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Intelligent Mobile Application for Route Finding and Transport Cost Analysis

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***Abstract*—**The explosive rate of increase in number of habitats and vehicles in different areas of the developing countries like Nigeria has motivated government of such world engage in both rural and urban road construction for ease of navigation. This brings stresses in navigating such roads with public traffic hence noise pollution to the environment. For effective autonomous geo-spatial navigation service, we propose a web based model implemented as intelligent mobile application for route finding and transport cost analysis. A case study observed on data collated from different areas within Ile-Ife and its surroundings shows that the system aid users in making decision regarding transportation alternatives. This study shows how to help people living in such parts of the world reach their destinations when navigating unknown routes with reduced transportation cost.

***Index Terms*—**Route Finding, Web Application, Mobile Locator, Route Navigation.

I. INTRODUCTION

Route navigation and making decision on optimal cost analysis for transportation has being a major concern in contemporary society today [1]. Most developing nations are faced with unacceptable levels of delinquency and crimes such as human trafficking due to human ignoramus in navigating across unfamiliar areas. In many of the world's industrialized countries, Geographical Information System (GIS) has be engaged to reduce the stress people pass through in order to move from one location to the order [2]. Moreover, the application of this technology has reduced crime rates recorded in such developed countries.

The explosive growth of the World Wide Web and emergence of e-commerce has led to the development of Internet-based systems. In recent times, the world revolves around the World Wide Web and mobile devices especially with great emphasis on sub-Saharan Africa where the gadgets have turned into 'smaller' computers with their ability to work as much and even more than computers. Information filtering is an emerging paradigm used to identify the set of raw and/or processed data that can be of interest to certain users. This buoyant paradigm has its root in information retrieval and thereby employs many of its techniques such as a textual and graphical retrieval [3].

A web service is a method of communication between two electronic devices over the World Wide Web, it is a software function provided at a network address over the web with the service always on as in the concept of utility computing (Wikipedia). According to W3C (World Wide Web Consortium) web service is a web-based application and the concept was introduced as Servlet written in Java language [6]. At that time, both JavaScript and XML had already been developed, but Ajax, a new framework compiled based on Java PL, had not yet been coined. Then, XML-Http request object had only been recently introduced on Internet Explorer 5 as an ActiveX object.

In 2005, the term Ajax was coined, and applications like GMAIL started to make their client sides more and more interactive. A web page script is able to contact the server for storing or retrieving data without downloading an entire web page [7]. Recently, HTML5 was finalized, which provided graphic and multimedia capabilities without the need of client side plugins.

HTML5 also enrich the semantic content of documents. The APIs and document object model (DOM) are no longer afterthoughts but are fundamental parts of the HTML5 specification. WebGL API paved the way for advanced 3D graphics based on HTML5 canvas and

JavaScript language. These have significant importance in creating true platforms and browser independent rich web applications [8].

Transport cost analysis is an integrated analysis that evaluates the full cost of transport. It serves as a basis for comparison of transport cost and possesses advantage such as having optimal information about transport systems and road paths that is better in different area. In addition, it act as an adviser to user who are plying certain routes for the first time hence guiding them on faster and more economical routes that can be taken. Research applications have shown that transport cost analysis system can enhance finding a perfect trade-off between pricing and other factors affecting the system.

GIS as a tool can be used to plan effectively for emergency response, determine mitigation priorities, and predict future events [9]. GIS can also be used to get critical information to emergency responders upon dispatch or while en route to an incident to assist in tactical planning and response. The ability to access and process information quickly while displaying it in a spatial and visual medium rather than textual allows users to allocate reason ahead of time to make good decision. This will assist users to cut edging prices required during transportation and, as well, hasten them in arriving at their destinations. GIS has been applied to different areas of life, such as planning, and it has effectively and efficiently benefited many aspects of human endeavors like crime and transportation analysis. Some specific applications of GIS in transportation include road design, highway mapping, and analysis involving volumes of accident data traffic, and identification or alternate routes for easy navigation.

