SMART ROAD FOR EMERGENCY RESPONSES: A MODERN TECHNOLOGICAL APPROACH

(Case Study of Ilaro Town)

BY

ADEDOKUN A.M*. & ADEWARA M.B.**

(DEPARTMENT OF SURVEYING AND GEOINFORMATICS, FEDERAL POLYTECHNIC ILARO)

Email: **ddknadebayor@yahoo.com*** **thawben@gmail.com****

Being Paper presented at the 3rd National Engineering Conference of the Federal Polytechnic, Ilaro

Abstract

In recent time, one of the developmental issues of concern in Ilaro town is road management. Consequent upon the limited road resources, the influx of people and goods in and out of the town has increased travel time especially in times of emergency situations. It is against this backdrop that this work aimed at using shortest route algorithm in Arc GIS to address the challenges associated with road management and emergency situation in Ilaro township The dataset used in this work involves both the spatial (road network, emergency service centres, accident spots and fire incidence spots) and attribute data (road names, road distance, road status and road classification such as dual carriage way and single carriage way). This paper reveals clearly the shortest route to hospital and fire stations from accidents spots and fire incidence spots. Consequently therefore, it will assist emergency service providers in their responses to road related distress call using the cut edge technological tools rendered by GIS.

Keywords:

Road, Network, Emergencies, Hospital, Fire Station, Algorithm, GIS technology.

1.0 INTRODUCTION

Emergency management programs are developed and implemented through the analysis of information. The majority of information is spatial and can be mapped. Once information is mapped and data is linked to the map, emergency management planning can begin. Once life, property, and environmental values are combined with hazards, emergency management personnel can begin to formulate mitigation, preparedness, response, and recovery program needs (ESRI, 1999).

Now-a-days road traffic volume increases significantly to an extent that it sometimes endangers human life. This is because of lack of immediate response or emergency service. Generally Emergency calls are manually done by the people who witness the accident and call the help center manually.

Population figure in Ilaro town is also on the increase yearly as a result of influx of people into the town for various reasons. This explosion is resulting in the settling down of people for new means of livelihood and for business activities. The implication of this is that in the nearest future traffic volume will further increase unabated since the major means of transportation in the town is by roads. Thus driving while finding one's way from place to place which is a complex cognitive task becomes more difficult and strenuous. In the bid to address situation like this, Petchenik (1989) opined that authentic computer-based assistance to drivers must come from devices and systems significantly different from the digital dashboard maps hitherto offered

In today's traffic world, ambulance plays a major role when accident occurs on the road. This need arises to save human life and properties. Transporting a patient to emergency hospital seems quite simple but actually it is quite difficult during peak hours (Suneet Naithani & Chauhan, 2015).

Creating a digital road network does not in itself offer any positive environmental impacts but brings about an improved access to integrated information that facilitates the operations of traffic services and better traffic planning. It is the. Information on alternative routes and transport modes that actually result in more efficient mobility, which produces environmental benefits

In Ilaro town there are three emergency service providers. These are the Nigeria Police Force, hospitals and fire service. Most of the emergency hospital ambulances are equipped with

paramedics, even though they are unable to reach the incident site because of bad roads. Location, identity, time and activity have been identified as primary context types for characterizing the situation of an accident (Arrington & Cahill 2004) .Global positioning system (GPS), geographical Information System (GIS) and Global System for Mobile Communications (GSM) plays an important role as path finder and managing the routes for the drivers and for the patients (Suneet Naithani & Chauhan, 2015).

It is against this backdrop that this paper focuses at road management and emergency situation in Ilaro Township using Geographical information system approach.

The specific objectives are:

1. To produce digital road network map of the study area
2. To determine the shortest path to reach hospitals from accident spots.
3. To determine the fastest route to fire outbreak from the fire service station.

