RSAC-UP Optimizes Green Organ Corridor Route with ArcGIS

Client
Remote Sensing Applications Centre, Uttar Pradesh (RSAC-UP)

Industry
Healthcare

Organization Profile
Uttar Pradesh was the first and foremost state in the country to establish the first state Remote Sensing Applications Centre, Uttar Pradesh (RSAC-UP) in May 1982 at Lucknow. RSAC-UP has been utilizing the geospatial technologies of satellite remote sensing, Image Processing, GIS, GPS, LiDAR, Bathymetry, customized software development using AI, ML, DL, and AL methods in conjunction with geophysical surveys, soil and water testing techniques for assessment, monitoring, utilization, and management of various natural resources of the state to achieve sustainable development.

Project
GIS-based Route Network Analysis for Developing Green Organ Corridor

Website
www.rsac.up.gov.in

Project Summary

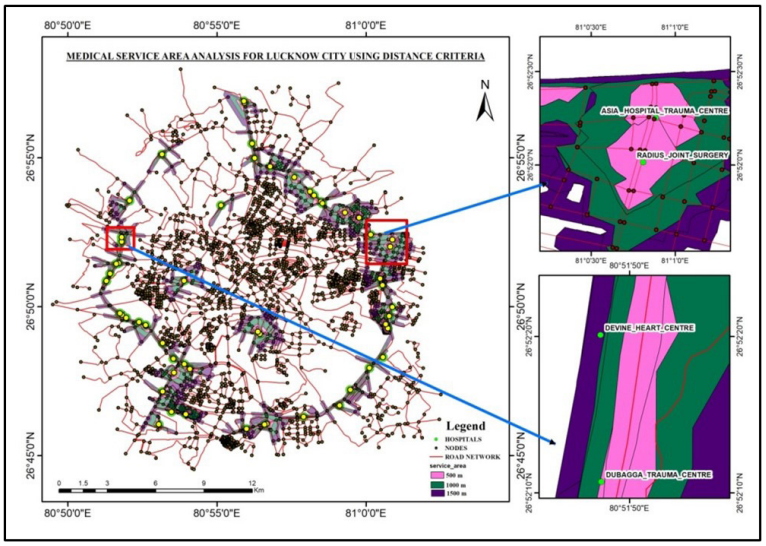
Green organ corridors are demarcated, cleared-out special road routes created so that the organs arrive at their specified destination within the shortest possible time. Traffic congestion can defeat the cause. With the help of ArcGIS, RSAC-UP discovered the best route for developing a green organ corridor between CDRI, Jankipuram, and Amausi Airport in the city of Lucknow.

The Road Network Analysis helped in finding the best route to healthcare facilities among the four possible routes. Network connectivity can explain significant variance in the spatial pattern of the network structure. Analysis reveals that transport network services are directly varying with respect to connectivity indices and coverage of the study area.

Solution & Benefits

In this study, an enhanced road network analysis was done using ArcGIS. A geodatabase was created to store the prepared data. After preparing point and line data for the study area, i.e. base map, road network data, and healthcare service data, network datasets were created. After that, the network analysis process was applied to the road network of Lucknow city to find the best route and service area for the organ corridor. Connectivity indices like Alpha, Beta, and Gamma were calculated for selected routes. The indices were used to find the best route for the green organ donation corridor between the selected points. It is imperative for the transportation of organ donation; minimum time is needed to save patients' lives.

The use of the ArcGIS Network Analysis tool in the route optimization study provided the following benefits to RSAC-UP:



Identifying the best new route among healthcare facilities: Utilizing network analysis methods, the optimal new route between CDRI, Jankipuram, and Amausi Airport, Lucknow was developed from a list of four possible routes. This route is more effective in terms of the minimal distance required for hospital connectivity. The best-new-route analysis identifies the network path with the lowest cumulative impedance between nodes. It is possible for the route to connect from origin to destination or to make stops at particular hospitals along the way.

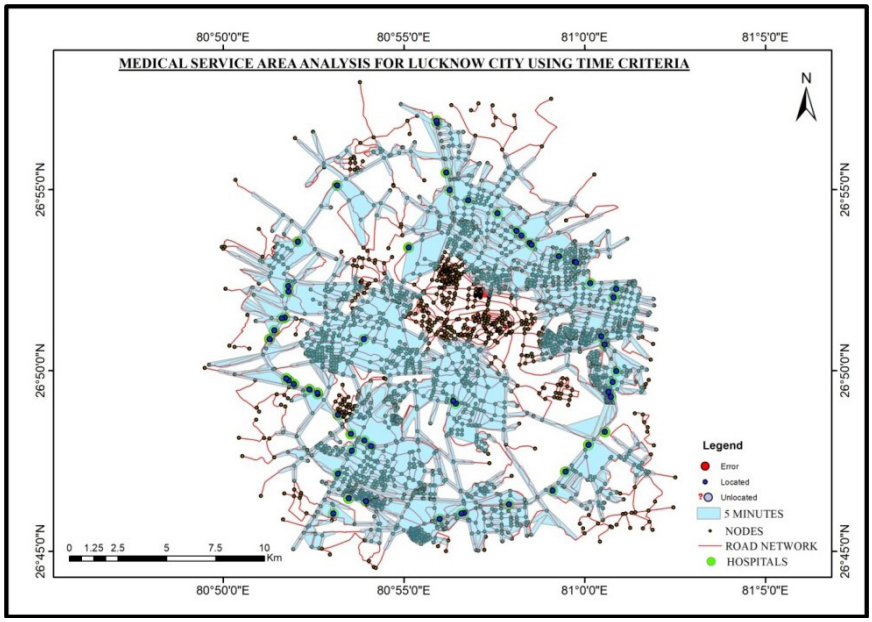
Defining service areas based on distance and time for healthcare facilities: The region known as the network service area is made up of all the accessible routes, or routes with a certain impedance. By this analysis, the actual service area of different facilities can be analyzed, and it can be determined whether these facilities are enough for that area,