Route selection has been a subject of study in different areas such as Stable Multipath Routing in mobile ad hoc network [10]. However, this study presents a Mobile Locator for user's navigation in unknown routes at optimal transport cost. The remaining part is organized that review of related works is presented in Section 2 while research methodology is discussed in Section 3.Implementation of the model and result are presented in Section 4. Case study of Ile-Ife used to show the viability of the model is also presented there. Lastly, conclusion and direction of future research areas are in section 5.

II. Related Works

As a result of years' of studies, there had been many solutions developed for route navigation problems. Research efforts like [1] based on solution to shortest path problems and provided an algorithm to find a *simplestpath* through a network for automated navigation systems while [4] introduced the algorithm for computing the shortest safe path between two nodes over a large time-dependent transportation networks. Jiang and Liu(2011) developed an algorithm about computing the fewest-turn map directions or routes based on connectivity of natural roads [11].

In Ref. [2], a general illustration of GIS application in transportation planning is presented and the study introduces a symbolic case study of Riyadh city (Saudi Arabia). The study relied on GIS to identify deficient facilities in the vital area within Riyadh's ring road. The deficiency analysis process is utilized to highlight streets where demand exceeds capacity. Verma et al [12] developed and designed a map navigator in India called Mapmy India. The study offers consumer products like GPS navigation system and business solutions along with online search of map and directions.

Ref [13] developed a mobile route finding application called Mumbai Navigator which plans travel within the city of Mumbai using BEST buses and local trains, hence providing shortest bus route scheduling. It also gives information relating to bus routes. Lars Rasmussen [14] developed the Google map which offers street maps, a route planner for traveling by foot, car, or public transport and an urban business locator for numerous countries around the world.

In Ref. [15] a path finding algorithm is implemented for navigation of visually impaired people. The system, tagged PUSULAL, is a help system that has been developed for the use of visually impaired people in order to help them for shopping by themselves. It uses RFID technology to find the location of the user in the market and to direct the user to the target location. This thesis study covers the administrator module of the PUSULAL. Accordingly, the scope is to build and implement a path finding algorithm to a predefined map, then step by step improve the system and develop it to the final application area. Also, Ref [14] proposes a routing technique in Large Dynamic Road Network in other to reduce traffic congestion and to increase efficiency of transportation system through the use of ITS (intelligent transport system).

Akhilesh et al [16] introduce a new way of modeling and processing of real road network into database format [17]. For the purpose, he has developed a WebBased GIS Route Finder System that helps one to Fig. out how best to get where one wants to go. It helps us to find better paths to travel from source to destination. The better route is defined over a set of constraints considered by the user during route selection process. The main aim of Web Based GIS Route Finder System is not only to plan a shortest route between source (s) and destination (t), but also to plan an alternate or next available shortest route when an edge breaks or gets congested with minimized number of re-computations of programs [18]. The system also provides different route finder options like shortest path finder, alternate path finder, facility based path finder, hierarchical path finder, top-k shortest path finder and multimodal path finder with the help of Java programs, PostGIS database and Geoserver.

Lastly, Microsoft [16] developed a mobile app called Bing maps where users can browse and search topographically-shaded street maps for many cities world wide. Maps that include certain points of interest built-in, such as metro stations, stadiums, hospitals, and other facilities. Ref [18] presents an autonomous robot framework for path finding and an obstacle evasion. The study designs a path tracker which can be used to detect

theft vehicles that follow some paths. The detection is either done using *Line Follower* which uses an IR sensor, mounted at the front end of robots, to capture the line position of vehicles following some reflecting line drawn on paths. The other method adopted is *Obstacle Handling* that performs detection and management of obstacles that appeared on a following line with the aid of sensors.

