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Evaluation the Short Urban Road Network by GIS: Case Study in Baqubah City

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Evaluation the Short Urban Road Network by GIS: Case study in Baqubah City

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Abstract

Urban road networks show the main role in urban spatial structures. The study was attempted to investigate the expected utilization of network analysis to determine the shortest road to Diyala provincial council in Baqubah. The distance is taken as a base so as to pursue out the most effective route and therefore the period is taken a base so as to search out the shorter road from the eight interning to reaching the Central business district (C.B.D) social, and economic activities. Spatial analysis has been most preferable to assess road networks with geographic data system (GIS) spatial analysis technology. The model was tested using the urban road network data (distance, intersection, actual travel time, and direction). It was concluded that GIS is a crucial tool for the success of the new urban informed decision-making in its planning process. The simplest solution was found for traffic problems and congestion within the city center. Drivers and road users would benefit from knowing the shortest route since it would allow them to save money on transportation, save time, and prevent traffic congestion on commuter routes by diverting excess traffic to less utilized alternative routes. The best route from the five north entering to reaching the C.B.D was founded road No.1.

Key words: road, distance, GIS, evaluation, shorter, Time

1 Introduction

People and things are moved by transportation systems. Streets, highways, railroads, mass transit, ports, and other infrastructure are included. There are several distance measurement methods in GIS, and accessibility is dependent on how the urban road network structure is organized (Sahitya & Prasad , 2021). For determining the shortest path in order to determine the optimal route for the user, Geographic Information System (GIS) -based application is often utilized (Bager & Ahmed , 2020).

For minimizing the travel time consumed in emergency trips to hospital, the GIS technique was used to assess the true extent of susceptibility in light of the time of travel on transportation network in Tlemcen city (Algeria). This may help to decrease casualties, which are all too often caused by taking the wrong route. A diversion strategy is supplied to the truckers if any viable alternate routes reduce travel time. Based on observed conditions, the suggested tool can aid the planners of transportation in diverting the truck routes. The findings of cost analysis and simulation by the GIS may increase the overall traffic network's safety and efficiency (Younes, 2020) .Geographic information system (GIS) software are using to study a transportation network in order to assist planning goals such as reducing traffic congestion, reducing pollution, improving commodities delivery, and forecasting transportation demand (Arora et al., 2020). For public transportation providers, passenger trip behavior and travel demand characteristics are critical (Minhans and colleagues, 2020). The use of shortest path methods for estimating journey distances on two-dimensional (2D) maps is regarded a realistic methodology for measuring from origins to destinations (Haji et al., 2019). One depicted BE geographically and discovered that the majority of people prefer the shortest path. The other topologically represented BE and demonstrated that the least amount of directional change is a crucial driver of route choice (Licence, 2019). The quickest route between two points, determined through careful research and digitization of the current road network system, in order to alleviate traffic congestion largely. Network Analyst is a one-of-a-kind tool of the ArcGIS that may provide crucial help in optimizing the routs during such emergencies like floods and hurricanes by examining the nearest facility available on a digitized network of lines. One of the finest models that can be developed using Network Analysis is the minimum path between two required origin and destination sites. (Das et al., 2019). (Kharel et al., 2018) analyzed the Chandigarh city network using Google Earth pictures and GIS tools. The shortest path between two locations was constructed to achieve the lowest travel time and, as a result, lowest travel cost. The shortest path to the destination was computed using custom Python scripts that looped over each origin and computed the route geometry and journey duration. The results were saved in a spatial database and visualized using a GIS (Allen et al., 2018). Cycling is an efficient means to travel distances ranging from short to medium in metropolitan settings mostly purposed as commuting to school or work, shopping, leisure, or tourisim (Mbanjwa, 2018). The relative impact of metric distance (MD), topological distance (TD), and geo-metrical distance (GMD) were analyzed in determining the route choice behavior of motorized travelers by mode (Jayasinghe et al., 2016). By mapping the services area based on journey time and employing the capabilities of GIS in network analysis and visualization to improve decision making in route selection to the nearest hospital (Fadlalla et al., 2016). Today, Geographical Information Systems (GIS) are employed in a variety of planning applications, utilizing information technology (Mohamad et al., 2015). The shortest route is not always the most convenient, terrain has a greater impact on how weary a person becomes than distance traveled. A commuter riding to work may be aware of the shortest route, but they may be unaware that it consumes more energy than a longer route. (Huntley and colleagues, 2011). Significant changes in travel behavior and public participation can transform the city in such a way that it becomes a sustainable city over the next decade. (Котлер, Ф. (2008). The quality of traffic at any point on a route is affected by the current traffic speed. While the intensity of traffic accidents mostly contributed to the excessive speed, the very low speeds are often undesirable forbeing a sign of congestion (Owusu and colleagues, 2006). The spatial network analysis must be applied to any road network in order to evaluate its status, including the efficiency, density of its roads according to several metrics, and the evaluation of accessibility between its nodes. In recent years, spatial road network analysis has been carried out utilizing advanced techniques such as Geographic Information Systems (GIS). Because it is the best information management and analysis tool for many areas of the transportation business, including both the public and private sectors, the (GIS) is the fastest expanding in many fields of transportation. In general, a spatial network analysis of any road network focuses on the state of the road network and its major issues before proposing solutions. Using a GIS system, the work of intersections with lights was completed. The capacity and level of service for three intersections in the study area were determined by selecting the best route and