2.0 METHODOLOGY

2.1 STUDY AREA

Ilaro is situated on the rich cocoa belt of South Western Nigeria and with an above average rainfall Geographically, Ilaro is bounded on the north by the Oyo Province on the South by Lagos and the east by the Egba Division and on the west by Dahomey (Republic of Benin). The boundary on the South is defined in the "Colony of Nigeria boundaries order in council 1913" (see page 311 of Vol.IV laws of Nigeria. It lies between 496505.830mE, 763173.51mN and

496435.980mE, 759321.670mN.

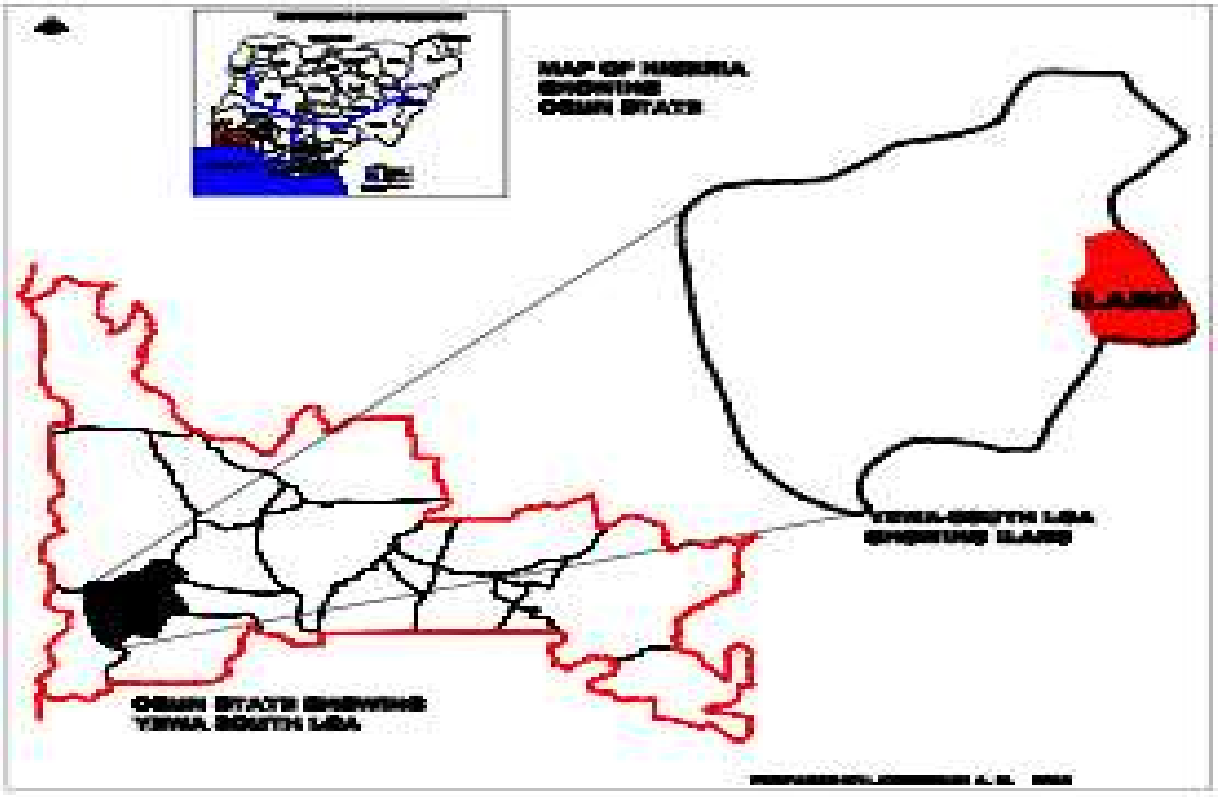

Figure 1: Map of Ilaro Town

2.2 DATA SOURCES

1. Field study using handheld GPS
2. Google Earth Imageries (2015)
3. Digital map of Ilaro town

2.3 DATA COLLECTION

Primary data were collected from the field using the handheld GPS and a georeferenced digital map of Ilaro was obtained from the department of Surveying and Geoinformatics, Federal Polytechnic, Ilaro. Attribute data were also gathered from field social survey.

