# An Intelligent Agent-Based Itinerary Route Optimal Director and Tourist Guide

**E. E. Ogheneovo & E. Seetam**
Department of Computer Science
University of Port Harcourt
Port Harcourt, Nigeria.
edward_ogheneovo@yahoo.com, eseetam@yahoo.com

## ABSTRACT

Route optimization is the process of devising an optimal pathway in a road network with start and terminal transit in advance. The need for tour optimization software or tool whether in a systematic or individual's act in Nigeria and elsewhere is very important in modern times. The major reasons behind such optimizations are for national security and development. The current routing schemes are faced with problems and limitations that affect it usage by the populace; these include accessibilities and user friendly. Traveling across the road is time consuming when the best route is not followed. Tourists also missed their destinations; consequently, time and money is wasted in the process of trying to discover the right route to such destinations. The road network and routing system is Nigeria is complex, difficult to interpret and error prone and hence inaccessible to the populace. In this paper, we develop an application that can be used to determine the shortest and most cost effective possible path that lead to a destination using agent-based approach optimizer that required two variables input (source and destination). The result shows that the technique takes shorter distance covered and hence lesser time when compared with existing techniques.

**Keywords:** Intelligent agent, route, tourism, tourist guide, optimization, route detector

## 1. INTRODUCTION

The demand for better transport and tourism development in Nigeria is far above the availabilities and keep increasing daily [1]. Route planners [2] [3] [4] depend principally on past occurrence of events associated with the subject matter; hence they use local knowledge, simple procedure, and ad hoc procedures to optimize the route. The use of computer for evaluating and estimating public transit routes optimization gives the best designed [5] [6]. This is very vital to facilitate competition in the global market and as a means of generating income for the Gross Domestic Product (GDP) [7]. Hence, the need to build a route detector and standard tourist locator that gives directions, guide travelers, and ensures that tourists and travelers can easily find their ways during tourism. This is very important because tourism can generate fund, employment and upgrade our foreign exchange index as well as facility rural-urban migration.

Tourism [8] [9] [10] is the process of going to places of interest or visiting place of attractions; it may be places of natural geographical attraction or manmade, the call for historical references [11]. Nigeria is blessed with great tourism resources, which attract the Nigeria government attention to an extent of treating tourism as a preferred sector, like agriculture, with the belief that tourism has the capacity and potential of increasing the economics of the nation [12] [13].

The Nigeria Government also go to an extent of initiating incentives such as tax rebate, tax holidays and soft loans with long term repayment plan to prospective investors in tourism. Tourism required efficient and a promising road network that facilitate mobility. Tourists need to have good understanding of the road network routing system [14]. The current state of road transport in Nigeria with increasing cases of incessant rate of road accidents, traffic congestion, bad roads, inaccessibility to tourist centres, etc., do not encourage the nation's policy in these sectors of the economy [15]. Thus, there is urgent need for awareness of the various routes and locations of the various cities and localities in Nigeria since it will promote tourism and economic development at state and national levels.

Route optimizing [16] [17] is the process of devising an optimal pathway in a road network with start and terminal transit in advance [18]. This is very necessary because users need a tool to guide them whenever they are embarking on a journey especially when they are not familiar with the place they are traveling to. The need for tour optimization software or tool whether in a systematic or individual's act in Nigeria and elsewhere is very important in modern times. The major reasons behind such optimizations are for national security and development. These factors can broadly be divided into three categories: Cost Security, Environmental Security, and Economic Development [19].

Cost security in the sense that travelers and tourists need to spend and judiciously utilize their money to avoid wastage and be costs effective; environmental security in the sense that travelers need to be secured on their roads while travelling; and economic development in that optimizing road usage can ensure that shorter and newer roads are opened to the hinterland to facilitate traveler's journey along these routes.

Optimization [20] [21] issue is considered cost effective when it involves fare management, that is, the actual amount of money paid by tourists from travelling from one point (i.e., the source) to another (i.e., the destination). It is considered as Environmental Security if pollution is the target of the optimization, a situation where public pollution by vehicle is the target of the optimization, and economic development as fund and employment generation is the target [22]. Transport and tourist site optimization is becoming very important since it is both economical and cost effective in the long run [23] [24]. Thus optimization of the best route that lead to various rich tourism locations in Nigeria is essential, since tourists need to know the various locations and the routes to these locations.