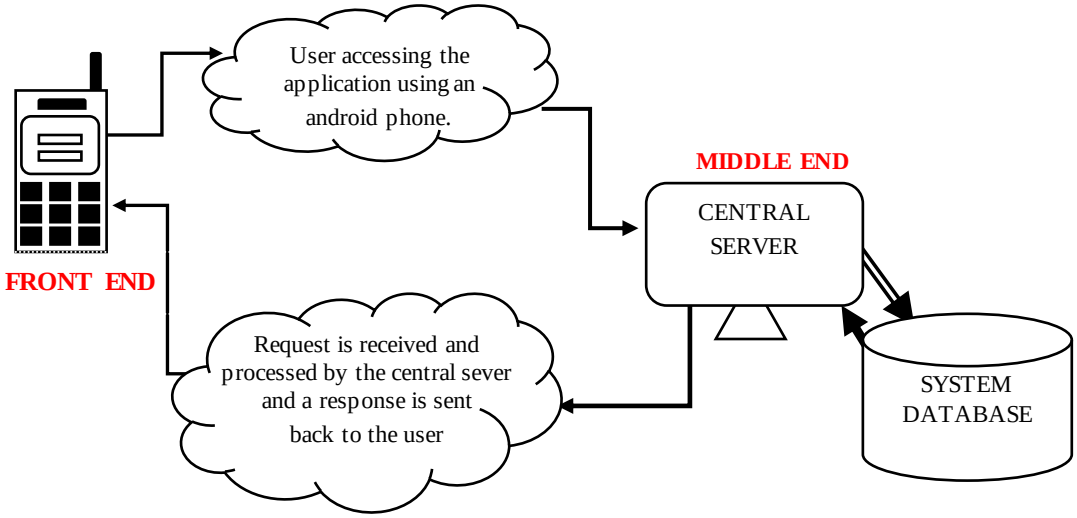

Fig.1. DFD Showing User Request Operation via Android Phone

III. Research Methodology

A. System Architecture

Architecture of the model that drives the model is given as Fig. 1. The model was designed with the aid of a Data Flow Diagram (DFD) which is a graphical technique used to describe information using various symbols that show how the system transforms input into useful information. A Data Flow Diagram shows how data moves through an information system but does not show program logic or processing steps. The architecture provides a logical model that shows what the system does though, not how it does it, and also it illustrate the functions that must be performed at each phase during the execution of the program. The architecture comprises of three basic ends explained hereafter.

1. Front End

The front end is a graphical interface coded to run on android platform so as to enhance users of the system to communicate with the back end. Users interact with this end to perform different activities such as finding locations, getting alternate routes between selected locations, and analyzing cost of transportation for different alternate routes. The mobile android application is developed as a Graphical User Interface (GUI) environment using HTML5, Java Scripts, and JQuery. HTML tags can be used to define the structural templates of pages (interface) in web application [4], Java Scripts determine the behavior of web pages while JQuery is a framework kitted out from Java Scripts' library functions. This framework makes client side of an application to be responsive to different display technologies and it also aids the dynamism interactivity of the application GUI [19].

HTML tags can be used to define the structural templates of the pages in the application [8]. Java Scripts determine the behavior of web pages while JQuery is a framework kitted out from Java Scripts' library functions. This framework enhances client side in being responsive to different display technologies and thereby, aids dynamic interactivity of the application GUI [17].

2. Middle End

This is the end through which users' requests are processed. It requires the presence of server, a web application server, which can listen to connection requests from mobile GUI (client-side) and direct the requests to the corresponding application module for service [5]. The middle end requires network connection to the database server at the back end. Activities at the middle-end can be implemented on the Internet, but WAMP which utilizes Apache Server, was used in this study for simulation. Personal Home Page, earlier abbreviated as PHP, is used to interpret requests sent or received at the server so as to display proper information on the client side, to store needed information in the database, and enables the client/server interaction. PHP has its Object Oriented root in features of Java and C# languages. PHP runs 5 to 20 times faster than Java and it is easy to use in developing complex web-based and mobile applications [20].

3. Back End

This component of the architecture holds the database of the model. The database is the repository for storing and managing data required by the system. It serves as a warehouse where the information is being stored. The back-end hosts the data used by the web application and

it is managed by the System Administrator.

In this research, the back-end is hosted using MySQL Database Management System (DBMS), an open source application. The System Administrator performs administrative tasks such as the creation and backing up of database base, recovery in case of database failure, data and system tuning. MySQL DBMS is a fast Relational DBMS with the functionalities of varying leading database applications; it does not carry a hefty price tag as it is an open source application which can be easily downloaded [18].