The collected datasets such as digital spot centre and the emergency were added to Arcmap and shapefiles for the different layers of the roads were created and reclassed as major, minor, streetlights etc,

The emergency centres data were also imported into Arcmap where shapefiles were created and attribute tables of the emergency response centers were populated based on the collected field data sets.

A road network map was created from the digital map. Network data set was created for the network analysis using the network dataset tool. The network data set consists of three layers; road segment as polyline features, junctions as point features and the road network itself. The network dataset (junctions and road segments), hospital location and other emergency centers are located on the road network map.

2.4 SHORTEST ROUTE ALGORITHM

On a weighted graph this algorithm solves single source and shortest route problem. To find a shortest route from a starting point P_1 to a destination point P_2, the algorithm maintains a set of junctions (point feature), hospital (H), accident spots (A) and emergency spots (E), whose final shortest route from P_1 has been computed. The algorithm repeatedly finds a junction in the set of junctions that has the least shortest route, adds it to the set of junctions H, A and E and updates the shortest route estimates of all neighbors of this junction that are not in H, A and E. the algorithm continues till the destination junction is added to H, A and E.

A new route layer is created with its three (3) categories – slope, Barriers, and Routes. A composite route layer (Route 1 and 2 etc) is depicted which comprises three (3) feature layers; slopes, barriers and routes. These composite route layers are modifiable in the layer properties.