In this paper, we develop an application that can be used to determine the shortest and most cost effective possible path that lead to a destination using multi criterion approach optimizer that required two variables input (source and destination).

## 2. PROBLEM STATEMENT

The current routing scheme is faced with problems and limitations that affect its usage by populace. These include inaccessibility and not user friendly. Traveling across Nigerian roads is time consuming when the best route is not detected; tourist also missed their destination, transport costs are incessantly increased by transport operators. The road networks and routing system in Nigeria is not accessible to the populaces, complex, difficult to interpret and error prone which contradicts the federal government policy in tourism. Tourists should be able to access the road networks from wherever they are located and obtained results, hence promote public awareness and investment in tourism. However, the opportunities for any Company willing to invest in tourism business in Nigeria will be highly educative through this research. Consequently, this research will enable market facilitation by providing an easy ways of locating their destinations via vital links between home and target markets. It will increase and alleviates regional inequality and fosters national integration and national unity via tourism.

## 3. METHODOLOGY

This research work is concerned principally with optima route director in Nigeria tourism. Hence, it provides a model of synthesis of route generator and adaptive routing, application software that performed route optimizing via synthetic analyzer and adaptive routing techniques is developed. It provides tourism site, hotel and path from your known location to the hotel or tourist site that a user wish to visit as well as compute the resource needed to wrap a trip in normal situation to a destination tourism site. Figure 1 shows architectural framework for the proposed model.
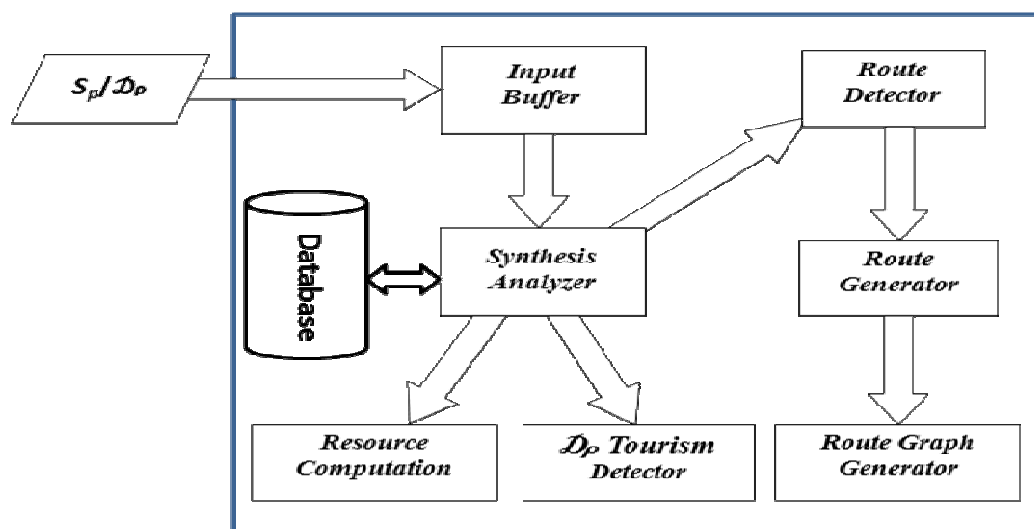


**Fig. 1: Route detector model**

The $S_p$ and $D_p$ indicates the source and destination respectively. The route detector works when the it is switched on by using an input buffer to temporarily store the direction of the route. This is then analyzed using the synthetic analyzer by computing the routes using resource computation and tourism detector and then stored in a database and this is then called upon when the need arises. A copy of the analyzed result is sent to the route detector which helps to detect the route and the generate the various routes that leads to a particular destination where different graphs are generated and distances between the different routes are computed and the user using the route detector can then choose the shortest and optimized route. The results of different routes are then displayed for user to decide on which route to take.

