



WEB-BASED ADVANCED TRAVELLER INFORMATION SYSTEM FOR MINNA METROPOLIS, NIGERIA

O. O. Adeleke^{1*}, S. Idoko², S. S. Kolo², A. R. Anwar³, O. O. Sijuwola¹ and O. Akinola¹

¹Department of Civil Engineering, University of Ilorin, Ilorin, Nigeria

²Department of Civil Engineering, Federal University of Technology, Minna, Nigeria

³Department of Civil Engineering, Kano University of Science and Technology, Wudil, Nigeria)

* Corresponding author's email address: adeleke.oo@unilorin.edu.ng

ARTICLE INFORMATION

Submitted 31 January, 2019

Revised 15 June, 2019

Accepted 20 June, 2019

Keywords:

ATIS

Route guidance

Electronic fare payment

Weather condition

Traffic condition.

ABSTRACT

Advanced Traveller Information System (ATIS) is used to provide accurate, integrated and comprehensive travel and traffic information to road users. The information helps in both pre-trip and en-route decision making. This study developed a web-based ATIS for Minna metropolis in Nigeria. The information provided is from both primary and secondary sources. The developed ATIS provides information on route guidance, available intercity transport services and hotels in the metropolis. It also allows users to determine both weather and traffic flow conditions. A component of the system makes provision for electronic fare payment and booking of trips and hotel accommodation. The deployment of the ATIS is a source of static and dynamic information.

© 2019 Faculty of Engineering, University of Maiduguri, Nigeria. All rights reserved.

1.0 Introduction

The dearth of detailed and explicit information on transportation routes and systems which are necessary to adequately prepare for any trip has almost all the times caused unnecessary delays, anxiety, added costs and even at times jeopardized the safety of travellers especially when using the transportation route or system for the very first time. The development and deployment of Advanced Traveller Information System (ATIS) which is a category of Intelligent Transportation System (ITS) is used in contemporary societies to address this issue (Adeleke et al., 2013, Zhanga et al., 2011).

ATIS refers to any system that acquires, analyses and presents information to assist surface transportation travellers in moving from a starting location (origin) to their desired destination (Adeleke et al., 2013). An ATIS may operate using information supplied entirely within the vehicle (autonomous system) or it can use data supplied by traffic management systems. Information such as location of incidents, weather and road conditions, optimal routes, recommended speed, lane restrictions are among those provided by the ATIS which help users in decision making (Kristof et. al., 2005; Zhanga et. al., 2011). This information is collected and disseminated using computer devices and telecommunication (US Department of Transportation (DOT), 1998a).

A review of existing ATIS deployments in some locations across the world include, The Metropolitan Transportation Commission (MTC) 511 ATIS which is widely recognized as one of the leading ATIS in the United States. It is a one-stop, multimodal and trip planning regional traveller information resource. MTC's 511 ATIS incorporates traveller information gathered from numerous sources, including the state Department of Transportation (DOT), regional transit agencies, local transportation agencies, toll tag transponders and a private data provider. The Utah Department of Transportation (UDOT) operates an ATIS website which contains traffic conditions map, a camera or dynamic message signs (DMS) image, detailed text on high-priority events or incidents, weather forecast and links to other travel-related information and maps of other areas of the State. Traffic conditions information can be shown graphically on the map or in text format while travel times can only be shown in text format. Other ATIS sites which include London ATIS, Taipei City ATI System, Munich ATIS also contain information on the various modes of travel which include Underground Rail, Over-ground Rail, Buses, Automobiles, Bicycles, Pedestrians, Airplanes, River, Tram, Taxis and Minicabs, and Light Railway System. Other features on deployed ATIS include information on road networks, hospitals, government and private offices, stadia, tourist places, real-time parking information, trip scheduling (Mid-Ohio Regional Planning Commission, 2009; Supergeo Technology, 2016; Kumar et al., 2005; European Commission, 2011; US DOT, 1998b; Minnesota DOT, 2003).

ATIS has been found to be of immense advantage in the transportation industry. The aim of the study therefore was to develop and deploy a Web-based Advanced Traveller Information System for Minna, Nigeria, a typical growing city in a developing economy in order to address the dearth of detailed travel information needed to facilitate the movement of travellers to, within and from the metropolis. The study had the specific objectives of improving travellers' convenience and safety through the provision of needed travel and traffic condition information.

2. Materials and Methods

2.1 Data collection

Primary and secondary data (Hox and Boeije, 2005) were used in the study. Primary data was collected from two sampled public transportation companies that provide inter-city transport services and which in this study were identified simply as Transport Services A and Transport Services B. The transportation companies are among those that provide regular inter-city services in Minna and are most widely used by travellers in the metropolis. They also have service networks that cover a sizeable number of states in Nigeria. A data acquisition form was given to the transportation companies to fill. Information obtained from the companies included: Name of transportation company; Addresses of parks in and outside Minna; Routes plied; Transport fares; Scheduled departure times and Company's transaction policy. Primary data were also collected on four sampled hotels in the city. Traffic surveys were carried out to determine the peak and off-peak periods at Kpakungu and Mobil intersections which were considered critical to the study as they are located in the Central Business Districts of the metropolis with high traffic density. The information on the traffic condition was based on the traffic surveys data.