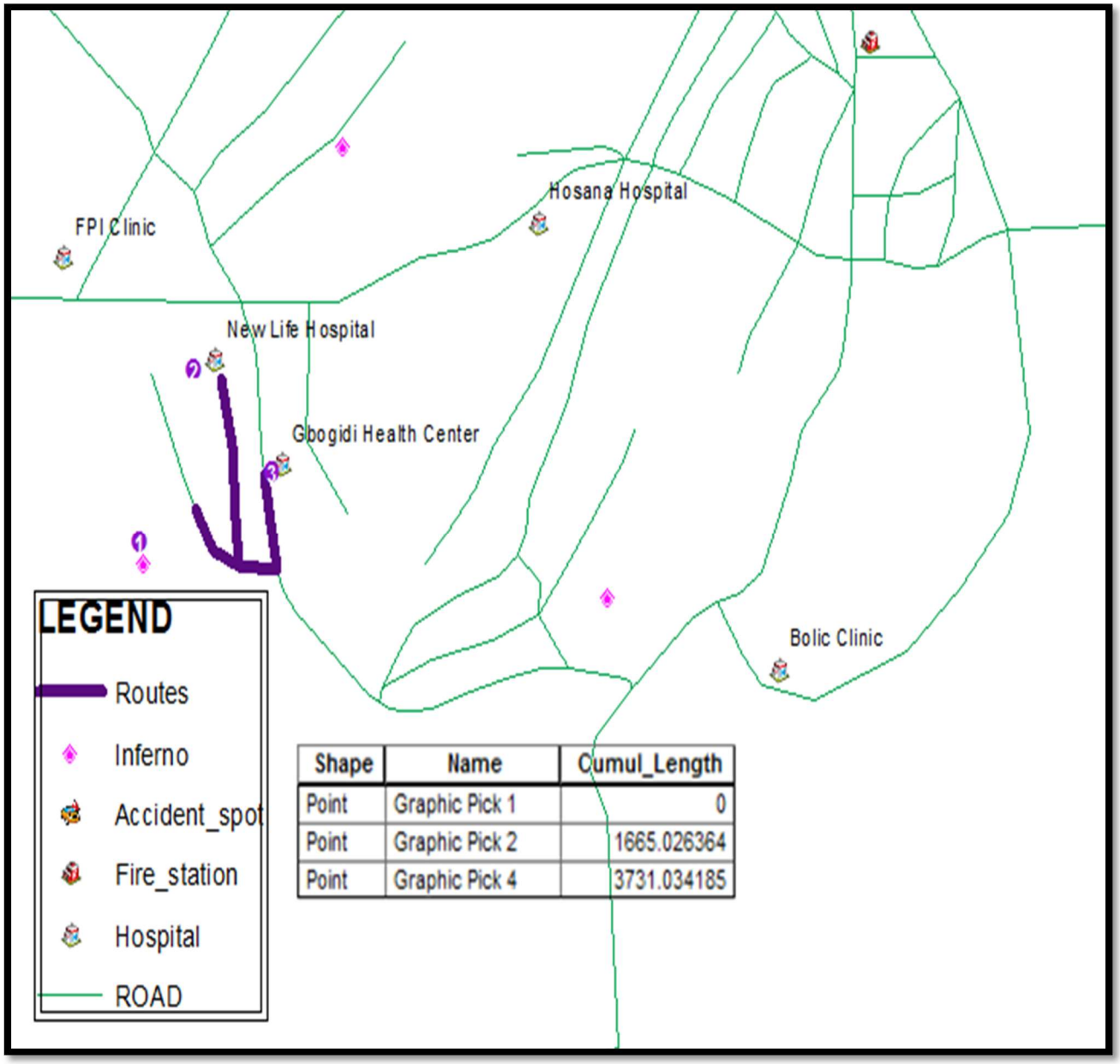

Figure 2: Route showing the nearest Hospitals (2) and (3) from a fire outbreak (1) in Gbogidi area of the town. Table inset is the distance (m) of the fire outbreak to the nearest hospitals

Table 1: Showing distances (m) of selected fire outbreaks to the fire station in the area

Name	Cumul_Length	SourceID	RouteName	Sequence	TimeWindowStart
Graphic Pick 1	0	ROAD	<Null>	1	<Null>
Graphic Pick 1	6210.330666	ROAD	<Null>	2	<Null>
Graphic Pick 2	10064.945548	ROAD	<Null>	3	<Null>
Graphic Pick 3	14253.362384	ROAD	<Null>	4	<Null>
Graphic Pick 4	22386.172555	ROAD	<Null>	5	<Null>
Graphic Pick 5	26552.492831	ROAD	<Null>	6	<Null>