## 4. RESULTS AND DISCUSSION

The system optimize the best route from Home State to Destination State by considering the least shortest distance in kilometer after detail evaluation of all possible route from Origin to Destination state extracted by system. Among the routes considered are: Rivers State to Enugu State, Rivers State to Lagos State, and Rivers State to Bornu State.

### 4.1 Rivers State and Enugu State Route
Consider the route between Rivers State and Enugu State; we have all possible routes as shown in the Table 1. From Table 1, we have seven possible routes from Rivers to Enugu labeled Route 1 to Route 7. Route 3 is the least and the shortest route, it has a total of three nodes (**Rivers State – Abia State – Enugu State**) and two edges with weight cost of 281 kilometers from Rivers state to Enugu state. Table 1 shows the Optima analysis of route between Rivers State and Enugu State.
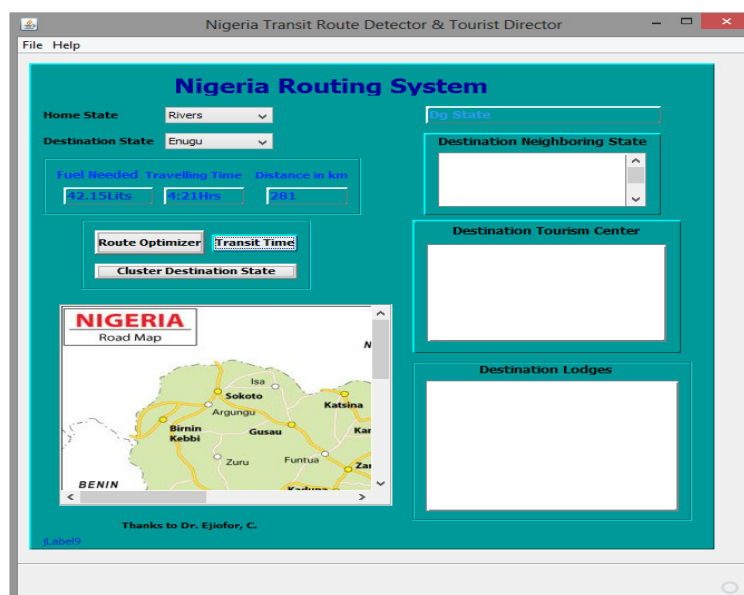


**Fig. 2: Optimizing Rivers State and Enugu State**

**Table 1: Optimal Analysis of routes from Rivers State to Enugu State**

| | | | | | | |
|---|---|---|---|---|---|---|
| Origin State: **Rivers** | Bayelsa | Delta | | | Target State: **Enugu** | 96+115+127 =338 | **Route** 1 |
| | Imo | Anambra | | | | 98+141+62=301 | **Route 2** |
| | Abia | | | | | 129+152=281 | **Route 3** |
| | Abia | Ebonyi | | | | 129+88+77=294 | **Route 4** |
| | Akwa Ibom | Abia | | | | 134+110+152=396 | **Route 5** |
| | Akwa Ibom | Abia | Ebonyi | | | 134+110+88+77=409 | **Route 6** |
| | Akwa Ibom | Abia | Cross River | Ebonyi | | 134+50+131+77=392 | **Route 7** |

Figure 2 is the graph of showing the various routes that can be followed when travelling from Rivers State to Enugu State. As seen in the graph, route 3 with a total distance of 281 Kilometers is the shortest and best possible route to follow.
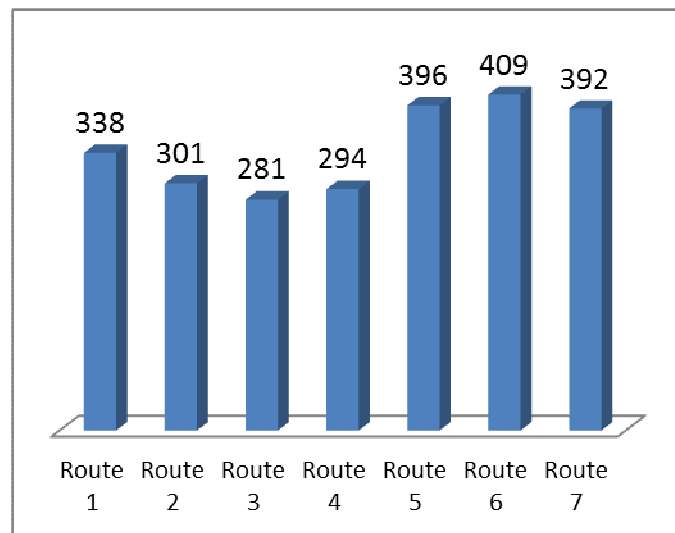