The secondary data used were: 1. additional information obtained from the websites of i. the sampled public transportation companies (the information included transport routes, travel times and fares) ii. hotels (information obtained included room types and fares); 2. route maps,

travel times and positional information as available on the Google map and 3. weather condition (temperature, wind speed, cloud cover, atmospheric condition) as provided through the Open Weather Map.

2.2 Programming languages used for the website design

Programming languages and syntaxes used for the website design include: (i) Hyper Text Mark Up Language (HTML5), (ii) Cascading Style Sheet (CSS3), (iii) Structural Query Language (MySQL), (iv) Java Script, (v) PHP-Hyper Processor and (vi) AJAX (Asynchronous Java Script And XML). The utilization of the programming languages gave flexibility in the process of the design. The Database Schema is shown in Figure 1 while Figure 2 shows the Flow chart.

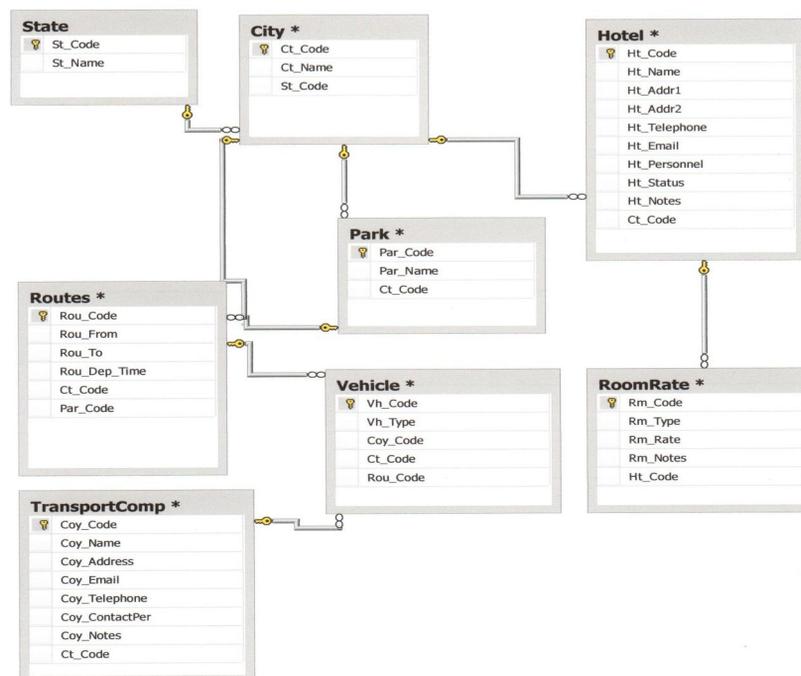


Figure 1: Database Schema

2.3 System Architecture

The system architecture is shown in Figure 3. The traveller interacts with the system using a mobile application or a computer which connects to the Google Map and Weather Map APIs. The payment and booking modules allow the traveller to obtain information on transportation fare and hotel costs and to also make bookings and payments.

2.4 Application programming interface

An Application Programming Interface (API) is a set of routines, protocols and tools for building software application. It is an already existing programme which is structured in such a way that would allow other programmers who may find it useful to easily engraft it into the application software or programme being designed (Conrad et al., 2015). The APIs used in the study include:

Google Maps: The Google Maps API is used as the base for everything related to location and route maps on the website. It finds both the users' instant location or queried location and also displays the maps and travel times of the respective routes as route guidance.

Open Weather Map: The Open Weather Map API serves the purpose of weather detection and prediction. It states the weather condition in relation to elements such as temperature, wind speed, cloud cover and atmospheric humidity.