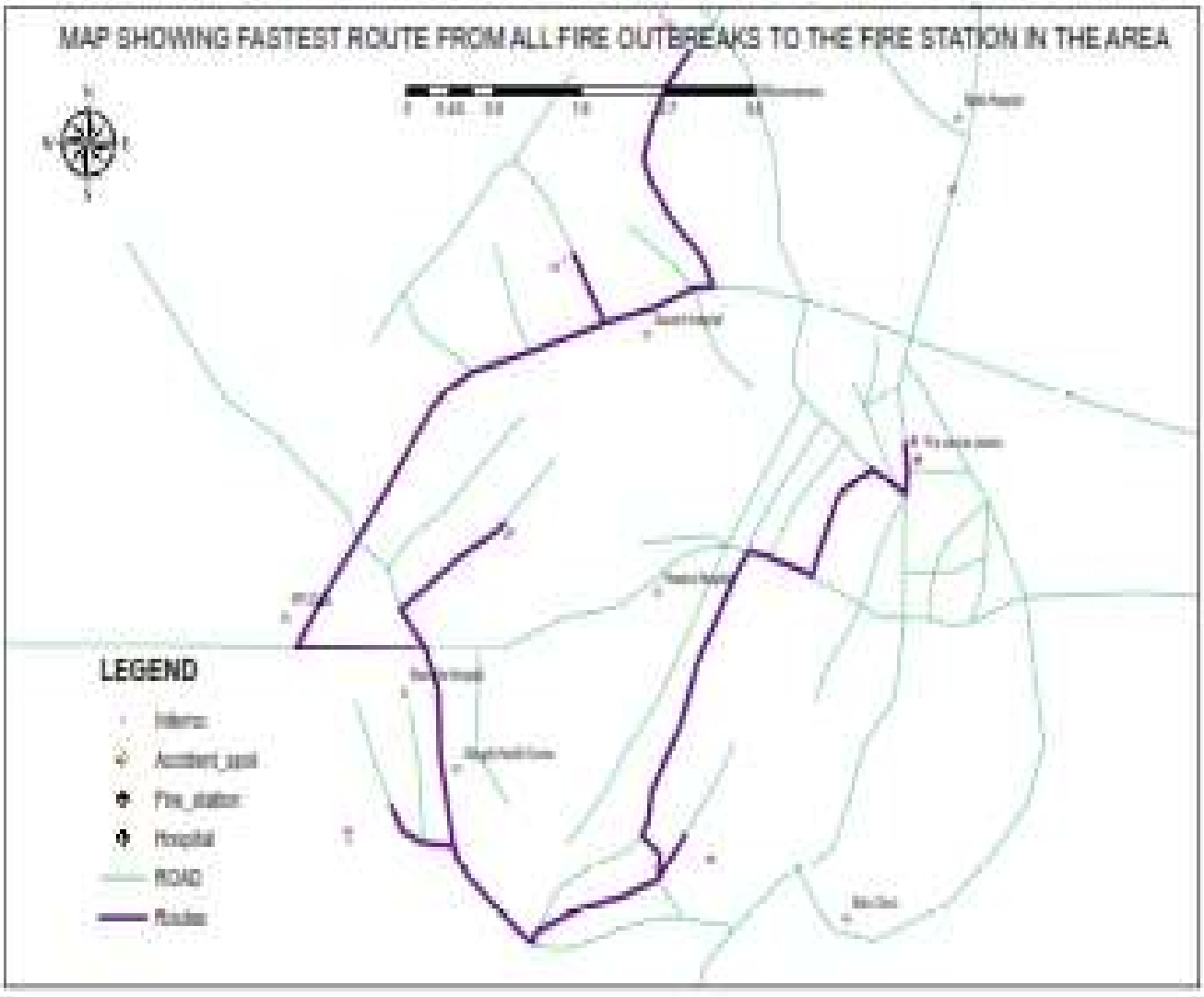

Figure 3: Map showing fastest route from Fire Outbreaks to the Fire Station in the area