determining the center and effect of its road networks, as well as querying about the characteristics and data of streets and intersections, based on selecting the best route. The geographical analysis was applied to the road network of AL Door city to work out its lengths, efficiency, densities and centroid of network by using the mathematical models of economic index. Finally, her deduction was that the density of roads is low and different among parts of city because that's capable zero in apart and 50% in another and therefore the centroid of network equal 16.3% which means the road network weren't centroid in one part (AL Dorry, 2010). The characteristics was showed of regional highway network and to see the foremost important effective spatial characteristics and therefore the dimension of that effect negatively or positively. The results of those were obtained; the spatial distribution of road network in city wasn't equitable and also the limited circulation of regional highways was adequate to 15% from the full length of roads within the city (AL Anbaky, 2009). The network analyst accustomed estimate interrelations between the dynamic factors, like network traffic changes within the area under study and to supply optimized solutions where the optimal solution is identified by various parameters, as an example the shorter distance etc. They used many origins and plenty of destinations to gauge the express road in reducing congestion and saving time and distance. Finally, the results obtained from establishing Al-Muthana expressway are saving time and distance. additionally, the utilization of GIS, as a tool is incredibly useful in Network Analysis (Abd Ali, & Al-Mumaiz ,2010). The rise of the density of road for any city meaning the town incorporates a good road network and the other way around is true in addition because the last must develop. The density in line with the population criteria is that the most vital criteria, because it depends on population that's. The most resource of movement within the road network, and deducted that the density of road network increase in apart of city and reduce in other parts refers to several roads isn't to be floored because of change within the transit within the city (Anoze, 2010). Network analysis tools in standard GIS software provide a straightforward thanks to conduct car drive-time analysis supported such data: road segment length divided by the respective ordinance provides an estimate of “free-flow” drive-through time for the segment, and also the optimal route between given origins and destinations is calculated employing a shortest path algorithm. The results of field studies involving the measurement of period of conveyance vehicles within the main streets (Birr et al., 2014). The evaluation of accessibility is one in every of the foremost important aspect in defining the performance of a road network structure. this study is concerned with proposing a strategy for the city—level opportunity (or) urban services and distance based accessibility evaluation (Elsheikh, Elhag, 2016).

The movement of transport was represented by the delay imposed by the presence of checkpoint on the car tracks .there is a difference between the time, the shortest roads in terms of distance time and the other way around, the gap is that the most crowded thanks to the waiting time that accumulates with the time it takes. This can be normal when the tracks are near the central commercial area where the big movement of the population and therefore the goods with multiple checkpoint. The quantity of vehicles in the city increases rapidly without considerable increase within the capacity of the road network, which results in increase delay and lower the extent of service (LOS) to pick out the shortest road to succeed in town center

1.1 Objective of study

The objective of this study is to find the shortest road reaching to the C.B.D from the eight entering point by calculating the length of network, classification types by using GIS tool and time. The new growth in Baqubah city is diagnosed to be tied up affecting the trip time, drivers’ mood, as well as economy.

