IOSR Journal of Applied Physics (IOSR-JAP)
e-ISSN: 2278-4861.Volume 7, Issue 3 Ver. I (May. - Jun. 2015), PP 19-26
www.iosrjournals.org

Route Mapping and Analysis With in Gidan Kwano Campus, Federal University Of Technology Minna, Niger State Nigeria

Onuigbo, I. C, Suleyman, Z. A. T, Zitta, N, Odumosu, J. O and Ibrahim, A
Department of Surveying and Geoinformatics, Federal University of Technology Minna, Niger State Nigeria

Abstract: *Understanding The Complexity Of Road Network Is Very Important As It Relates To Movement From One Point To Another.Finding The Optimal Route To Access Some Locations Within The Campus Like: Theclinic, Fire Service Department, Senate Building, And Faculties' /Schools Can Be A Challenge. Modern Surveying Techniques Are Used To Address Such Problem. In This Work, Dual Frequency Global Positioning System (DGPS) Was Used To Capture The Ground Information (X Y Z) Of The Existing Features On The Campus. Using This Approach, The Road Network Map Was Obtained, Georeferenced And Digitized. The Integrated DGPS Data And The Road Network Layer Were Imported Into The Arcgis Environment For Analysis Using The Network Analyst Module.An Optimal Route Analysis And Alternative Routes Selection Were Carried Out As In Figures 6-9. From The Results, Four(4) Optimal Routes And Another Four (4) Alternate Routes Were Specified As In Table 1. This Paper Also Shows Eight (8) Illegal Routes Connecting The Campus At Various Points As Shown In Figure (5).In The Work Recommendations Concerning Insecurity Are Given.*
Keywords: *Optimal Route, Network Analyst And Route Mapping.*

I. Introduction

Nigeria as a developing country is an example where the population growth is increasing significantly amidst accentuated transportation problems. Therefore, various situations particularly emergencies demand a network that can ensure speedy transportation for example ambulance Services, fire Services etcetera. This shall also be needed for better provision of security services as speedy transportation in such circumstances saves valuable human lives. Remote Sensing and GIS playsvital roles in transportation and urban planning applications. This paper attempt to find optimal and alternate routes within the Gidankwano campus of the University based on shortest travel time using GIS.

For a given origin (start) and destination (stop), use of the shortest distance route is always preferred. Generally, however this may not be the best route. In emergency situations for example the shortest travel time is to be preferred over shortest distance. A shorter route does not always translate to shorter travel time, because it may be narrow in width or it may have higher volume of traffic, or more numbers of signals and turns etc.

Therefore, solving a route analysis means finding the quickest, shortest, or even the most scenic route, depending on the impedancechosen as a solution. If the impedance is time, then the best route is the quickest route. Hence, the best route (optimal) can be defined as the route that has the lowest impedance, or least cost, where the impedance is chosen. Any cost attribute can be used as the impedance when determining the best route.

Abdul-lateef, Abdul Nasir, Dano and Imtiaz(2012) uses GIS technology to determine optimal oil pipeline route in Malaysia's rich Baram field taking into consideration the various factors affecting the route (weigthing). Also, inMacharia and Charles (2012) various data were integrated with GIS as a first look for pipeline routing and strikes a balance among environmental, engineering, technical and social factors. Road network has certain spatial attributes that define some factors in environmental technology and built-up engineering.

Road network is several interconnected lines and points representing a system of road or street in a given area. (Wikipedia 2014).This system is a trigonometric edifice in determining distances, routes directions as well as cost and benefits.

Optimum route analysis tries to discover a way with least travel cost from one or more origins to one or more destinations through an associated system. In all applications, it is valuable to know the alternate routes between two locations as in Yongtaek&Hyunmyung(2005), Ammar, Sitalakshmi,Jemal and Mamoun(2011).The application of GIS and Remote sensingto solve route problem can be seen in Namir and Noor (2012). In this work, geometrical, geotechnical, social and economic factors for MultiCritera Evaluation (MCE) were considered in the selection of the best alternate route.Kumar & Mohan (2013) also looked at the entangled systems of streets oblige examination to enhance the development of individuals, products, administrations and the stream of assets. Ganorkar, Rode and Bhambulkar (2013) applied GIS in transportation engineering to solve road network problem by determining the optimal or best routes considering minimal travel distance and time.

These issues of optimal and alternate routes introduced and explored by some researchers have made a platform upon which the study was carried out.

II. Study Area

The GidanKwano Campus of the Federal University of Technology, Minna is located along Minna - Bida road which is approximately 12 km from the main town. The campus lies between Latitudes 9°31'15"N and 9°32'30"N and Longitudes 6°26'15"E and 6°28'00"E with an estimated land mass of 10,000 hectares. The details of the study area are shown below in the map.