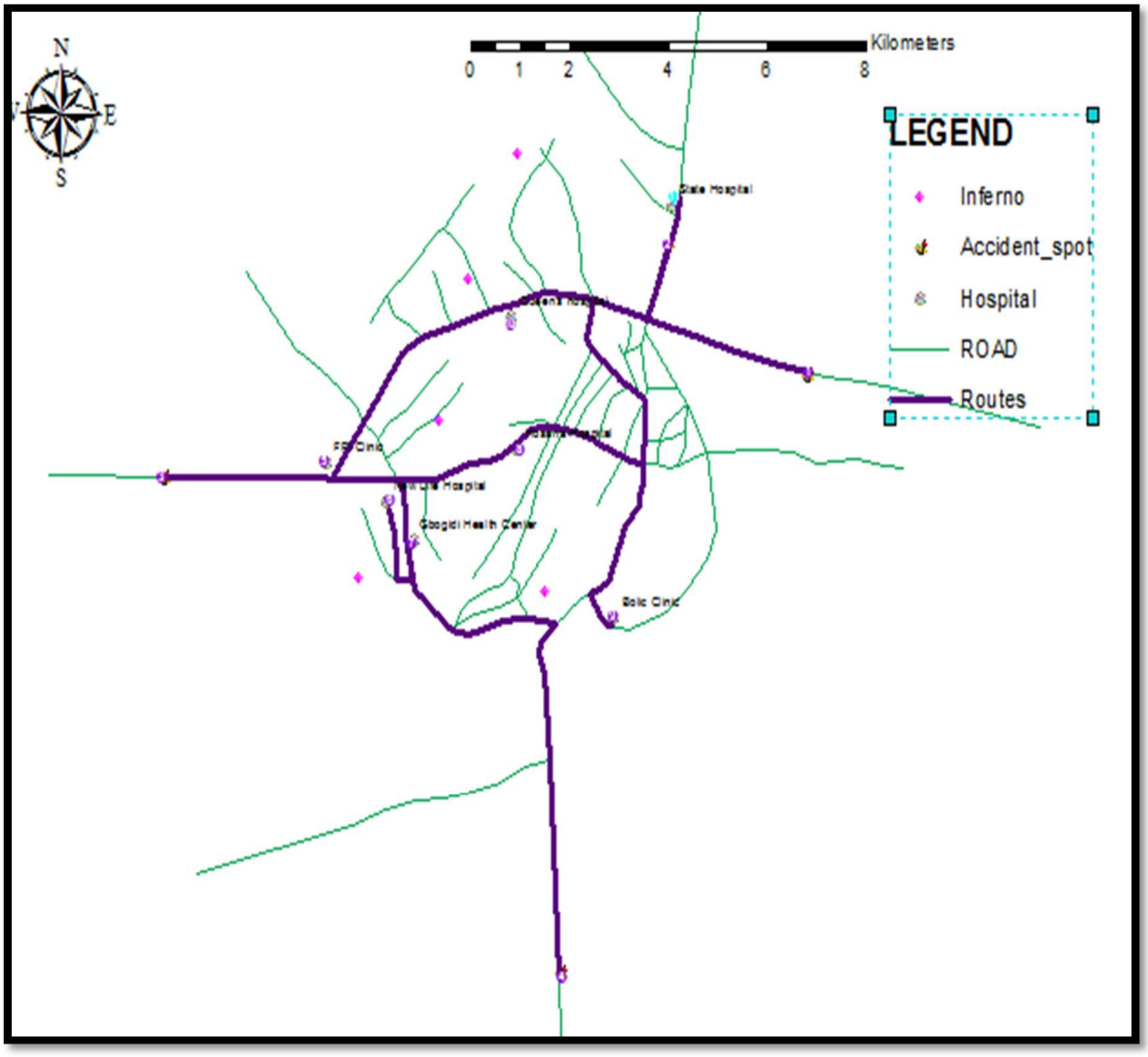

Figure 4: Map showing fastest route from all Accident spots to all Hospitals in the area

3.0 RESULTS AND DISCUSSION

The results of the shortest paths above seeks to demonstrate that finding one's way from place to place while driving a car is a complex cognitive task, and that authentic computer-based assistance to drivers must come from devices and systems significantly different from the digital dashboard maps hitherto offered. It discusses the support of digital maps in finding shortest route in times of emergencies. These maps would be integrated into computer system mounted inside the vehicle as a navigation system. It is concluded that computers are unlikely to replace human drivers in any significant way, but there are many ways to supplement the human driver's skills and knowledge.

During multiple emergencies (Accidents, inferno, mud slides, earthquake damage) in different locations, a digital map can display the current emergency unit locations and assigned responsibilities to maintain overall situation status.

The result of the analysis shows that the closest fire incidence to the fire service station is inferno (3) at a distance of 5168.9m

.