2 The Study Area

The city region was located about 60 Km to the north east of Baghdad city the capitol of Iraq, bounded by [latitude (33° 25 50) to (35° 40 52) N, longitude (44° 16 39) to (45° 55 32) E] the system of UTM and the data image was accreted according the reference(Ahamed et al., 2015) . The city is divided Diyala river as shown in Figure 1. Baqubah is Diyala province's capital city (Ahamed et al., 2015). The city of Baqubah is one of the fast growing cities with an increasing rate of car ownership, but at the same time there is no proper planning to accommodate the growing demand due to the absence of transportation planning studies. Figure 2 illustrates the study area where the problems of traffic is found, so it's represent Baqubah city province's heart; because it contained all residential districts which have a high population, and contain the city center that has many activities such as schools, governmental buildings, market, etc. Some steps should be fulfilled to ensure the continuous and logical buildup of defining and justifying this study. These steps have been explained, first which include data collection of the road network for the study area and how to present them. GIS data include the satellite image (raster) with an accuracy of one pixel which is equal to 0.6 m. The whole of satellite image (raster) of the Baqubah city is shown in Figuer.2 (Abd et al., 2020) .

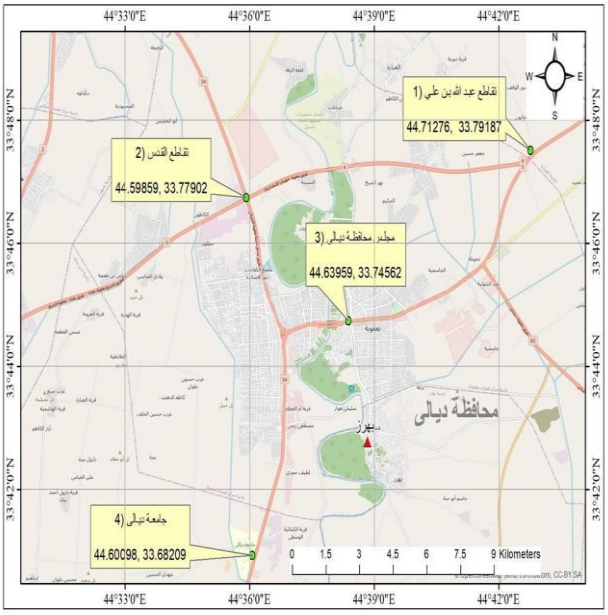

Figure 1: The coordination of the city

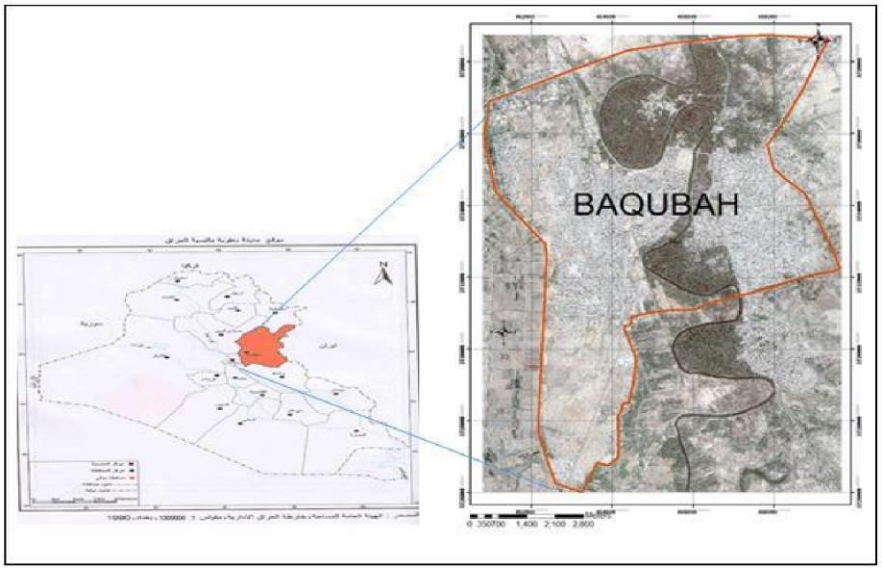

Figure 2: The location of the case study(Al-kaissi & Hameed, 2016)

3 Data Collection and Methodology

The basic data of the road network included the form of distribution of roads network that was taken from the satellite image for Baqubah city as Figure 1. The class of roads analyzed in this study area was mostly the main roads that were chosen from the master plan map of Baqubah city. The data collected can be classified into sub-classes depending on its necessity as below .The flowchart of data collection and methodology as shown in figure 3:

- Feature data about the study area
- Attribute data about the Arterial road in the study area
- Attribute data about the Residential road in the study area
- Attribute data about the Intersection in the study area
- Attribute data about the bridges and rivers in the study area

In addition to that, for more details about the collecting and presentation of data for the road network of the study area:

- Collecting the data for road network of the study area and presenting it by Arc GIS 10.1 program in the form of layers (shape files).
- Building the database of road network by inserting all its attribute data of road network.
- Building the database of all nodes intersection by inserting all its attribute data of road network.