**Fig. 3: Optima Route Cost of Rivers State to Enugu State**

It is the best optimal route when considering traveling from Rivers State to Enugu State since it is shorter and will save costs in terms of the amount of fuel a car will consume and the time to spend on the road.

**4.2 Rivers State and Lagos State Route**
Consider the route between Rivers State and Lagos State; we have all possible routes as shown in the Table 2. From Table, we select the least three possible route from Rivers to Lagos Sate labeled Route 1 to Route 3. Route 2 (**Rivers – Imo- Delta – Edo – Lagos)** is the least and the shortest route having a total of four (4) edges with a total with a distance of 672 Kilometers from Rivers state to Lagos state.
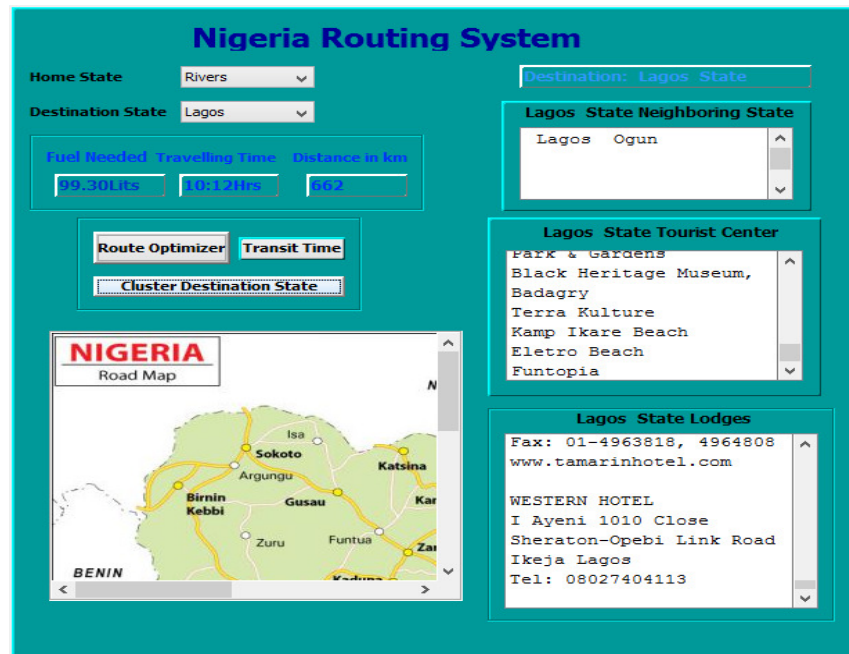
**Fig. 5: Optima Route between Rivers State and Lagos State**

**Table 2: Routes between Rivers State and Lagos State**

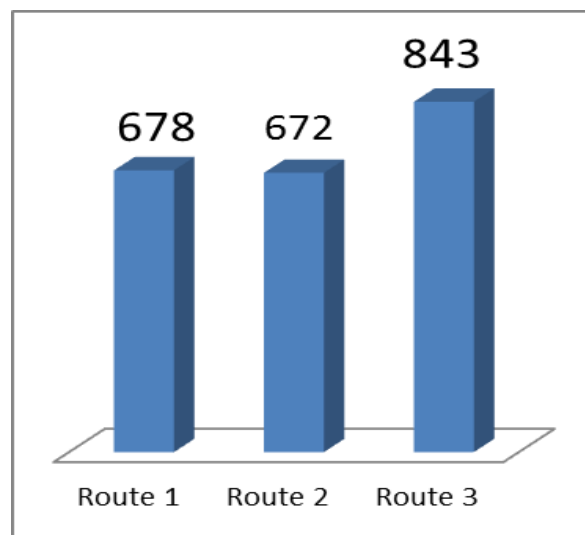| Origin State: **Rivers** | Bayelsa | Delta | Edo | | Target State: **Lagos** | 96+115+139+328 = 678 | **Route** 1 |
|---|---|---|---|---|---|---|---|
| | Imo | Delta | Edo | | | 98+107+139+328 = 672 | **Route 2** |
| | Imo | Anambra | Delta | Edo | | 98+141+137+139 +328 =843 | **Route 3** |