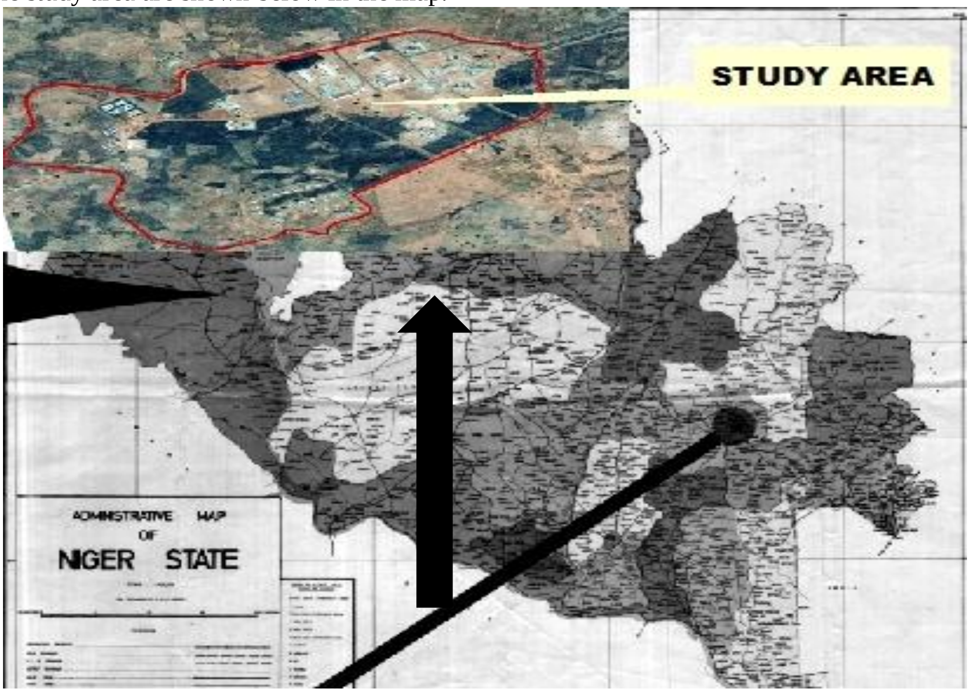

Fig 1: Map of Study Area

III. Methodology

3.1 Materials

The hardware used consisted of a Hp 630 Laptop computer with 2.00 GB of RAM and 500 GB HARD disk; a DGPS (Hi-target V30 model) Global positioning system, Hewlett Packard 710c desk jet printer, Pegeot 406. Three different software packages were also used ArcGIS 10.1, AutoCad land development 2009 and Microsoft full kit 2010. The data used included the X Y Z coordinates from DGPS, road network map of the campus and IKONOS satellite image (1m spatial resolution) acquired in October 2013.

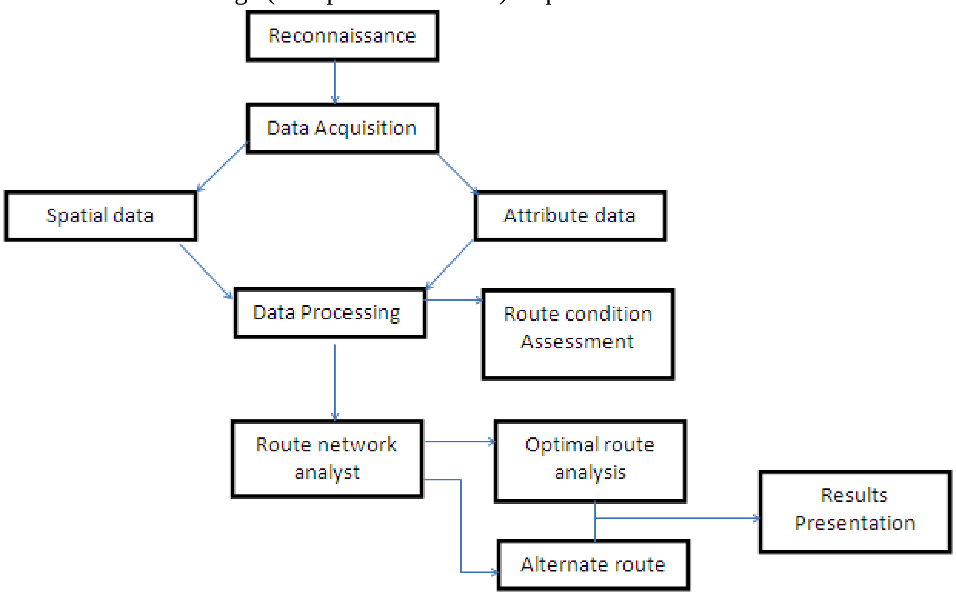

Fig: 2 Work flow of Methodology

3.2 Creation of Vector Layers

The analogue map of the campus road network was scanned, georeferenced and digitized. The various layers extracted where, dual carriage road, single lane, design walk ways and foot paths. The use of satellite data also revealed some illegal routes to and from the campus. The coordinates of all the points obtained as a result of field work were plotted as point layer. These include the existing structures and all the turns on the road network.