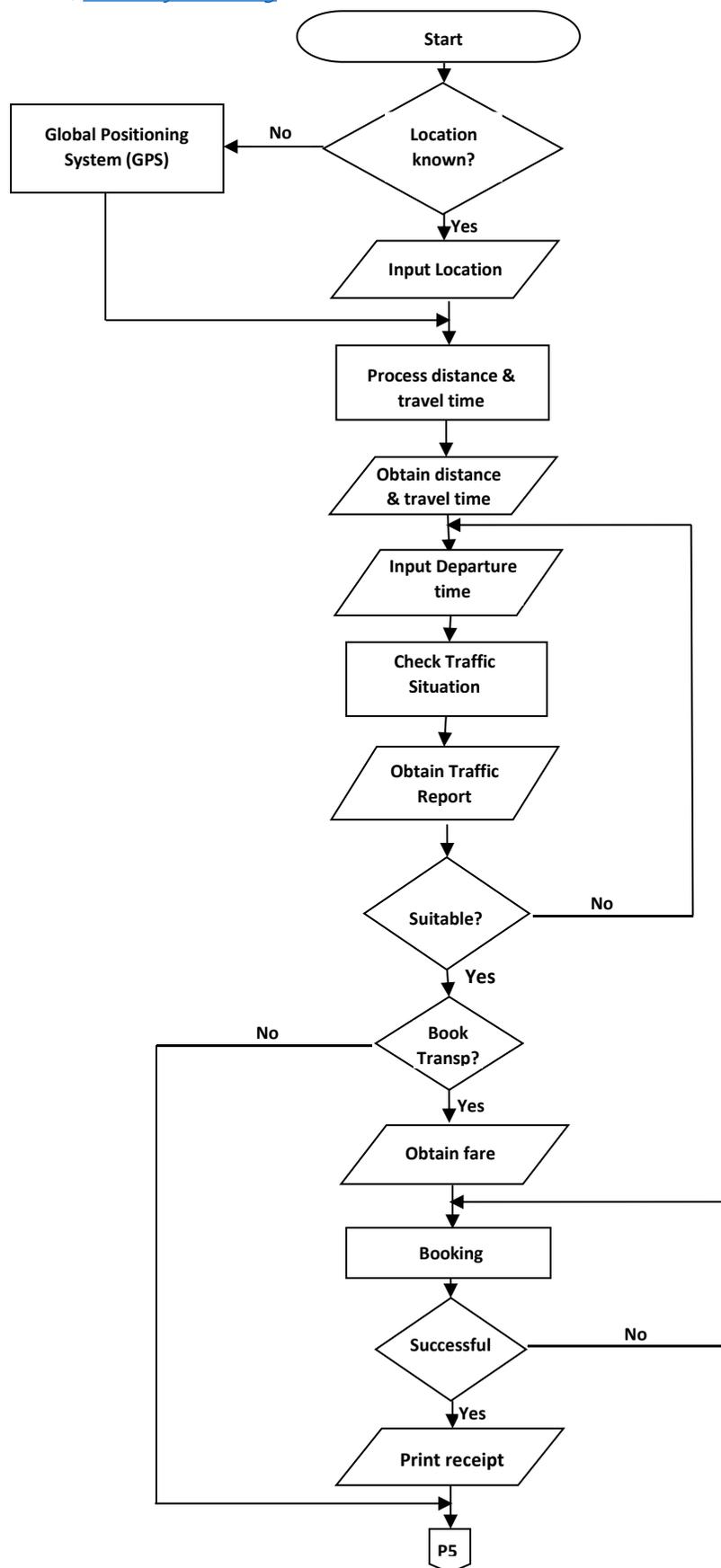


Figure 2: Flow chart

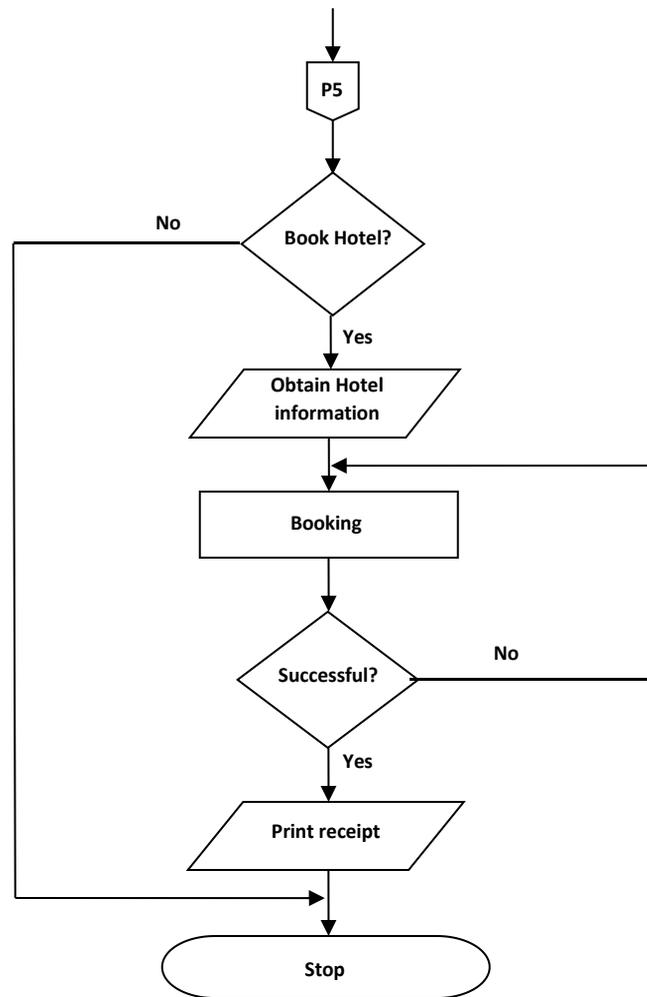


Figure 2 cont'd: Flow Chart

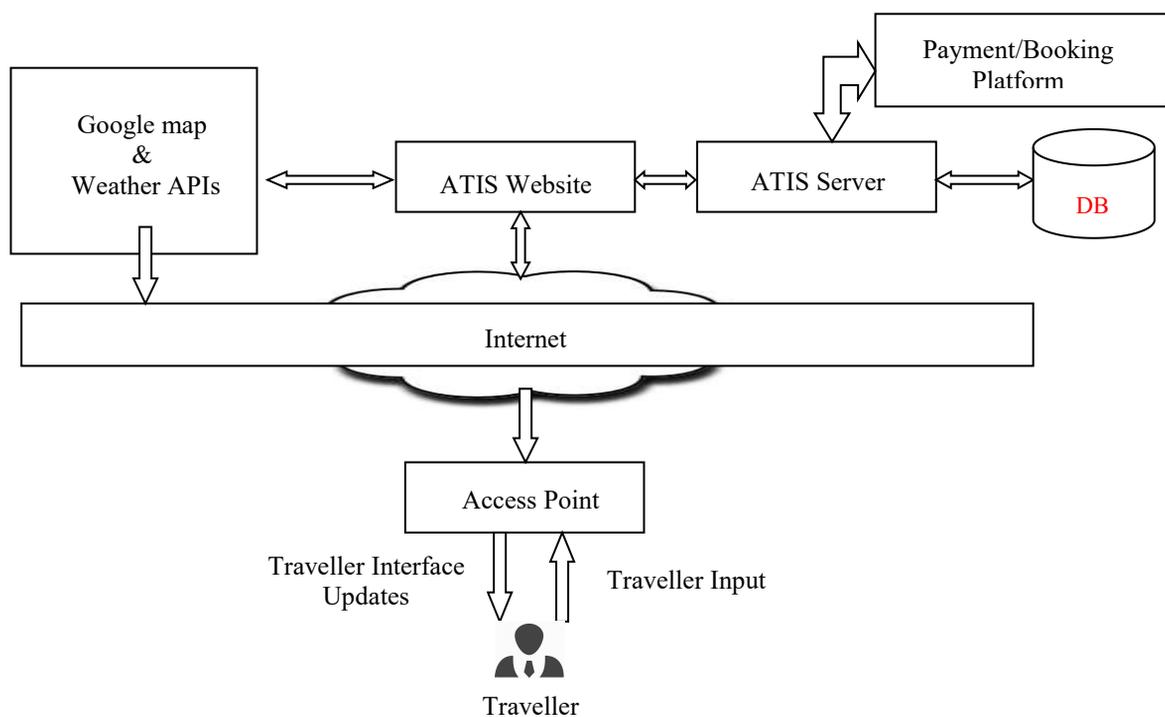


Figure 3: System architecture

3. Results and Discussion

Homepage

The homepage of the developed website is shown in Figure 4.

Route guidance

This functionality provides users adequate route guidance from the point of origin to Minna and further to any of the two campuses of the Federal University of Technology, Minna (Bosso and Gidan-Kwano Campuses). The site is designed to help give drive directions to users who have knowledge of their startup locations and those that cannot identify their startup locations. If startup location is known, simply enter the name of the location in the space provided to answer the question "where are you coming from?". The name of the place entered can either be that of the state, local government, town or district. After entering the name, click on 'Get Information'. The 'Get Information' button leads to a new page that displays a map with the drive directions to Minna.

To get drive directions to any of the campuses of the Federal University of Technology simply select the campus of interest from the upper right hand corner of the map area. The outcome is the route map depicted in Figure 5. Attached to each of the routes shown on the map is a text box that shows the distance between the entered startup location and the destination. The expected time of travel is also displayed.