**Fig. 6: Optima Route Cost of Rivers State and Lagos State**

### 4.2 Rivers State and Borno State Route

Consider the route between Rivers State and Borno State; we have all possible routes as shown in the table 4.3 below. From table 4.3 we select the least seven possible routes from Rivers to Borno Sate label Route 1 to Route 7. Route 3 is the least and the shortest route, it have total of seven nodes **(Rivers state – Abia State – Enugu State –Benue State –Taraba State–Adamawa State –Borno State)** and six edges with weight cost of 1470 kilometers from Rivers state to Borno state. The system output the optima graph as shown in figure 4.8 below.
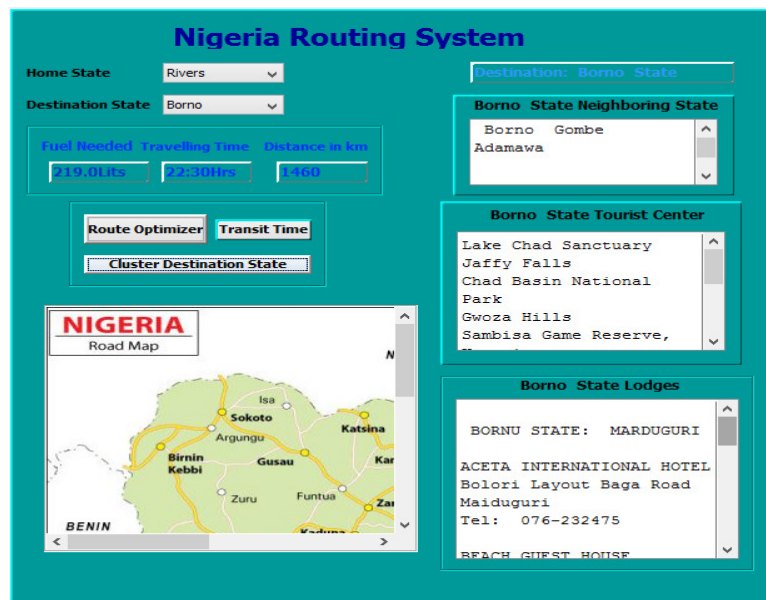


**Fig. 7:**

**Table 3:** Optima Route between Rivers State and Borno State

| | Bayelsa | Delta | | | E N U G U | B E N U E | T A R A B A | A D A M A W A | Target State: Borno | 96+115+127 +270+ 368+142+409 = 1527 | Route 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Origin State: Rivers** | Imo | Anambra | | | | | | | | 98+141+62+270+368+ 142+409 = 1490 | Route 2 |
| | Abia | | | | | | | | | 129+152+270+368+ 142+409 = 1470 | Route 3 |
| | Abia | Ebonyi | | | | | | | | 129+88+77+270+368+ 142+409 = 1483 | Route 4 |
| | Akwa Ibom | Abia | | | | | | | | 134+110+152+270+ 368+142+409 = 1585 | Route 5 |
| | Akwa Ibom | Abia | Ebonyi | | | | | | | 134+110+88+77+270+ 368+142+409 = 1598 | Route 6 |
| | Akwa Ibom | Abia | Cross River | Ebonyi | | | | | | 134+50+131+77+270+ 368+142+409 = 1581 | Route 7 |
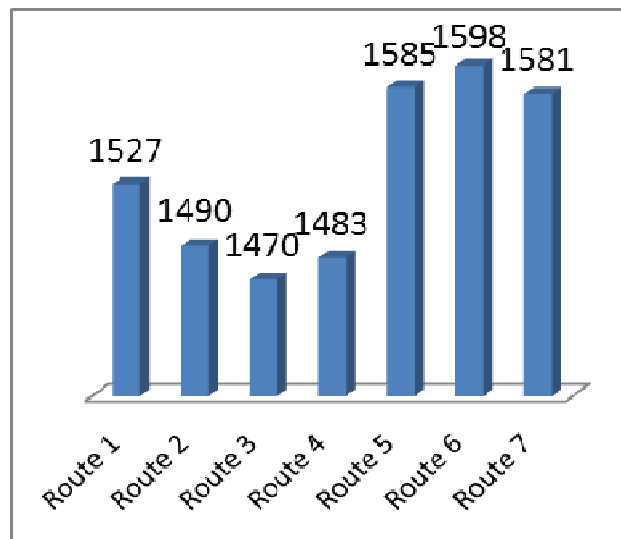
**Fig. 8:** **Optimal route cost of Rivers State to Borno State**