3.3 Integration of Spatial and Attribute data

The attribute data collected during the field observation was linked with the spatial data appropriately in an orderly manner as Road features data where integrated to road layers and structure features data to structure layers and so on.

3.4Adding Field for Distance and Travel Time

A field name ‘meters’ was added to the attribute table and two new fields were added as "Ft_minute (Fromto)" and "Tf_minute (Tofrom)" This is to know the time taken alone a particular polyline To and Fro at a given rate. This paper adopted a velocity of 20km/hr.

3.5 Creating a Network Dataset

Network dataset was created based on the shape file and feature class network. The name of the network dataset was set to “Road_Analysis_ND” by default.

3.6 Route Analysis and Optimal Route Identification

The best routes were chosen owing to some considerations like shortest route from an origin to the destination, road conditions, and the parameters set for analysis in the network dataset.

3.7 Adding Stops

This is to depict where the analysis starts alongside with where it stops, the analysis starts from the origin and ends at the destination hence stops were used to define that. The network analyst automated to calculate the optimum route. See figure3 fromstudents’ hostel to University clinic as stops 1 and 2, respectively.

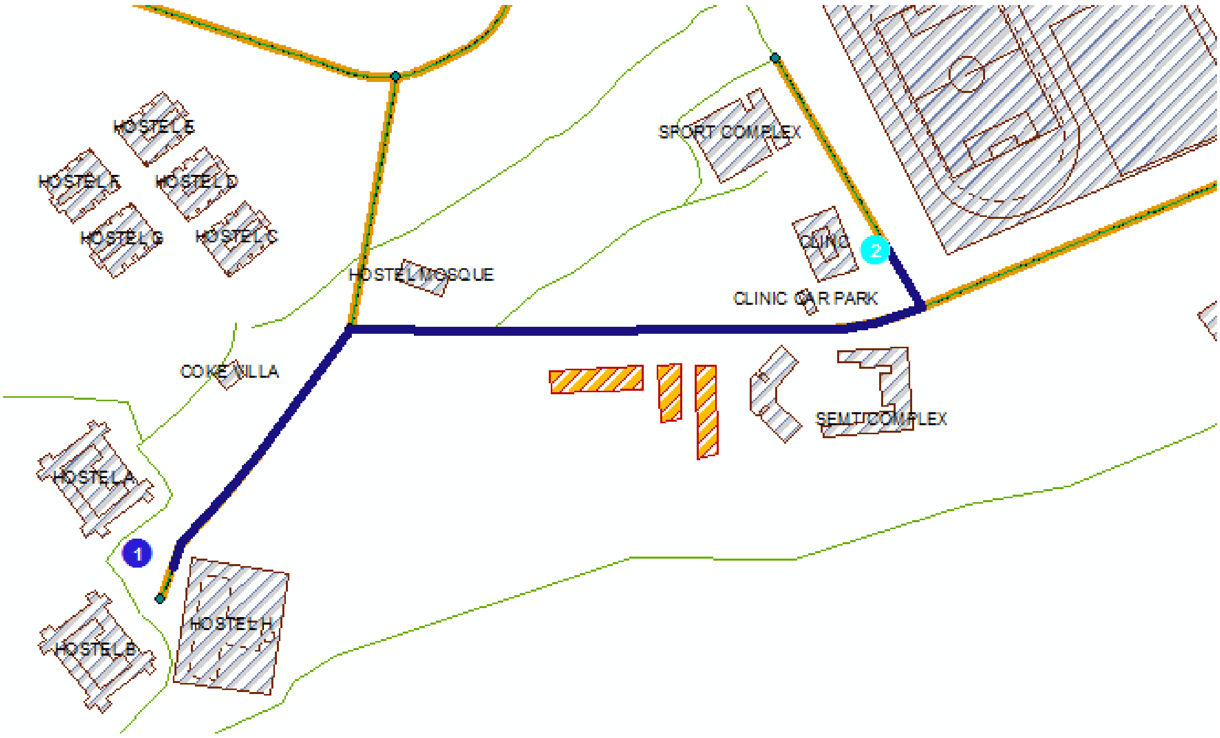

Fig 3: solved shortest route from stop1 to stop2.