- Building the network dataset of road network for obtaining the optimal route between origin and destination point.
- The actual travel time for the eight path were calculated at the same time of the day by eight vehicle from the entrance to reaching the C.B.D

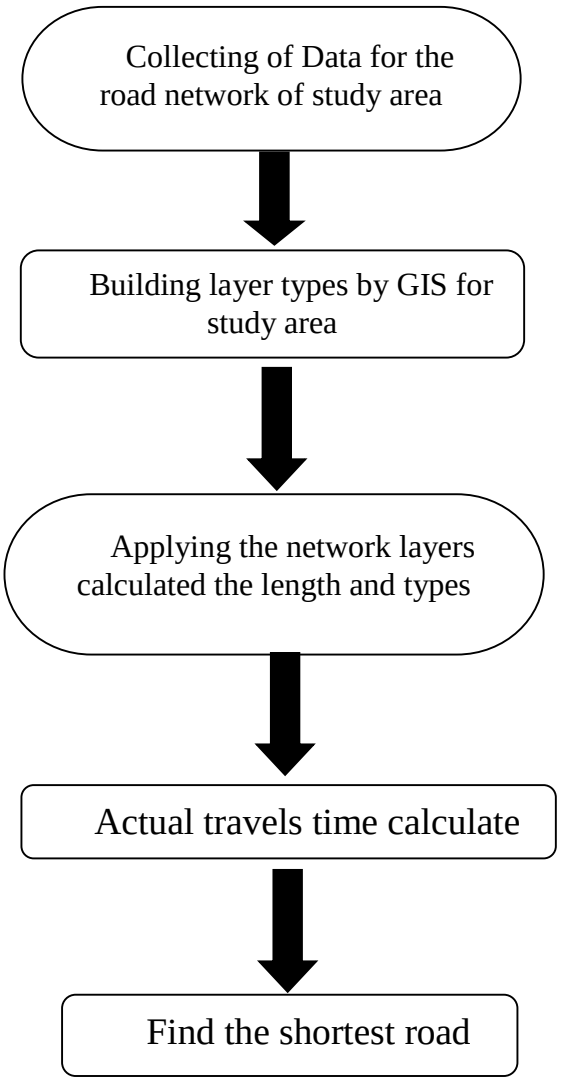

Figure 3: Methodology and Stages of Collecting Data for the Road Network of the Study Area

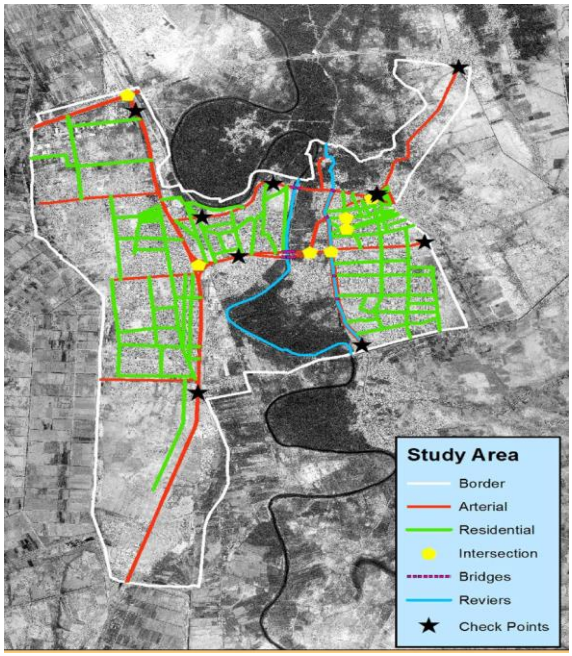

Figure 4: The road network in Study area, check point and intersection

4 The Analysis and Results

Geographic information systems (GIS 10.1) is Provided ,a tools and functions in network analysis elements befell a bundle , anchor points and whose lines with each other as links Which represent with each route between the site.

The urban road network was utilized to promote efficiency, which may be accomplished through traffic flow sound management, which necessitates a significant amount of journey time, travel speed, and data latency (Ziboon et al., 2017).