## 5. CONCLUSION

An intelligent agent-based itinerary route optimal director and tourist guide is an economical routing system for road network that provide the best optimal rout that link from a source to a target destination. Observing the current situation on our road today, traveler need to know his route, the transits cost, as well as the tourism location of their destination. The tourism operators also need publicity of their business location for economic growth. This research work offered a brief usefulness of graph theory in optimization using expert system. It also illustrates the benefit of a model developed using a synthesis of heuristic graph and adaptive routing technique in route optimization. The evaluation of the system show that optimal path between two points may be more than one, thus, the system in question is capable of opting for the best optimal path. Consequently, it is crucial to declare that this work boaster transit and tourism sector of the economy, since it promote the national policy, aim and objective in tourism and as well as increases the benefit of road transit and reduce overhead enchanter in the road network routing.

This research work has made a tremendous impart to humanity in the area of tourism publicity and transport management. It has removed the difficulties in interpreting road map on paper for traveler. This research work provides convergent traffic control in road transit since it offer target pursue optimization in which routing is base on directing the tourist to its destination using the best optimal path. The system offer road network routing and report the best graph path which help the user to locate it destination from the source. It increases the benefit of road transit and reduce overhead enchanter in the road network routing. Hence, it is very imperative since it proved solution to real life problem; boaster transit and tourism sector of the economy and promote the national policy, aim and objective in tourism. This software can be embedded into car for route navigation, so that the system reviews the route to the driver as the car move from location to location within Nigeria. The system also solves the problem of transit need such as amount of petrol needed to make a journey. This work has made it know that Heuristic graph and adaptive routing can model an intelligent route optimization system.

## REFERENCES

[1]. Adler, J. L., Satapathy, G., Manikonda, V., Bowles, B., Blue, V. J., (2005). A Multiagent Approach to Cooperative Traffic Management and Route Guidance. Transport Res. Part B: Methodology.

[2]. Ammar W. M,, Nirod Chandra Sahoo, Tan Kim Geok, (2008). Solving Shortest Path Problem Using Particle Swarm Optimization, J. Elsevier, Applied Soft Computing,

[3]. Avineri, E., (2005). Soft Computing Applications in Traffic and Transport Systems: A Review, Soft Computing Methodology Application. Adv. Soft Comput. 32.

[4]. Bazzan, A. L. C., Klügl, F., Ossowski, S., (2005). Agents in Traffic and Transportation: Exploring Autonomy in Logistics, Management, Simulation, and Cooperative Driving. Transport. Res. Part C: Emer. Technol. 13(4).

[5]. Brakatsoulas, S., Pfoser, D., Salas, R., and Wenk, C. (2005). On Map-Matching Vehicle Tracking Data. In Proceedings of the 31st Int'l Conference on Very Large Data Bases, VLDB Endowment.

[6]. Chang, S. K. and Schonfeld, P.M. (1993). Optimal Dimensions of Bus Service Zones, Journal of Transportation Engineering, ASCE. Vol. 119, No.4.