Table 1: Attribute table for calculated TF and FT

Table

SINGLE_CARRIAGE_ROAD

NAME	CONDITION	FT_Meters	TF_Meters
SET, ICT, LIBRARY, SAAT ROAD	FAIRLY GOOD	0.665041	0.665041
SEMT, CLINIC, STUDENT AFFAIRS, HOSTEL ROAD	UNDER CONSTRUCTION	0.480298	0.480298
HOSTEL, COKE VILLA ROAD	BAD	0.284933	0.284933
E CENTER, SET, AUDITORIUM, BANK ROAD	GOOD	0.253796	0.253796
UNI LIBRARY, ITS	GOOD	0.228007	0.228007
QUARTERS STREET	FAIR	0.970077	0.970077
E CENTER ROAD	<Null>	0.048369	0.048369

Source: Researchers' field work (2015)

IV. Results And Discussion

This paper presents a digital map of GidanKwano campus of the Federal University of Technology,Minna. It depicts all the details on the campus as seen in figure 4, a map showing all routes leading to and from the campus whether legal or illegal as shown in figure 5. A simple demonstration of route network analysis shows the optimal and alternate routes between some selected points on the campus:

1. From the school gate to the senate building.
2. From the school gate to student hostel.
3. From the school gate to the clinic,
4. From the staff quarters to the school clinic,

The results presented in this paper clearly demonstrate the capabilities of GIS in the mapping industry. Figure (4) displays the digital map of the entire campus showing all the features (point, line and polygon). Figure (5) is a map shewing all routes connecting the campus whether legal or illegal. The map reveals about eight (8) different routes with the main gate exclusive. This clearly shows that the main gate is the only legal route in and out of the campus while all other routes are termed illegal. Apart from route number 3 and 7 which are footpaths, all others are motor able linking farmlands, neighbouring villages and communities.

A demonstration of optimal route analysis can be seen in figures (6-9) alongside the alternate routes. From the main gate to the senate building, the optimal route is 1930.830m and the alternate route is 2157.137m with travel time of 5,798min and 6.477min respectively. Similarly from the main gate to the school clinic, a distance of 2745.546m and travel time of 8.244min was obtained on the optimal path while 2892.988m and 8.687mins along the alternate route. The optimal and alternate routes were also determined from main gate to students' hostel as 3030.963m and 3328.812m as against 9.101min and 9.996min respectively. A speed limit of 20km/hr was adopted for this paper.

V. Conclusion

The use of GIS in the transportation sector as a powerful tool to solve route network problems in the urban environment has been able to yield reliable and realistic results. This paper has revealed the ability of GIS tool (network analyst) to determine both optimal and alternate routes of some selected points within GidanKwano campus of Federal University of Technology Minna and the illegal routes connecting the campus at various locations.

VI. Recommendation

The illegal routes determined from this work can constitude security risk to the University community. The following recommendations can be worthwhile in view of the current national insecurity:-

(i) All illegal routes need to be well monitored, secured and possibly blocked.
(ii) Ther is the need to install CCTV devices at all origins and destinations of the road network on the campus.
(iii) More extensive and intensive similar research efforts could be needed so as to better understand the general University community to ensure safety of lives and properties.

References

[1]. Abdul-Lateef.B, Abdul-Nasir.M, Dano U. L and Imtiaz. C (2012): Optimal Oil Pipeline Route Selection Using Gis: Community Participation in Weight derivation and Disaster Mitigation. International conference on future Environment and Energy IPCBEE vol.28 (2012) @ (2012) IACSIT press, Singapoore

[2]. Ammar A, Sitalakshmi V, Jemal A and Mamoun A (2011): An Optimal Transportation Routing Approach using GIS-based Dynamic Traffic Flows. 3rd International Conference on Information and Financial Engineering IPEDR vol 12 (2012) @ (2011) IACSIT press, Singapoore

[3]. Macharia P. M and Charles N. M (2012): GIS Analysis and Modelling for Optimal Oil Pipeline Route Location: A case study of proposed IsioloNakuru Pipeline Route. International Journal of Science and Research (IJSR) ISSN (online):2319-7064

[4]. Namir G. A and Noor M. A (2008): A GIS-Assisted Optimal Urban Route Selection Based on Multi Criteria Approach. The Iraqi Journal for Mechanical Engineering, Special Issue (D).pp 556-567.

[5]. R. A. Ganorkar, P.I Rode and A. V Bhambulkar (2013): Application of GIS in Transport Engineering. International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622. Vol 3, Issue 2.

[6]. Yongtaek LIM, Dundeok-dong, Yosu city Chunnam (2012): A shortest path algorithm for Real roadnetwork based on path overlap.