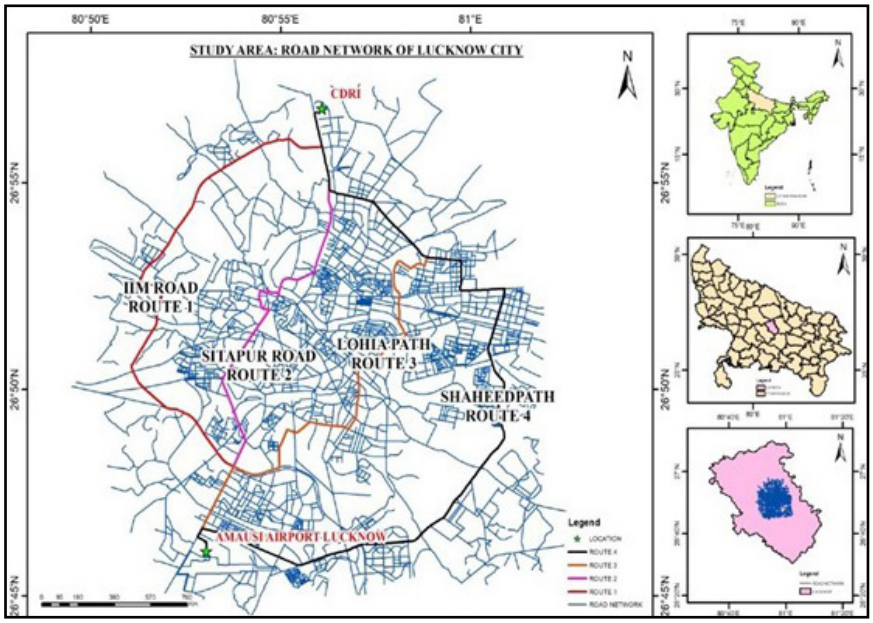
if not then how much is required. This is also called service allocation analysis. The primary goal of a spatial allocation study is to evaluate the effectiveness of the services in terms of time and distance. For the present study, services such as hospitals were chosen for analysis purposes, and their service areas were defined based on time and distance.

The service area map of hospitals with multiple buffers is based on distance intervals of 500 meters, 1000 meters, and 1500 meters showing the actual service area with efficiency.

Connectivity of Road Segments: The most basic characteristics of a transport network are measured by the Alpha Index, Beta Index, and Gamma Index. The network (line) and junction (node) are required to obtain the connectivity index. These indices are useful for system and traffic analyses to detect changes in network structure. The Beta index (β) is used to determine the level of road connectivity. The Alpha index (α) is the ratio of the actual number of circuits in a network to the maximum possible number of circuits in that network. The Gamma index (γ) is a measure of the ratio of the number of edges in a network to the maximum number possible in a planar network.

382 edges and 252 nodes were found in the buffer zone of 1 km in Route 1, 772 edges and 497 nodes were found in the buffer zone of 1 km in Route 2, 949 edges and 567 nodes were found in Route 3, and 1335 edges and 847 nodes were revealed in route 4 through the road network analysis using ArcGIS.





Following a thorough analysis of all four routes, it was noticed that Route 3 has the highest network connectivity, resulting in a low rate of accidents involving pedestrians and bicyclists. It was also observed that higher connectivity levels are associated with fewer accidents involving non-motorized users. Nodes around Route 3 also displayed a good level of accessibility.

> Unlocking the power of ArcGIS technology, we delved into the intricate web of road connectivity, seamlessly mapping and analyzing the intricate network of routes. By employing sophisticated service allocation analysis, we redefined healthcare accessibility, determining optimal service areas based on both time and distance. ArcGIS not only helped us in visualizing the efficiency of hospital service areas with precision but also pioneered the discovery of the best new routes, minimizing distances for vital connectivity. In the realm of road segments, ArcGIS becomes a compass, guiding us through the Alpha, Beta, and Gamma indices, revealing insights into network structure changes, and fostering safer, more connected communities. In the language of maps and indices, ArcGIS emerges as a transformative tool, reshaping our understanding of spatial dynamics and promoting a future where connectivity enhances both efficiency and safety.
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> **– Project Team, RSAC-UP**

Project Team Members:

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