International Journal of Application or Innovation in Engineering & Management (IJAIEM)
Web Site: www.ijaiem.org Email: editor@ijaiem.org
Volume 7, Issue 4, April 2018 **ISSN 2319 - 4847**

Transportation Network Model For Route And Closest Facility Analysis In Central Bengaluru

Subham Kharel[1*], Dr. P. Shivananda[2] Dr. K. S. Ramesh[3], Shri K. Naga Jothi[4] and Dr. K. Ganesha Raj[5]

[1*, 2] School of Civil Engineering, REVA University, Bengaluru, India

[3, 4, 5] Regional Remote Sensing Centre-South,
Indian Space Research Organization, Bengaluru.

ABSTRACT

It is necessary to find out the best traversing route between any two places within an area for making travel easy and faster to everyone even if the routes to reach desired locations are unknown. Due to the increase in utilities and facilities all over an area, it is also necessary to find out the closest facility or utility to reach from a specific location at any point of time whenever required. The aim of this paper is to use Network Analysis module of Arc GIS to evaluate the best routes and closest facility on a route network. The selected study area is the Central part of Bengaluru in the state of Karnataka. The results are used to find out the optimum route to reach a facility at any given point of time. [1]

KEYWORDS: ***GIS, Shape file, Arc GIS, Network Analyst, Route Analysis, Closest Facility***

1.0 INTRODUCTION

A new person must be familiar with the road network and the routes of a city for his daily travel. The Route Analysis module of Network Analysis in Arc GIS is a tool for finding the best route depending upon existing traffic conditions, travel cost, time and distance. The Closest Facility module of Network Analysis calculates the cost of travel in between origin and desired destinations and finds which facilities are nearest to the a specific location. When finding closest facilities, we can specify few numbers of facilities to find the specific direction of travel (towards or away from the origin). The closest facility solver displays the best route or routes between origin and the desired facility, finds the travel cost, and g ives us the driving directions for the selected facility. These types of measures can be done with the help of latest developments in the Network Analysis module in the Geographic Information System (GIS). The application of Network Analysis Module of Arc GIS in Transportation Engineering is now well established. It is a powerful tool for solving and handling non-spatial and spatial data.

1.1 Objectives

The following objectives were proposed for conducting the study:

a. To create the network dataset and validate the data to be used.
b. To add impediments/barriers to strengthen the above dataset (e.g. point, line and polygon barriers).
c. To find the best route between specific locations based on considerations such as traffic conditions, travel time, distance and cost
d. To find the best route between any location and the desired facility taking into consideration different conditions such as traffic conditions, travel time, cost and distance.

1.2 Study Area

The study area selected is Bengaluru in the state of Karnataka. Bengaluru has a population of over ten million. Bengaluru is the second fastest-growing major metropolis in India. Bengaluru is located in between 13°04'00"N to 12°49'00"N latitudes and 77°25'00"E to 77°44'00"E longitudes at an elevation of 924 meters height i.e. 3,031 feet above the mean sea level. The total area of Central Bengaluru is 709 km^2.

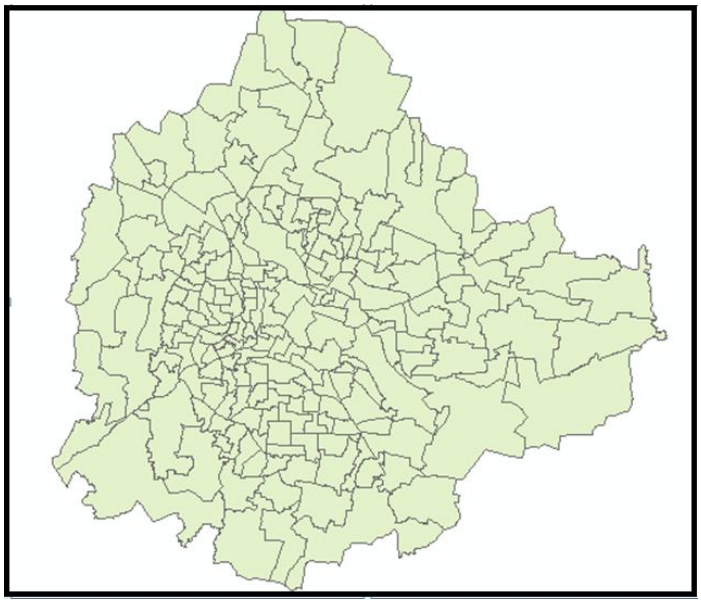

Fig 1: Central Bengaluru

2.0 LITERATURE REVIEW

1. Aman Arora[1] and Manish Kumar Pandey[2] reported that the use of Remote Sensing and GIS Network analysis can readily yield the demands of professionals associated with transportation planning and development by the use of Network Analyst tools which can provide enormous benefits for urban planning.