[7]. Wikipedia(www.wikipedia.com) The Online Encyclopaedia (Accessed date 12th July, 2013)

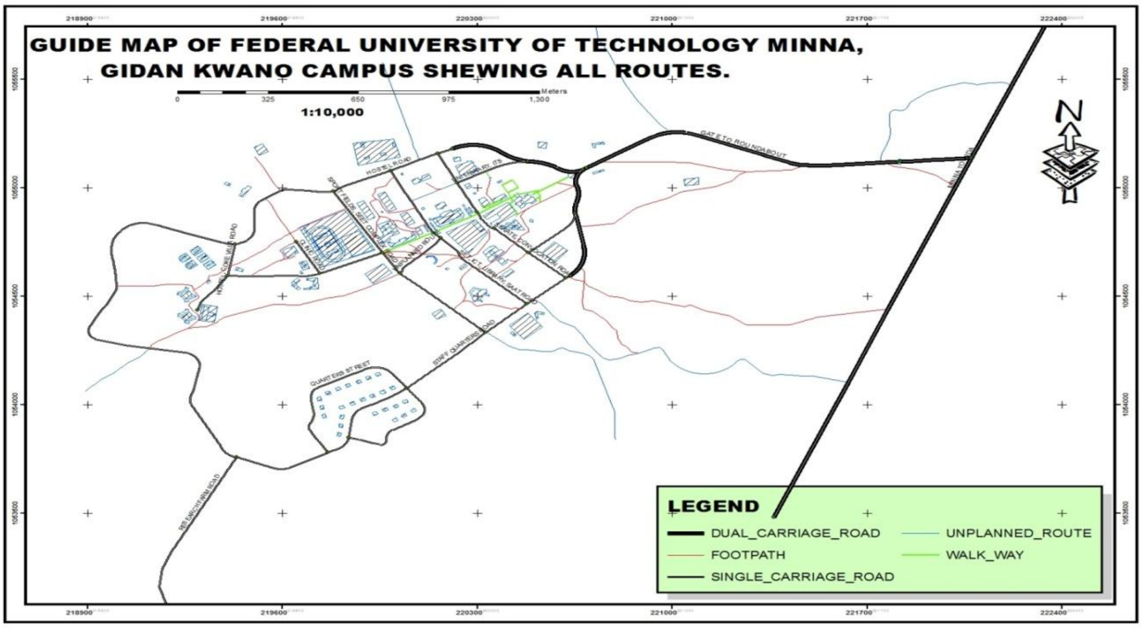

Fig 4: Digital map of Gidankwano campus

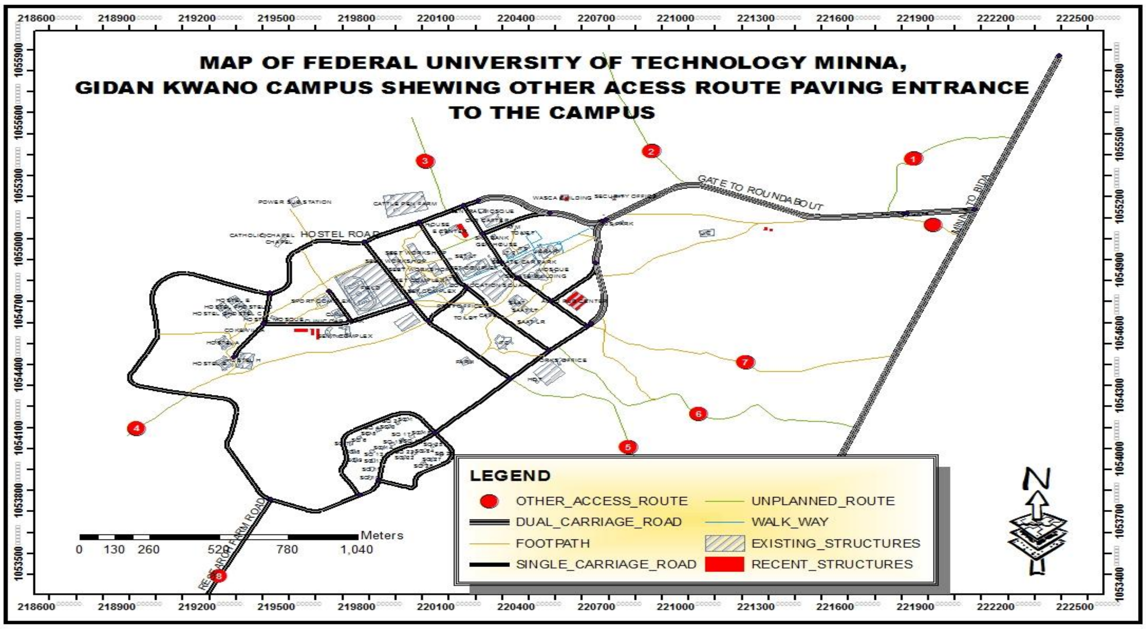

Fig 5: Digital map showing all routes to and from the campus

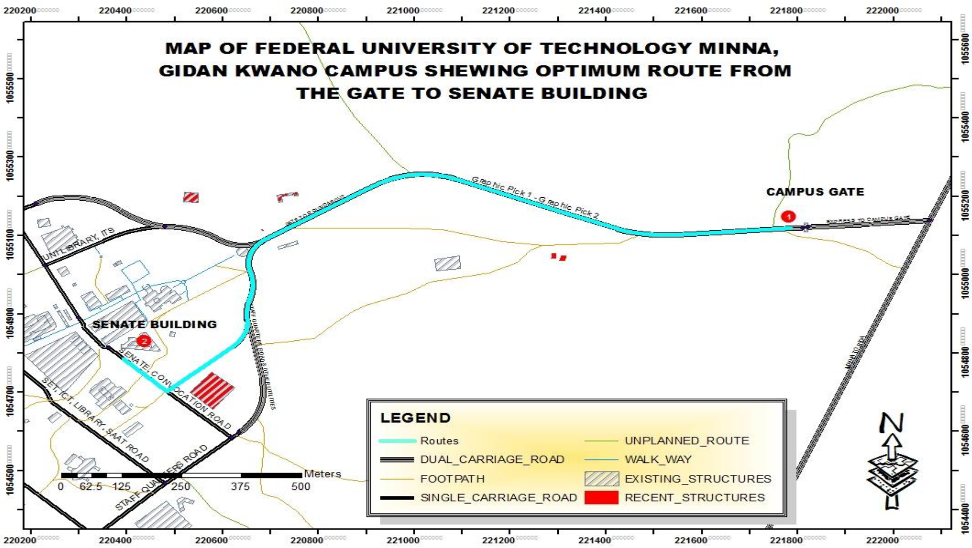

Fig 6.a: optimal route from campus gate to the senate building

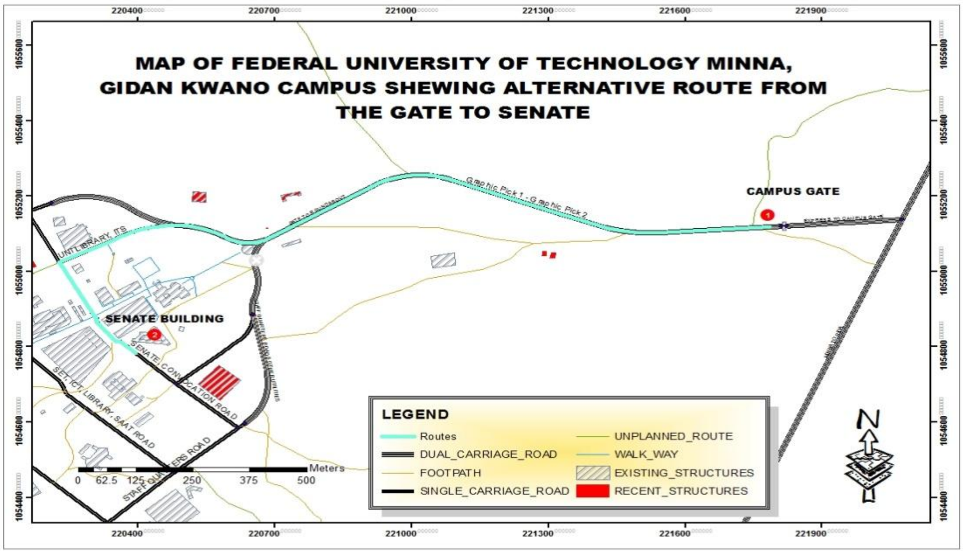

Fig 6.b: alternative route from the campus gate to the senate building