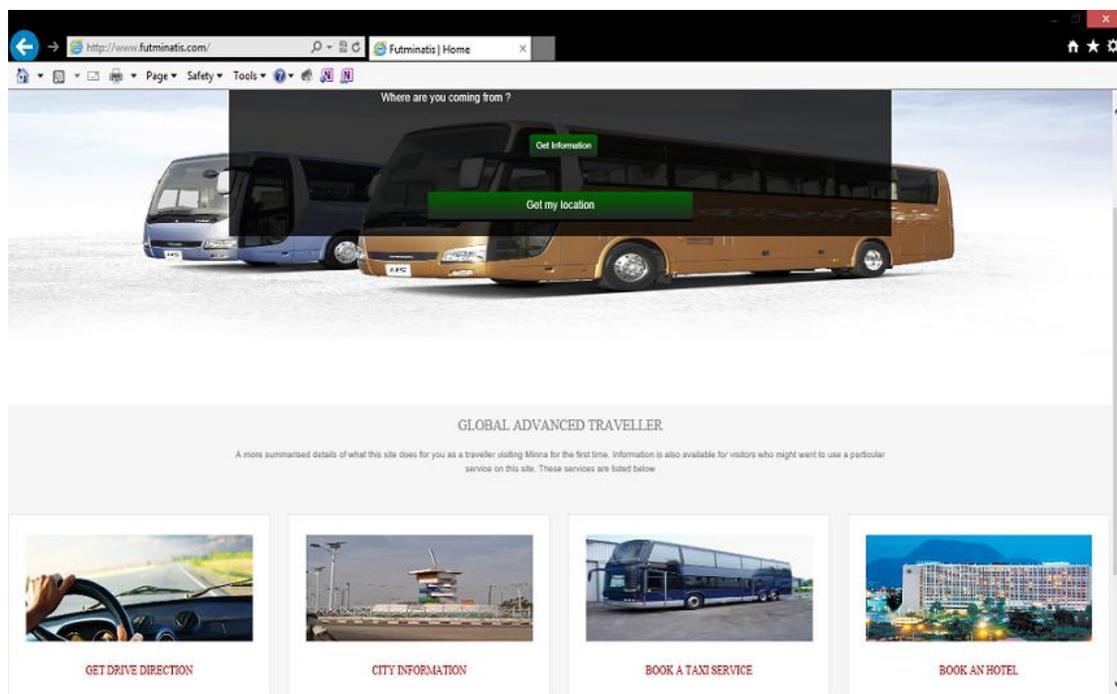


Figure 4: Screen print of website homepage

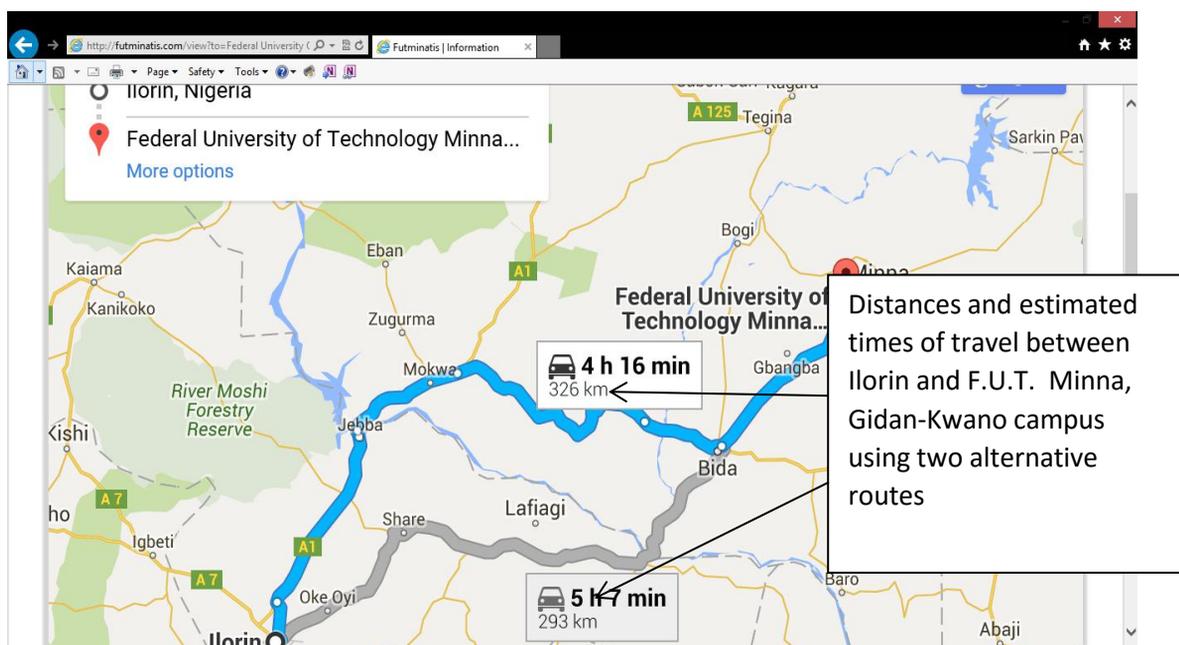


Figure 5: Screen print of drive directions from Ilorin to F.U.T Minna Bosso Campus (Source: Google Map)

The option of 'finding your location' is included to make provision for a user who either does not know or is not sure of his current location; this facility is however operational if the internet browser has a GPS facility installed. A user simply finds his location by clicking on 'find me' in the homepage. This leads to a page showing both the name and the map of the user's current location.

Trip booking

This site provides users the platform through which booking can be made for a public transportation from any point of location through electronic means instead of going to the booking office of the transportation company. Click on 'Transport' to book a transport service. This leads to a page where it is required to select the name of the startup point (State) from the drop down menu as shown in Figure 6. After selecting the state, click on 'search'. This leads to the page shown in Figure 7 which displays a list of all the transport companies in the database that go to Minna from the selected state, the addresses of their parks, and the transportation fare.

