi and Palavasana Chokdi. Also give the Suggestion of Extension or Modification in route 8 only for morning and Evening time for better connectivity for outer part of city area.

Table 4: Proposed Routes with Road Length

Sr. No.	Name	Road Length (KM)
1	TORANVALA MATAJI –RADHANPUR CHOKDI – PALAVASANA CHOKDI	6.50
2	RAMOSANA BRIDGE-SAFFRONY COLLEGE (MORNING-EVENING)	16.20

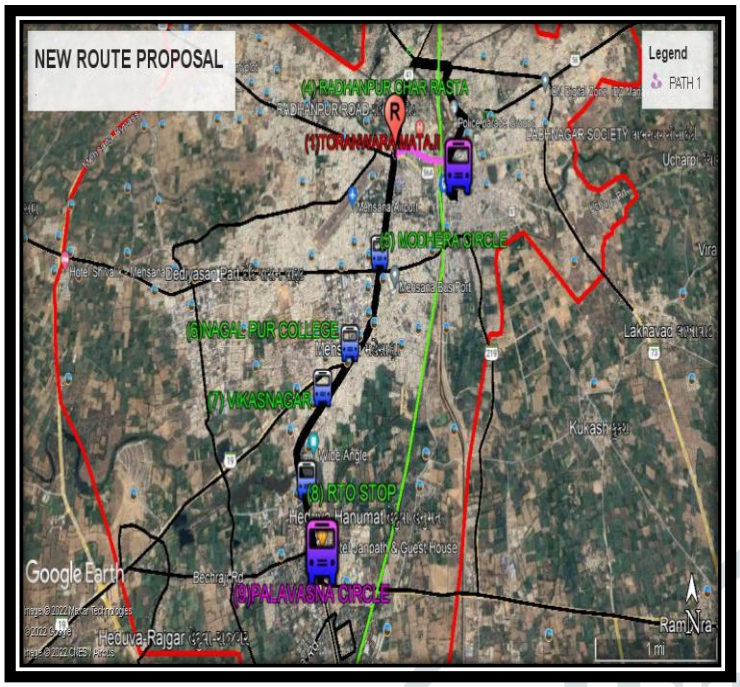


Figure 9: Proposed Route Map for Route Number 8

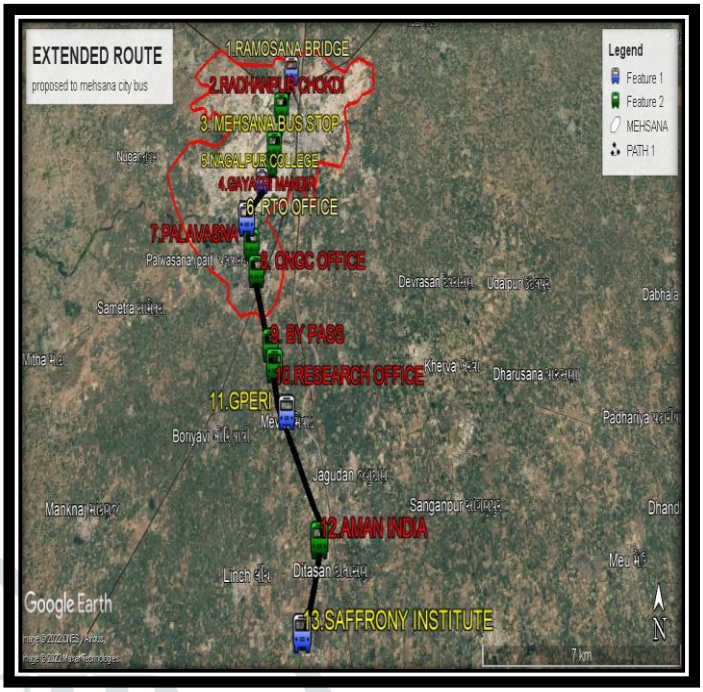


Figure 10: Proposed Route Map for Extra Route

- Mehsana is an over densely populated city and its transport system is mainly road based with mostly non-motorized vehicles (predominantly rickshaw). Mehsana is experiencing lots of traffic congestion and a great lack of traffic management. Mehsana city is developing very fast requiring proper communication system for providing adequate and quick services to the industries, offices, hospitals and education institutes.
  - After the carried out the O-D survey and detail study of Mehsana city road observed that problem of traffic occurred due to improper management of traffic and some of area developed fast as compared to other one like area starting from Radhanpur chokdi to Shankus Water Park.
  - Many show rooms, offices of ONGC, industrial shade, dairy product units (Vimal dairy), Dudhsagar dairy, Shankus water park toward Ahmedabad side so I observed that many passengers need to change vehicle after Palavasna chokdi, in solution of changing vehicle strongly recommended extend route 8 for better connectivity and income.
  - In Mehsana city bus route number 8 which passing through rapid growth area of town so movement of people toward Ahmadabad side is more but improper city bus schedule so many passengers choose private vehicle for saving travel time.
  - After carried out of survey concluded that city bus services authority needs to modification schedule of city bus and route of city bus, so I suggest the city bus route (Toranvala mataji chowk- Radhanpur chokdi- Palavasna- Shankus Water Park) and (Ramosana Chokdi- Saffrony) proposal and schedule also.
- This type of analysis is very crucial especially for the transport-based planning. The present study will help in transportation planning and for providing proper communication not only for Mehsana city but also for another developing city.

VII. ACKNOWLEDGEMENT

I am very much grateful to my guide Prof. Vijay J. Chitaria , Associate Professor, Civil Engineering Department, L. D. College of Engineering, Ahmedabad and Dr. Rajesh K. Jain, Professor and Head, Civil Engineering Department, L. D. College of Engineering, Ahmedabad, for their valuable guidance, cooperation and untiring encouragement of all levels of the work, whose guidance and support helped me to complete this research successfully, without their guidance my work would not be completed.

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