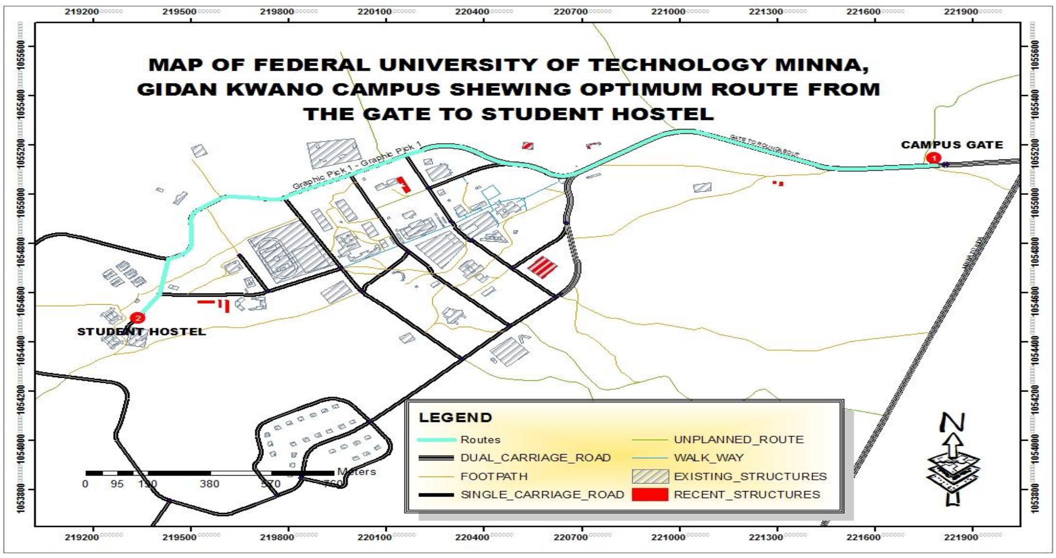

Fig 7.a: optimal route from campus gate to the student hostel

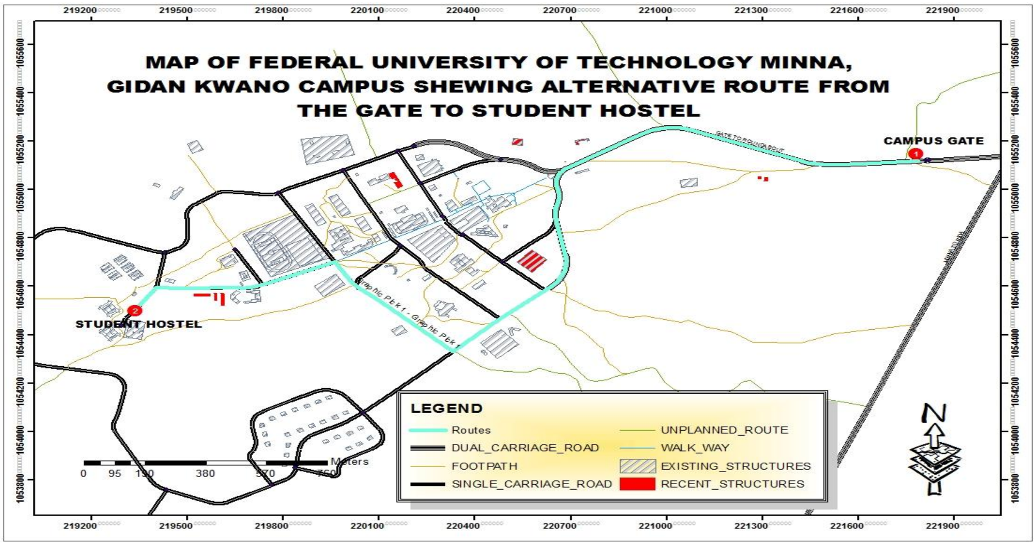

Fig 7.b: alternative route from the campus gate to the student hostel

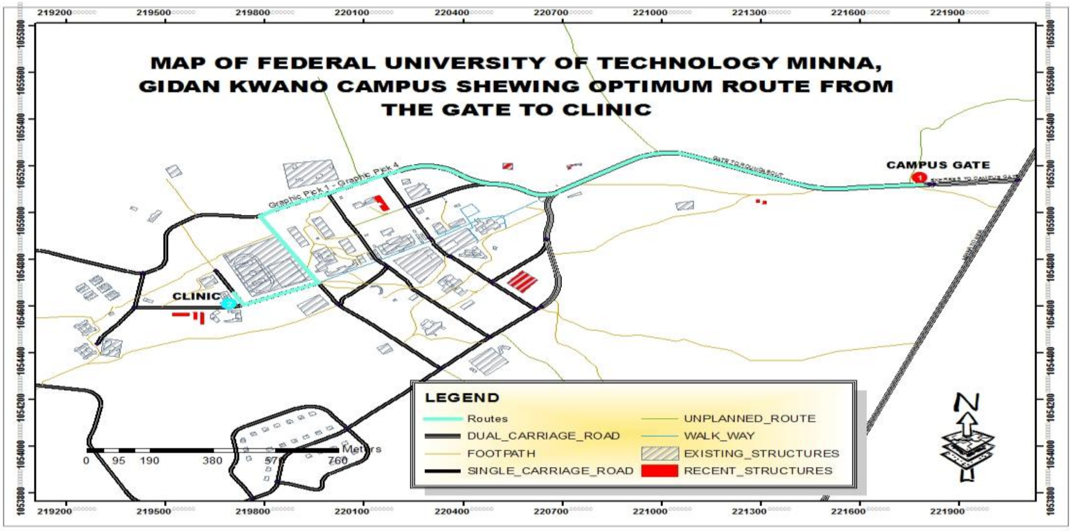

Fig 8.a: optimal route from campus gate to the clinic

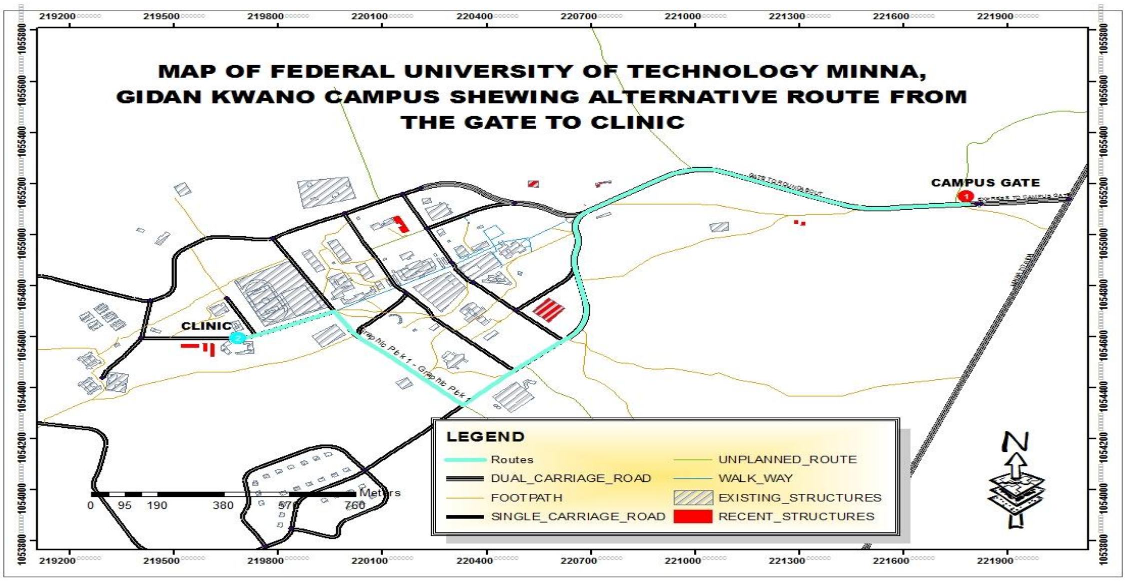

Fig 8.b: alternative route from the campus gate to the clinic