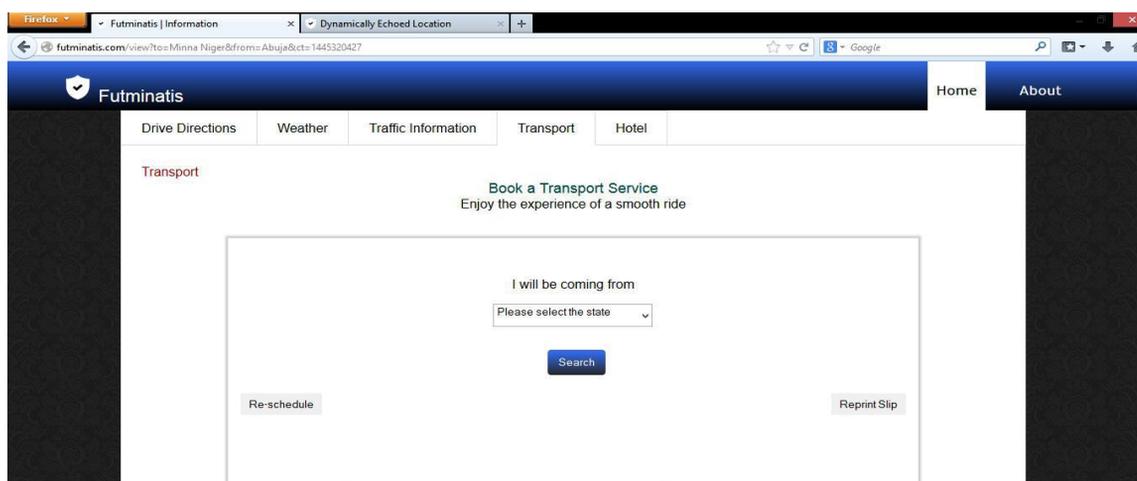


Figure 6: Screen print of 'Transport' option

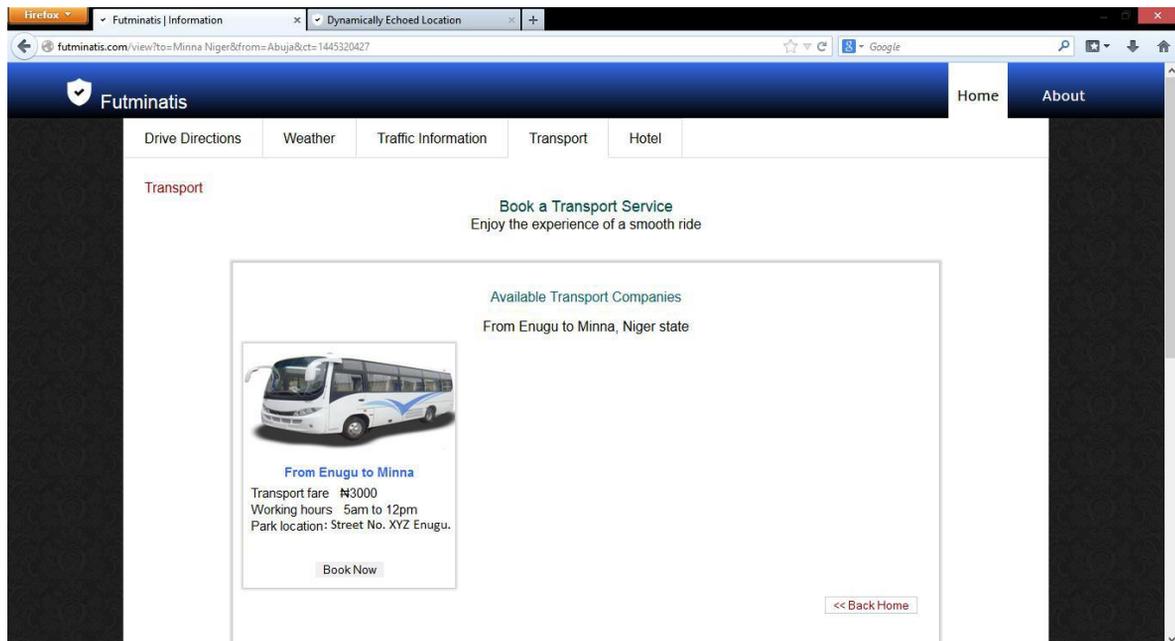


Figure 7: Screen print on a transport company that plies Enugu to Minna

If none of the transport companies included in the database goes to Minna from the selected 'startup point' it displays "No transport service available from this location". Click on "book now" to book the desired option. Enter your name, phone number, next of kin phone number, date of trip. After the details, click on "proceed", Select Automated Teller Machine (ATM) Card type and enter the ATM details and click "pay". This leads to a page where payment receipt will be displayed on the screen and payment receipt number will be sent as SMS to the phone number provided. Click on 'Print' to print the receipt. Trips can also be rescheduled.

Verification of weather condition

The weather functionality provides information on the expected weather condition of the day in Minna. The weather parameters provided include: i. Temperature in degree Celsius ii. Humidity in percentage iii. Wind speed in Mph iv. Time of sunrise and v. Time of sunset. A screen shot for the weather condition is shown in Figure 8.

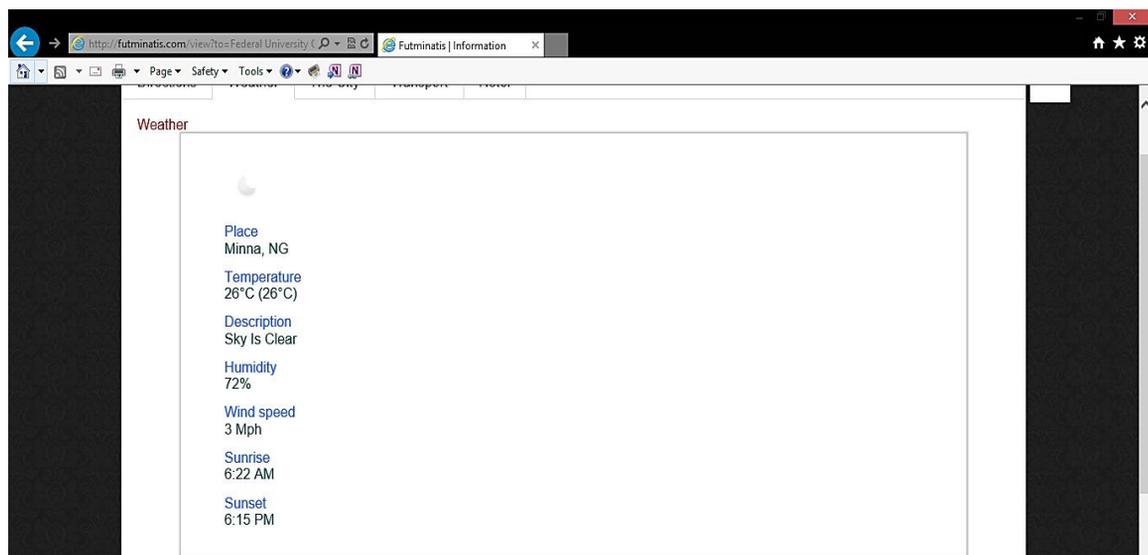


Figure 8: Screen print of a day's weather reading in Minna

Hotel booking

Click on the “book a hotel” option to book a hotel. This leads to a page where the list of available hotels is displayed as shown in Figure 9.

Click on the name of the hotel of choice for further details and take other needed steps to book. Details to be entered by user include: Name, Check in and checkout dates, Phone number and the Number of adults.