In transportation management, the question ofthe shortest path is a major concern, and GIS plays an e ssential role. People are represented by the sources of goods stepped down travel across networks by cars according to travel on tracks. Polyline layers build the roads and the nodes are representing the intersections as shown in figure 4. The model for the travel paths with the network, it is possible that the analysis provides a linked to calculate the distance for all roads.

4.1 Feature Data and Representation in GIS

Feature data of the study area collected by extracting them from the satellite image to find out the location of all-important features. The most important feature is road network, which was identified from this type of data. These showed the connectivity of all roads by means of nodes at intersections with each other. GIS organizes and stores information about the world as a collection of thematic layers that can be linked geographically each layer contains features having similar attributes, like streets or

intersection, which are located within the same geographic extent. By Arc Catalog program six layers were built from road network, these included (Arterial, Residential, Intersection, bridges, river and Check point) as shown in figure .4. The Arterial layer and intersections are represented as polylines and points feature figure.5. The Check points layer were represented as point feature shown as figure .6 .the results are showing the position of intersection and check point very restricted the moving in the city and cussing delay for all activates.

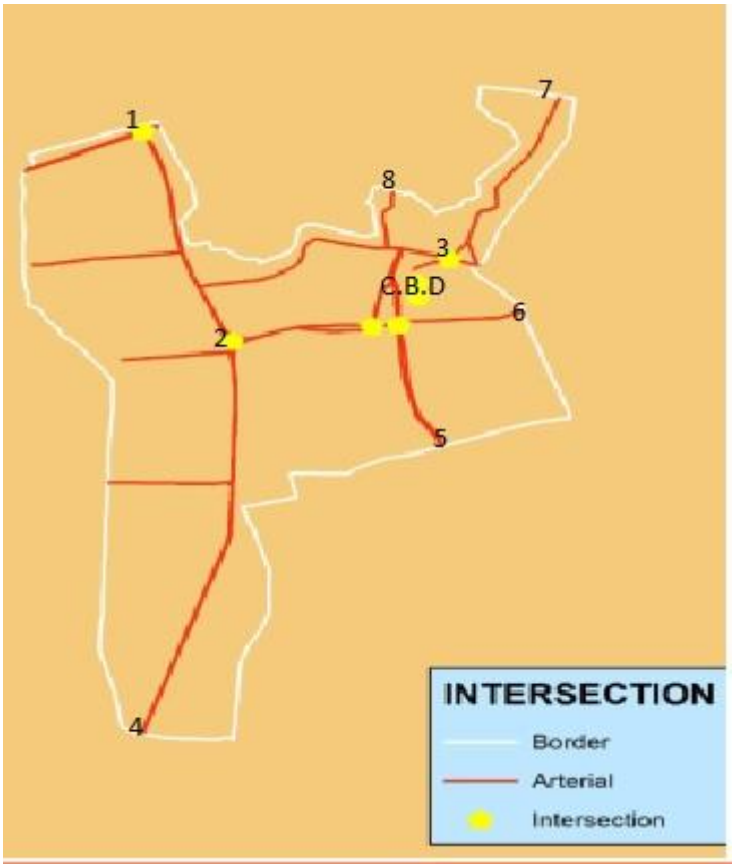

Figure 5 : The arterials road and intersections layer

The lengths city streets have reached (24856) km for Diyala provincial, the main streets that cause slow and paralyze the movement on the streets. From table (1), This can be seen in the streets types percent, length to area of the city area 2.87% for arterial road. This present is lowered from the specification the length of roads and classifications are shows in figures .6 and 7.

Percent of area %	Percent %	Area Km^2	Percent %	Length km	Street type
2.87	32.5	1.524	12	3316	Arterial
6	67.5	3.178	88	21540	Residential
8.87	100	4.702	100	24856	total