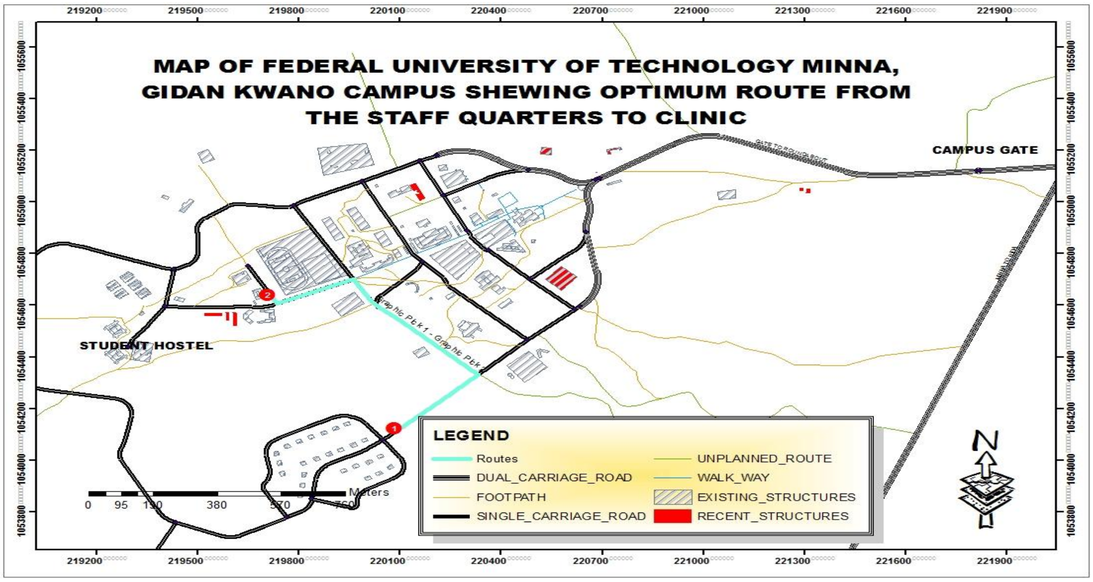

Fig 9: optimal route from staff quarters to the clinic

Table 2: sample of comparison between optimal and alternative routes with respect to 20km/hr speed limit

Origin-Destination	**optimal route distance (m)**	**Alternative route distance (m)**	**Difference between distances (m)**	**Travel time for best route (min)**	**Travel time for alternative route (min)**	**Difference between travel time (min)**	**Summary**
Gate to clinic	2745.546	2892.988	147.442	8.244	8.687	0.443	**The alternative route is longer than the best route, hence has a less travel time**
Gate to senate building	1930.830	2157.137	226.307	5.798	6.477	0.679	**The alternative route is longer than the best route, hence has a less travel time**
Gate to student hostel	3030.963	3328.812	297.849	9.101	9.996	0.895	**The alternative route is longer than the best route, hence has a less travel time**

Source: Researchers' lab work (2015)