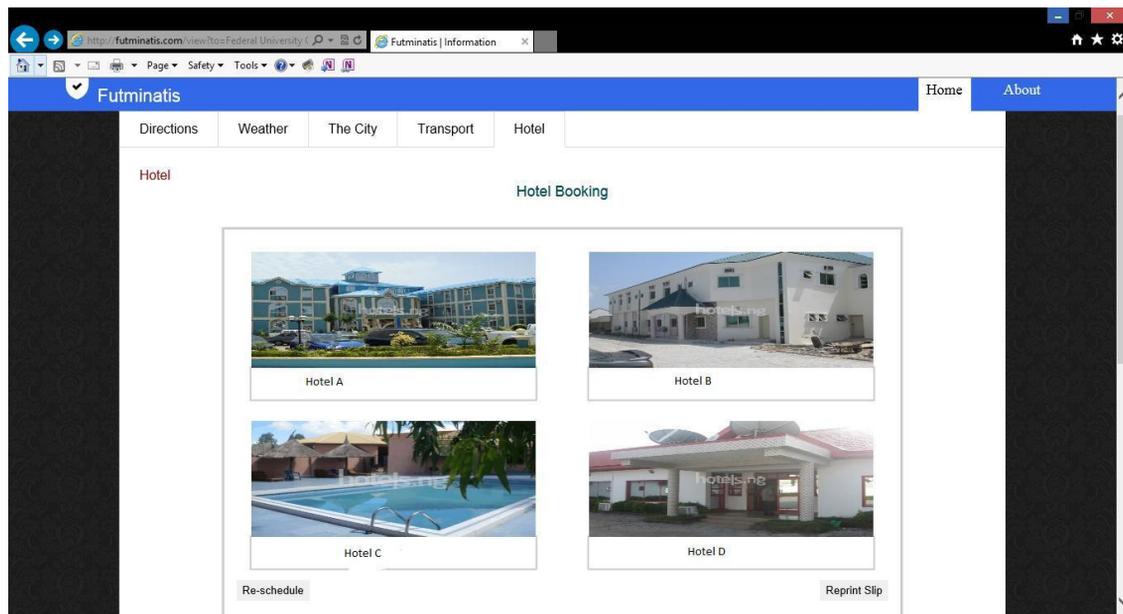


Figure 9: Screen print of ‘book a hotel’ page showing available hotels

After entering the details, the user clicks on ‘proceed’ which leads to a new page where payment is made through electronic means online using ATM details. The user will be required to select his card type, enter ATM details in the appropriate spaces provided, and then click on “Pay”. If the payment is successful, the receipt of payment is displayed on the screen. The user can then go ahead to print the receipt by clicking ‘print’ on the page. The receipt number is also sent to the provided phone number as SMS. Provision is also made for rescheduling of the hotel booking.

Traffic condition

The Website also presents to its users the traffic situation of Minna at the expected time of arrival. The traffic information provided is however historic and not real-time. The traffic information is available on only the two most prominent intersections in Minna (Kpakungu and Mobil intersections).

The information on the traffic condition is obtained by clicking on ‘Traffic Information’ and the result is displayed on the screen. Information displayed is on whether the roundabouts are expected to be congested (peak period) or not congested (off-peak period) at the time of arrival to Minna.

The ADMIN PANEL

The ‘Admin Panel’ is the section of the website that is reserved solely for the website administrator. The website administrator is granted access to the database of the website and can add or remove any information. Access to this portion of the website is restricted with a

Username and a Password. The inventory of trip bookings is monitored by the administrator as shown in Figure 10.

The activities that the administrator performs are:

View and/or print the list of hotel bookings done from the website alongside all the details of the bookings.

View and/or print out the list of trip bookings done from the website alongside all the details of the bookings.

Add or remove a transportation company from the list of transportation companies ditto for hotels.

Admin Panel								
Transport Bookings								
S/N	Receipt No	Name	From	Transport Service	Amount Paid	Contact No	Nok Contact	Date Of Departure
1		sam	Enugu	Transport Service A	3000	1234456	1234567	2015-10-20
2	NT00000004	Sike Oloma	Lagos	Transport Service B	5566	090674635	098765432	2015-10-19
3		Mike Make	Oyo	Transport Service B	360000	09056453322	090778866432	2015-10-19
4		Mona Moxie	Oyo	Transport Service A	360000	08065793425	080364537389	2015-10-26
5	NT00000003	Mona ggg	Lagos	Transport Service B	5566	456789	556789	2015-10-15
6	NT00000002	Mona Moxie	Lagos	Transport Service A	5566	22222222	343555545	2015-10-01
7	NT00000001	Mona Moxie	Lagos	Transport Service A	5566	08065784536	08079542323	2015-10-15

Figure 10: Webpage screen print of Trip Bookings from the Admin Panel

4. Flexibility and Limitation of the System

1. Information on route guidance (travel route map and travel time) between any two locations (other than Ilorin and Minna) can be obtained from the system's website as presently designed by entering the appropriate locations information in the 'where are you coming from' box (the trip origin box) and the destination in the trip 'destination' box. Similar enquiries and operations as done for Minna can also be carried out for other cities by providing information on hotels, transportation services, traffic flow situations on the cities in the database of the developed ATIS.

2. Re-routing that may be necessary as a result of unanticipated incidents en-route, such as traffic accidents, work zone is handled by the system. If a traveller is aware that a route has become impassable the user seeks for alternatives from a location before the incident scene or at the incident scene as the case may be, to the desired destination through the systems route guidance module. The traveller enters the location where he gets stuck as his new trip origin, then possible routes from this location to his destination will be displayed.