B. System Activities and Analysis

Use Case diagram is used to demonstrate the major activities that are enabled by the model. Such activities are usually triggered by users of the system while results either cause some information to be viewed by users via the front end, or such actions causes certain information to be saved in the system database at the back end. Hence, the model is capable of working on two major types of database transactions which are Update and Query transaction.

Transaction consists of statements that can interact with the database so as to view or make changes to the data stored in the database. In update transaction, users have the opportunity to add information about new routes to the system or modify an existing one by altering the content or removing such content from the database. This transaction is an exclusive operation that can only be carried out by specific users such as system's Administrators. However, query transactions are utilized to question the database so as to generate useful information about different routes in order to get to a particular destination. Such transactions can be carried out by any type of users on the system because it poses not security threat to the system's database nor does it allow for data altering which can in turn lead to data dishonesty or invalidity. Hence, two levels of users that can work with this model are Administrator and Ordinary Users with each having different functions that they can perform on the system. This is justified with the aid of Use Case diagram shown in Fig. 2.

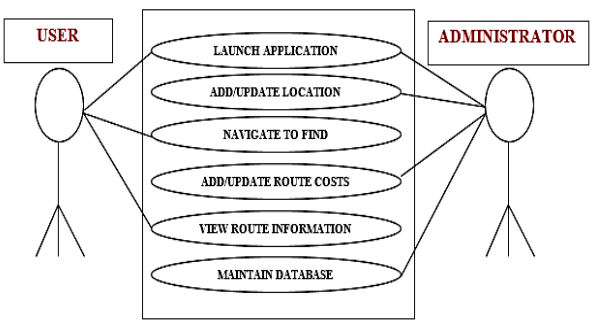

Fig.2. System activities at Users' Levels.

C. Basic Objects in Locator Model

The operations in the locator model presented in Fig. 1 are based on the basic objects which are Locations, Alternate Routes, and Prices. The inherent attributes of these objects are utilized and analyzed in order to generate an optimal route that users can navigate.

1. Location

This is the most important object/class of the Locator model and it embodies the characteristic of a particular location within the scope of a study area. For instance, in this research, the study are is Ile-Ife and its Environs while some of the locations within this scope includes Mayfair, Lagere, OAU school gate (Ile-Ife), OUI (Ipetumodu). ***Name*** and ***About*** are two basic attributes of these locations which are kept in the system's database. The attributes are distinguished as:

i. ***Name***: gives a string representation of the title of such location and it is ensured to always uniquely identify a location, hence, no two locations can have the same name for easy identification. Examples are Lagere, and Mayfair;
ii. ***About***: this attribute gives a general description of the location and gives in most simple terms what the location is known for on a general perception of the habit there. Examples are Filling Station and Restaurant.

2. Alternate Routes

This is another important class/object in the model and it is, during actualization of the model, expected to contain a concatenated string of arrays which will hold information about individual locations and a graphical map of its alternate routes. This is the basis upon which the database is queried once a destination location is desired.

3. Prices

This, as the last consideration, holds the prices regarding the cost of transportation of different routes between two locations. This is based on available (known and alternative) routes between such locations as featured on the map of such routes and all modes of transportation applicable to the routes. In this study, Taxi and Okada are the mode of public transportation considered because they possess features that help to estimate the cost required for all possible routes in considered locations. The features are:

i. ***Id:*** which stands as a unique identification in the database
ii. ***Amount:*** which holds the amount in naira it takes to use such transport
iii. ***Description:*** this contains a stringed general description of the price and most importantly the map of the amount of time it takes for that journey to be completed

4. Data Collection

Transporters and other agents involved in road navigation and transportation such as cab drivers are interviewed to collect data used in this study. The data

include information about routes and prices applicable to each route. Moreover, data used in different mobile locator applications which are developed and used in other countries, specifically Mumbai Locator, were consulted.