2. Ranya Fadlalla Abdalla Elsheikh[1], Abdelrahim Elhag[1], Salah Eddeen Khidir Sideeg[1], Aisha Elhadi Mohammed[1], Nagla Ali Gism[1], and Mohamed Sharif Abd Allah[1] reported that in GIS networks are used for finding routes and much more. It provides successful results in finding the closest facility and service area layers. It shows how GIS information can be used to improve decision making.

3. Parveen Kumar[1] and Dinesh Kumar[2] stated that network analysis tools are more efficient in terms of time and distance. They stated that for transportation planning we can use network analyst tools for different purposes like shortest path analysis, closest facility analysis, service area determined analysis and also for the best recourses allocation and for the creating of emergency route services.

4. Ifeanyi R. Ejiagha[1], Johnbusco C. Ojiako[2] , Chijioke G. Eze[3] recommended that Healthcare facility should be provided to those deprived areas and GIS unit should be a basic component of all agencies responsible for administration of healthcare facility.

5. Sidhtharthan.S[1] and Durgadevagi.S[2] reported that Network analysis proves efficient in finding the best route, shortest route, minimal path. It also helps in creating new locations for health care units, cost estimation between multiple origins and destinations. When compared with field study, the data acquired through network analysis gives accuracy above 91%.

3.0 METHODOLOGY

3.1 Tools Used

1. Arc GIS software package - Used for digitization, topology and network analysis of the data that was collected from requires source.
2. Open Street Maps - Used for downloading the basic data required for the analysis.
3. Tables of data obtained through web survey and data collection.
4. Different software e.g. excel, word were also used.

3.2 Procedure

The following steps are followed to create the network model.

a. The Open Street Maps (OSM) for India which is available in OSM websites were extracted and incorporated into the Arc GIS software to implement the GIS model. The map having the road network, rail network, sub-urban rail network, bus/metro/rail stops and stations and traffic signal shape files was extracted as a layer and various elements (facilities and impediments) were added depending upon the requirements.
b. The attributes were incorporated thereafter which included one way and U-turns. The network dataset was created and the route analysis and closest facilities feature was used to obtain desired results.
c. The next step included the creation of a Geo-database for storing the data required for the analysis under Arc Info Network Analysis environment. The Network Dataset was created for performing network dataset maintenance tasks like building dataset and dissolving them. The Route analysis and closest facility layers were added thereafter.

d. The route analyst option was selected which is located in the New Network Dataset toolbox. The best route can be identified by providing information about origin, destination and impediments.

e. The Network Analyst performs the analysis and displays the best route with information on directions of travel.

f. On a new Arc Map document, the closest facility option was selected which is located in the New Network Dataset toolbox. This analysis is done on major petrol bunks in Bengaluru city. The data for the petrol bunks were collected from an online source that will be used as facilities in the analysis.

g. The location and number of facilities with appropriate co-ordinates are created and validated with reference to available data.

h. The network analysis performs the analysis and displays the nearest facility and the best route to travel to reach that facility with information on direction of travel.

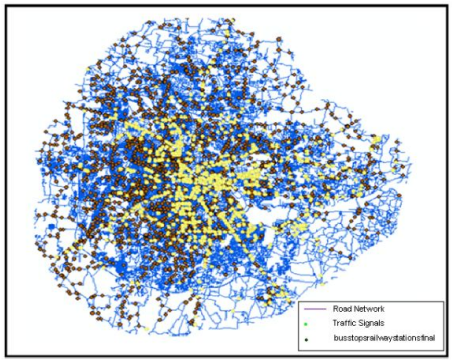

Fig 2: Network Creation

4.0 RESULTS AND DISCUSSIONS

4.1 Finding The Best Route

The best route is identified by taking into consideration the minimum distance from a point to another. Two pickup points were added to the layers and the model was tested. The best routes was analyzed by the model taking into consideration various factors such as driving time, distance and travel costs. The directions were displayed thereafter.