3. The traffic data as presently displayed on the website is static, however, in future; real-time traffic condition information can be incorporated into the developed system. This can be obtained by providing a link in the website to a Traffic Management Centre that broadcasts real-time traffic information to the public or registered users.

4. The database in the study is limited and would need more funding to capture more traveller's needed information and services.

5. Conclusion

A Website for Advanced Traveller Information System (ATIS) has been developed in the study. The website provides route guidance for travellers to Minna Township. The website also provides static information on traffic condition at the two most prominent intersections in the town to the traveller based on the expected arrival time to Minna. Other information and services on the website include weather information on Minna, available transportation services from major cities in Nigeria to Minna. Trip and hotel bookings can also be carried out in the comfort of one's room or from wherever using ATM details directly on the website. The website deployment improved on travellers' convenience, safety and economy. The database should be enlarged with more funding to capture more traveller's needed information and services. The historic traffic condition data can also be improved on with real-time data as this will improve on the timeliness and accuracy of information provided. Other means of relating traveller information other than the developed internet website; such as Variable Message Sign (VMS), Highway Advisory Radio (HAR), Interactive Television, Teletext, Cable Television should be explored and used to relay traveller information for the study area thereby increasing the information outlet options available to road users.

Acknowledgement

The authors acknowledge the contributions of Mr. O. T. Adeleke in the production of some of the Figures.

References

- Adeleke, OO., Jimoh, YA. and Akinpelu, MA. 2013. Development of an advanced public transportation system for captive commuters on urban arterials in Ilorin, Nigeria. *Alexandria Engineering Journal*, 52: 447 - 454. <http://authors.elsevier.com/sd/article/S1110016813000355>
- Conrad, E., Misenar, S. and Feldman, J. 2015. *CISSP study guide*. 3rd Ed. Elsevier Inc. USA. <https://sciencedirect.com> accessed on 14 June, 2019.
- European Commission, 2011. *ITS ACTION PLAN – Study 'Towards a European multi-modal journey planner'*. European Commission Directorate-General Mobility and Transport, Brussels, Belgium. pp. 85
- https://ec.europa.eu/transport/sites/transport/files/themes/its/studies/doc/2011_09-multimodal-journey-planner.pdf accessed on 16 January, 2016.
- Hox, JJ. and Boeije, HR. 2005. Data collection, primary vs secondary. *Encyclopedia of Social Movement*, 1: 594 – 599 http://www.joophox.net/publist/ESM_DCOL05.pdf accessed on 11 June, 2019
- Kristof, T., Lowry, M. and Rutherford, GS. 2005. *Assessing the benefits of traveler and transportation information systems*. Washington State Transportation Commission, Department of Transportation, Olympia, Washington and Transportation Northwest, University of Washington, Seattle, Washington and in cooperation with the U. S Department of

Transportation, Federal Highway Administration, Washington DC, USA. pp. 69. <https://www.wsdot.wa.gov/research/reports/fullreports/597.1.pdf> accessed on 12 March, 2016.

Kumar, P., Singh, V. and Reddy, D. 2005. Advanced traveler information system for Hyderabad city. IEEE Transactions on Intelligent Transportation Systems, 6(1): 26-37. <http://web.mit.edu/rama/Public/papers/paper8.pdf> accessed on 11 February, 2016.

Mid-Ohio Regional Planning Commission, 2009. Advanced traveler information system study: Final Report. Mid-Ohio Regional Planning Commission, Ohio, USA. pp. 72. <https://www.yumpu.com/en/document/view/45833709/advanced-traveler-information-system-study-mid-ohio-regional-> accessed on 11 June, 2019.

Minnesota Department of Transportation, 2003. Commercial Vehicle Operation (CVO) Advanced Traveler Information Systems (ATIS) summary of national practice final report. Minnesota Department of Transportation, Office of Freight and Commercial Vehicle Operations, USA. pp. 65.

http://www.dot.state.mn.us/ofrw/PDF/CVO%20ATIS%20Final%20Report_Final.pdf accessed on 22 January, 2018.

Supergeo Technology, 2016. Taipei city advanced traveler information system web. Supergeo Technology Inc., Taipei , Taiwan. pp. 2.

<http://www.supergeotek.com/inner/Download/Taipei%20City%20Advanced%20Traveler%20Information%20System%20Web-20100505141358.pdf> accessed on 17 January, 2016.

US Department of Transportation 1998a. Intelligent transportation system field operation test cross-cutting study: Advanced travelers information systems. Department of Transportation, Federal Highway Administration Washington D.C, USA. pp. 27.

<https://www.fhwa.dot.gov/publications/research/operations/its/jpo99038/fotatis.pdf> accessed on 04 January, 2019.

US Department of Transportation 1998b. Developing traveler information systems using the national ITS architecture. Intelligent Transportation Systems Joint Program Office, Washington D.C, USA. pp. 226.

<https://www.fhwa.dot.gov/publications/research/operations/its/98031/index.cfm> accessed on 04 January, 2019.

Zhanga, J., Liaoa, F., Arentzea, T. and Timmermansa, H. 2011. A multimodal transport network model for advanced traveler information systems. Procedia Social and Behavioral Sciences, 20: 313–322