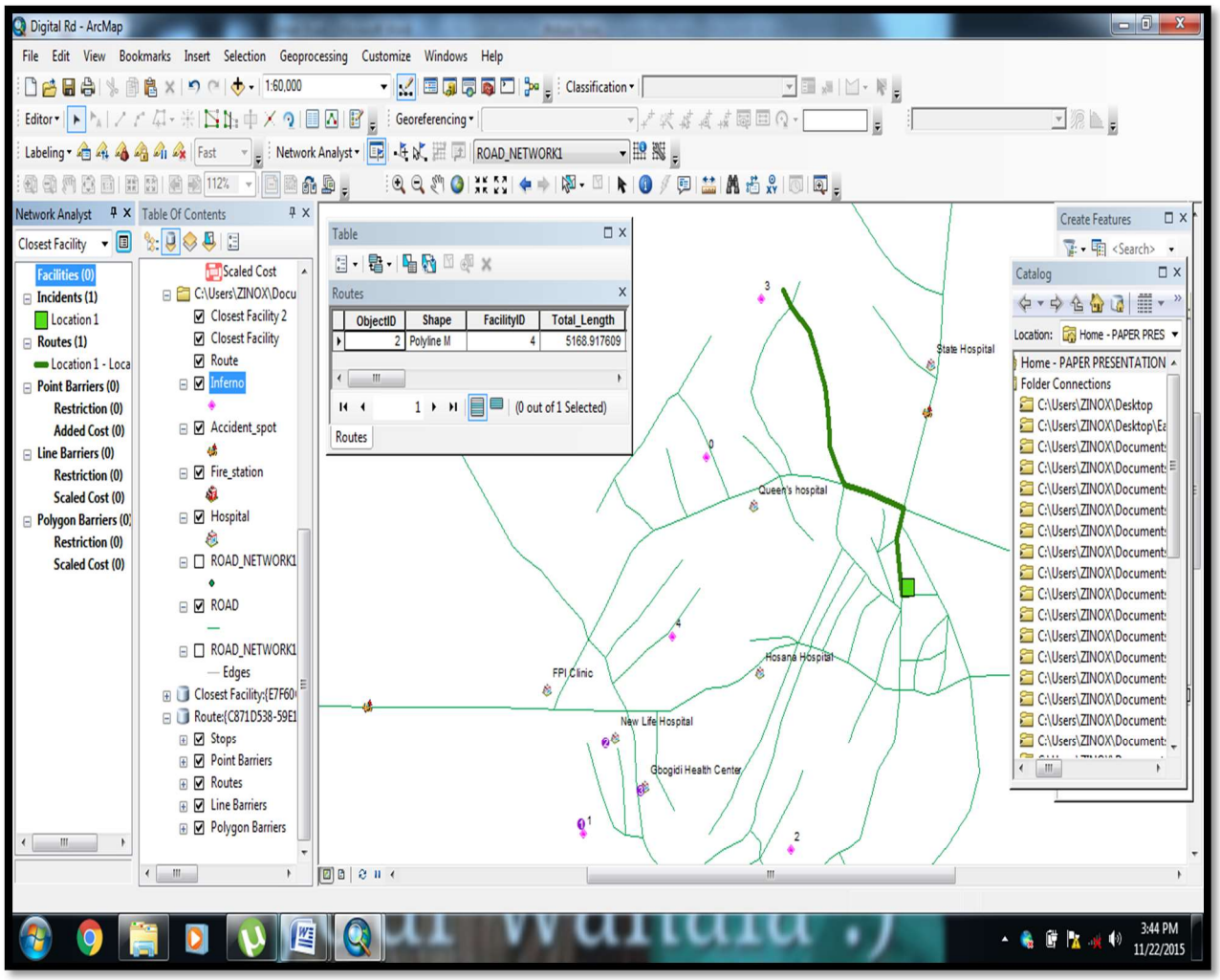

Figure 5: Map showing the closest route to the Fire Station in the area

4.0 CONCLUSION

The paper reveals the shortest path to reach hospitals from accident spots. It also reveals the fastest route to fire outbreak from the fire service station. This type of Emergency Response Management System reduces the fatality rate to a great extent. It is therefore proposed that a Digital Road Network Map be used for Emergencies Responses.

By utilizing a GIS, all Departments concerned with emergency services can share information through databases on computer-generated maps in one location. Without this capability, emergency workers must gain access to a number of department managers, their unique maps, and their unique data. Most emergencies do not allow time to gather these resources. This results in emergency responders having to guess, estimate, or make decisions without adequate information. This costs time, money, and, in some cases, lives. GIS provides a mechanism to centralize and visually display critical information during an emergency.

REFERENCE

ESRI. (1999). *GIS for Emergency Management.* USA.

Pertchenik, B. (1989). The nature of navigation: Some difficult cognitive issues in Automatic Vehicle Navigation. *Vehicle Navigation and Information Systems Conference.* Toronto: IEEE.

Shanthi, K. P (2012). Location based Emergency Response Management System through Satellite in Road Network. International Conference on Advances in Electronics, Electrical, and computer Science Engineering (pp.1-5). Indian Institute of Research, Engineers and Doctors

Suneet Naithani & Chauhan, A.C. (2015). *Decision* Support System for Emergency Response *Scholarly Research Journal for Interdisciplinary studies (pp. 680-687).* Dehradum Research gate.