IV. System Experimentaion and Discussion

Once required information are supplied, the application navigates to Axis Information page where information about axis is displayed. On this page, users can click on "Get Alternate Route" button to explore information of alternate routes and select a route of choice to navigate between the chosen end points. However, if there is an error on the Activity screen, the application will ask the user to re-specify the required information.

A. System Hosting and Operations

To test the operation of our proposed model, the system was implemented as a three-tier web system. In the front tier, HTML tags were used to structure templates of each page, while JavaScript determines their behavior. The activities at middle tier were coordinated with PHP Script. The designed model was implemented as a web-based system accessible on Localhost or in an Internet environment with a view to ensuring online and real-time access to location information. Localhost, characterized by Windows Apache MySQL PHP (WAMP) Server, is adopted in this project however, sister platforms like LAMP provides the same services for users of machines source application that allows users to run web based applications on their local machine just the same way the applications behave in an Internet environment. Sequence of operations in the system is demonstrated in a top-down approach modeled in Fig. 3.

The activity diagram is a simple stepwise view on how the user can navigate the application from the splash screen to route finding and cost analysis screen. Upon a successful login, users of the application gets to a welcome Screen which is called splash screen and therefrom, she or he can navigate to the Activity screen where options for choosing the source-destination locations are features.

1. Welcome Page

The welcome page is triggered immediately after the mobile application is activated on any android moblie platform. Information on this page includes the application name (*Mobile Locator*) and application version at the time of this study (V1.2). A typical display of the welcome page is shown in Fig. 4.

2. Location Module

The location module has two parts which are **LocationSelection** and **Location Display** pages.

Location selection page is the view launched immediately after the welcome page. This page presents users with variety of locations available so that they can select a destination location they wish to know much about from their certain source location. Users initiate such request by completing a from hosted on location selection page and submit to the server.

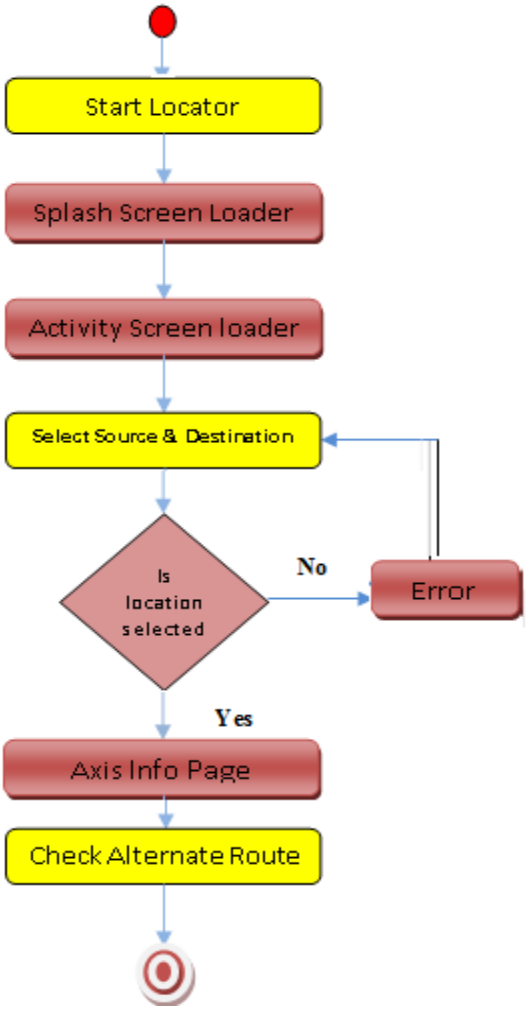

Fig.3. A Conceptual Representation of System Operations

Fig.4. The Welcome Page

The application utilizes data supplied by user to query database and retrieve accurate route information about the available routes in between source and desired destination locations. Typical views of operations that are described are presented as Fig. 5.

Location Display Page gives the description on how an individual can route between OAU School Gate in Ile-Ife to OUI School Gate in Ipetumodu. For this route, the application gives current cost of transportation for Taxi, Motorcycle, and Public Bus.