[7]. Desrochers, M., Lenstra, J. K., and Savelsbergh, M. W. P. (1990). A Classification Scheme for Vehicle Routing and Scheduling Problems, European Journal of Operational Research 46.

[8]. Gilbert Laporte, (1992). The Vehicle Routing Problem: An Overview of Exact and Approximate Algorithms, European Journal of Operational Research Vol. 59, pp. 345-358.

[9]. Gumel, H. A. (2010 ). Maintenance: A Yet to be Defined Agenda in Nigeria, Nigerian Society of Engineers, October Lecture, National Engineering Centre, Lagos.

[10]. Habib M. Kammoun, Ilhem Kallel, Jorge Casillas, Ajith Abraham, Adel M. Alimi, (2014): Adapt-Traffic: An adaptive multiagent road traffic management system based on hybrid ant-hierarchical fuzzy model", Transportation Research Part C 42.

[11]. Hallam, N., Hartley, M., Blanchfield, P., Kendall, G., (2004). Optimization in a Road Traffic System Using Collaborative Search, In Proc. of the IEEE Int'l Conference on Systems and Cybernetics SMC, IEEE.

[12]. Han, S. and Tabata, Y. (2002). A Hybrid Genetic Algorithm for the Vehicle Routing Problem with Controlling Lethal Gene, Asia Pacific Management Review, 7(3).

[13]. Kallel, I., Chatty, A., Alimi, A.M., (2008). *Self-organizing Multirobot Exploration Through Counter-ant Algorithm.* In Proceedings of the 3rd Int'l Workshop on Self- Organizing Systems IWSOS, LNCS, Vol. 5343. Springer-Verlag.

[14]. Kammoun, M. H., Kallel, I., Casillas, J., Alimi, A.M., (2008). A Road Traffic Multi-Agent Simulation Using TurtleKit Under MadKit. In Proceedings of the 9th Int'l Conference on Artificial Intelligence and Soft Computing ICAISC, Academic Publishing House Exit.

[15]. Lup, L.W., Srinivasan, D., (2007). A Hybrid Evolutionary Algorithm For Dynamic Route Planning. In Proceedings of the IEEE Congress on Evolutionary Computation CEC, IEEE.

[16]. Nikolova, E., Brand, M.; and Karger, D. (2006). Optimal Route Planning Under Uncertainty. In Proceedings of International Conference on Automated Planning and Scheduling.

[17]. Nikolova, E.; Kelner, J.; Brand, M.; and Mitzenmacher, M. (2006). Stochastic Shortest Paths via Quasi-Convex Maximization, Algorithms–ESA 2006.

[18]. Peeta, S., and Ziliaskopoulos, A. (2001). Foundations of Dynamic Traffic Assignment: The Past, the Present and the Future. Networks and Spatial Economics 1(3).

[19]. Royset J. O. and Sato H. (2009). Route Optimization for Multiple Searchers, Operations Research Department, Naval Postgraduate School Monterey, California, USA.

[20]. Sanjiv, K. S., and Anupam, A. (2015). Present and  Future Perspective on Optimization of Road Network Management, International Journal of Computer Trends and Technology (IJCTT),Vol. 22 Number 2.

[21]. Teodorovic, D., Kikuchi, S., (1990). Transportation Route Choice Model Using Fuzzy Inference Technique. In Proceedings of the 1st Int'l Symposium on Uncertainty Modeling and Analysis, IEEE.

[22]. Wirasinghe, S.C. and Seneviratne, P.N. (1986). Rail Line Length in an Urban Transportation Corridor, Transportation Science, Vol. 29, No. 4.

[23]. Zhang, X., Rice, J.A., (2003). Short-Term Travel Time Prediction. Transport Research Part C: Emer. Technol. 11.

[24]. Zuo, J., Ng, S. X., and Hanzo, L. (2010). Fuzzy Logic Aided Dynamic Source Routing in Cross-Layer Operation Assisted Ad hoc Networks. In Vehicular Technology Conference Fall (VTC 2010-Fall), 2010 IEEE 72nd, IEEE.