Table 1: The street types, lengths and area in the city

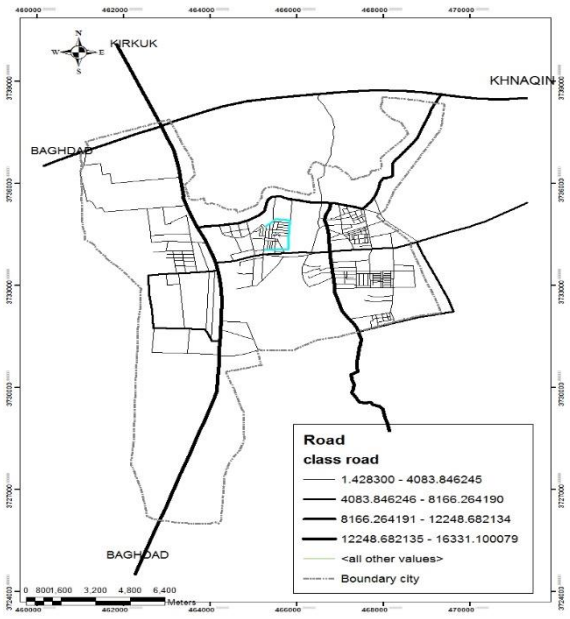

Figure 6: The length of road in the study area

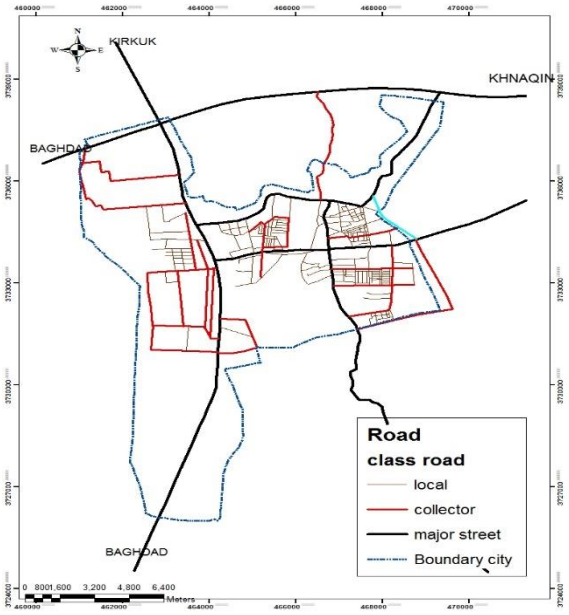

Figure .7: The types of road in the study area

4.2 Description paths cars to the city of Baqubah:

There are many car tracks in the city of Baqubah, it depends on what they offer street network, through this research we try exploring the cars pathways from the Central Business District towards the exits and vice versa shown in Figure .5, it has been identified eight tracks seen (C.B.D Central) in table .2. The most important elements that go into installing network features two (distance by GIS, actual travel time calculated by the vehicle). Through Which each have both elements can build a geometric network set distance and time to cut that distance,

Road NO.	Entering Direction	The path ways	Direction	Length (km)	Actual Travel Time (min)
1	North	C.B.D to – alwathba- Al-Qudes	2-direction	7.7	20
2	North	C.B.D to- almafraq - Al-Qudes	2-direction	7.8	28
3	North	C.B.D to – alameen - Al-Qudes	2-direction	8.4	30

4	South	C.B.D to – almafraq – Almradeah	2-direction	12	23
5	South	C.B.D to - Bohraiz	1-direction	3.6	27
6	East	C.B.D to – Altrbeah - kanain	2-direction	2.7	12
7	North	C.B.D to – Alsidah	1-direction	5.5	29
8	North	C.B.D to - Hweder	1-direction	4.2	25

Table 2: The path direction, lengths and actual travel time in the city

Now measure distance between entering to the city center as showing in table .2 .The measured distance (road no. 1) is 7.7 km and time in driving is 20 minutes from the north entering of the city and the distance (road no. 4) is 12 km with time 23 minutes for the south entering to the city . The comparison of the results of shortest path search shortest distance is 7.7 km which is the distance of ALQudos cross road so that the shortest road to C.B.D. Accordingly; network analysis is efficient for determining service effectiveness in regards to distance and time, in order to identify the best route to the C.B.D, which is defined based on the distance and time and in provider of availability in specific area without the other. It also facilitates the identification of the existing gaps between the allocated various services in the city and to determine if the existing services distribution is effective or not.

5 CONCLUSIONS

The network analysis has been evaluated especially for transport. It is going to reach the C.B.D during this study are concluded:

1. The city is suffering from a controversy in traffic, represented by the delay imposed by the presence of auto inspection and GIS is calculate the length of road No.6(2.7 km) has been taken 12 minutes for the east direction of the city.
2. The results have been shown more practical by reducing the number of nodes are required to achieve the goal point, therefore the road No.1 in north entering shorter path is attending to C.B.D by 20 minutes because this road has been lowered node.
3. The density of roads per total area study has been computed 2.78 %, it is lowed value with respect to the requirement.
4. The shortest way often easier to access in terms of distance and time (road no.6 for east direction) because it is reducing the time and cost and consequently enhancing the economy and the environmental impact.

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