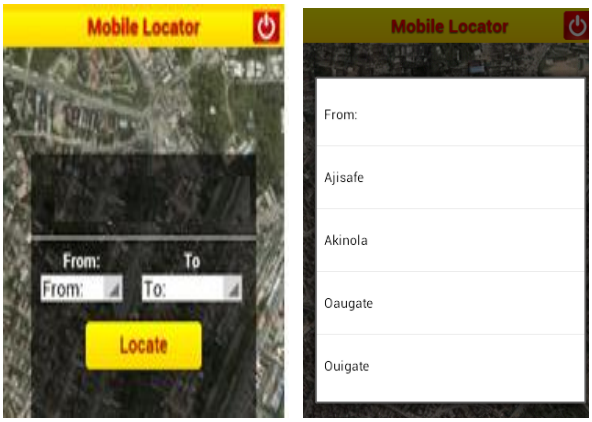

Fig.5. Operational views of Location Selection Page

A map of this locations is navigated to when the android-based mobile phone's screen is swiped to the left. The map also shows the alternate routes that can be taken to get to the destination and Moro, a nearby city to Ile-Ife, is given. A typical image of the geographical movement from OAU School Gate and OUI School Gate is shown in Fig. 6.

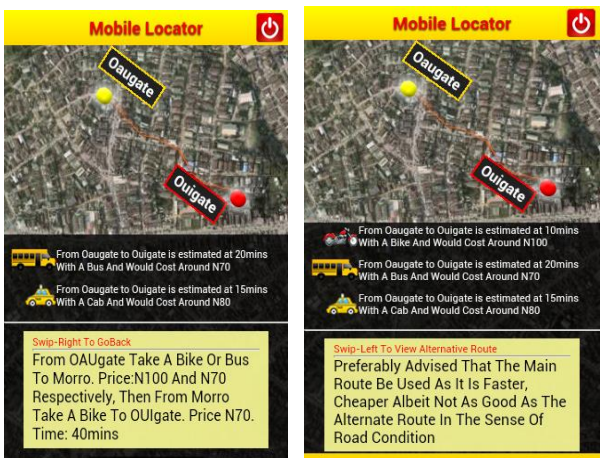

Fig.6. Routes between OAU Gate and OUI Gate

In another case study, information for movement between locations Ajisafe and Odeomu (both in Osun State of Nigeria) was observed and the search result is as presented in Fig. 7.

Fig.7. Information of Route between Ajisafe and Odeomu

3. *Option Page*

The option page appears to indicate user wants to shut down the application after any usage session. This page is prompted whenever the power button that appears at the top right of other pages of the application is clicked. A dialogue is presented to the user for system shut-down confirmation, or cancelation in case of mishandling.

A typical view of this page is shown in the dialog box shown in Fig. 8.

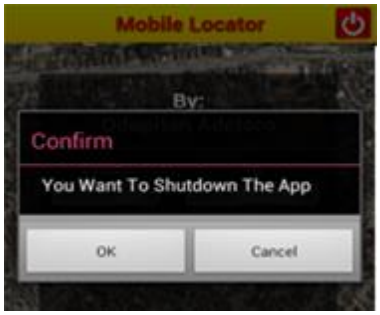

Fig.8. Option Page showing Shutdown Process

V. Conclusion and Future Works

Transport cost analysis is an integrated analysis that evaluates the full cost of transportation. It serves as a basis for comparison of transport cost, it tends to give the advantage of estimating which routes and forms of transport are better over a given analysis range or area.

The study acts as an adviser to user who wants to navigate certain area and provides them with information on routes that are faster and more economical. It also finds perfect trade-off between pricing and other affecting a simple transport system. This research effort ensured effective transportation among users finding locations within and outside Ile-Ife (and its environs) and also shows how such users can be helped to locate and view information of available routes in an online and real-time approach. This can enable people who live or are just on visitation to Ile Ife have decision making alternatives on route finding with cost and time analysis enhanced. Also, the study helps them to be aware of alternate routes that may be available and even shorter.