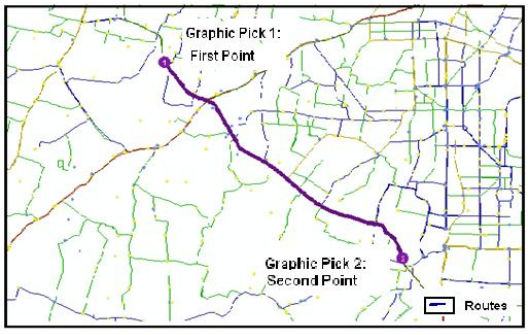

Fig 3: Shortest distance without impediments

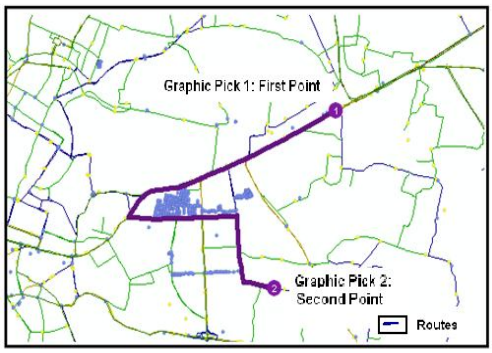

Fig 4: Best Route with restricted turns

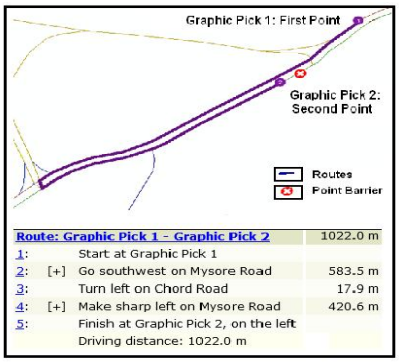

Fig 5: Best route with Point Barrier

4.2 Finding The Closest Facility

The closest facility, for e.g. petrol banks is identified based on the shortest distance between the present location and nearby facilities. The shortest distant petrol bank closest to the desired location on the road network was identified and the driving directions were displayed.

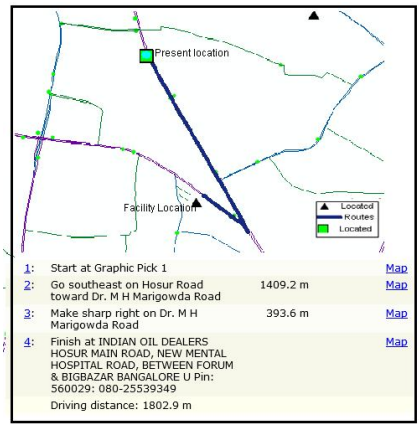

Fig 6: Driving Route to the Nearest Facility

5.0 CONCLUSION

The network analysis tool is very efficient in solving different problems such as identifying routes, finding the closest facility, service area, origin-destination matrix and much more. Currently, only few models are implemented and efforts are being made to solve many other network problems chosen for the current project. The use of Network Analyst module of Arc GIS facilitates transport engineers to tackle many complex situations.

6.0 ACKNOWLEDGEMENT

We sincerely acknowledge BMTC and Bengaluru Traffic Police Department for providing the data that was needed for our work. Sincere thanks to Dr. Ramalinga Reddy, Director, School of Civil Engineering, REVA University, Bengaluru for allowing Subham Kharel to work under RRSC-South, ISRO, Bengaluru. The whole of RRSC-South team is acknowledged for providing technical and non-technical assistance when needed.

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AUTHOR(S)

1. **Subham Kharel** received the B.Tech degree in Civil Engineering from Sikkim Manipal Institute of Technology 2016 and currently working for his M.Tech Transportation Engineering and Management dissertation under Regional Remote Sensing Centre-South, National Remote Sensing Centre, Indian Space Research Organisation.

2. **Dr. P. Shivananda,** Professor, School of Civil Engineering, REVA University, Bengaluru, India
3. **Dr. K. S. Ramesh,** Sci/Eng ' SG', RRSC-South, NRSC, ISRO/ISITE Campus, Bengaluru, India
4. **Shri K. Nagajothi** Sci/Eng ' SF', RRSC-South, NRSC, ISRO/ISITE Campus, Bengaluru, India
5. **Dr. K. Ganesha Raj,** General Manager, RRSC-South, NRSC, ISRO/ISITE Campus, Bengaluru, India