In the light of current globalization trends, it is apparent that IT solution providers in locality of developing worlds are yet to bring out the best of it. In the area of transportation in Nigeria, most developers have not effectively tried to improve or develop efficient and effective mobile locators. In this study, the use of GIS technology was adopted to develop a local mobile locator mapping some locations in Ile-Ife (Nigeria), and its environ for easy navigation of users.

This study shows how such technology can solve a number of problems people encounter while moving between some locations. The study has presented a platform by which some transportation problems can be reduced. The application developed, Mobile Locator, is still in a developmental stage and a number of technical

and ethical issues remain to be resolved. Hence, it is recommended that these areas should be investigated so as to improve transportation systems in developing countries.

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REFERENCES

[1] Duckham, M. and Kulik, L. "Simplest Path: Automated Route Selection for Navigation", Lecture Notes in Computer Science Vol. 28, No. 25, pp 169-185, 2003.
[2] Mezyad A., "Application of GIS in Transportation Planning: The Case of Riyadh, the Kingdom of Saudi Arabia," GBER Vol. 1 No. 2 pp. 38-46, 2001
[3] Ojokoh B.A., Omisore M.O., Samuel O.W., and Eno U.I. "Archetypal Personalized Recommender System for Mobile Phone Users", International Journal of Information Research Retrieval, Vol 3, No. 3, pp.40-58, 2013.
[4] Chaffee A, Duncan J. D, Coward D., "Web Application" webtrends.about.com, Retrieved on 15-01-2014
[5] Whitten, Jeffrey L., and Lonnie D. Bentley, "Introduction to systems analysis and design", McGraw Hill, 2008.
[6] Robert G. F. and Laurie A. U., HTML in 10 Simple Steps or Less, Wiley Publishing, Inc, Indianapolis, 2004
[7] Olutayo V.A and Eludire A.A, "Traffic Accident Analysis Using Decision Trees and Neural Networks", International Journal of Information Technology and Computer Science, pp. 22-28, 2014.
[8] Wu, J., Song, J., Ji, H., and Srikanthan, T. "Algorithm for Time-dependent Shortest Safe Path on Transportation Networks". Procedia Comp Sci, vol. 4, pp. 958-66, 2011.
[9] Greenspan J. and Brad B., "MySQL-PHP Database Applications", M&T Books Worldwide, pp. 71-94, 2001
[10] Omisore M. O. and Samuel O. W., "Personalized Recommender System for Digital Libraries," Int. Journal of Web-Based Learning and Teaching Technologies, vol. 9, No. 1, pp. 18-32, 2014.
[11] Verma R. "Mapmy India Locator" mapmyindia.com/dealer-locator, 2003. Retrieved on: 7th of June, 2014.
[12] Csedi E. A. "Mumbai Navigator" Retrieved 08-06-2014 from World Wide Web., 2003.
[13] Miller, C. "Google Grows, and Works to Retain Nimble Minds", New York Times, November 28, 2010.
[14] Mustafa K, "Path finding algorithm for the navigation of visually impaired people" a Master's Thesis in Computer Engineering Atılım University September 2007.
[15] Akhilesh K S. "Routing technique in large dynamic road network" Computer Science & Engineering Indian Institute of Technology, Bombay Mumbai, 2009
[16] Akhilesh K. S. "Web Based GIS Route Finder System 1" Computer Science & Engineering, IIT Bombay, 2010
[17] Imran S, Natasha N. and Arshad M. J., "An Autonomous Robot Framework for Path Finding and obstacle evasion", International Journal of Computer Science and Telecommunications, Vol. 1, No. 1, 2011
[18] Goodman D., JavaScript Bible, 4th Edition, Hungry Minds, New York, ISBN: 0-7645-3342-8, 2001
[19] Jiang B. and Liu X.. "Scaling of Geographic Space From The Perspective of City and Field Blocks and Using Volunteered Geographic Information", Int. J. of Geographical Info Sci, Vol. 26, pp. 215-229, 2012.
[20] Mallapur S.V. and Patil S. R, "Fuzzy Logic Based Trusted Candidate Selection for Stable Multipath Routing", I.J. Information Technology and Computer Science, pp. 12-21, 2015.

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