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TRAVEL TIME ANALYSIS OF GIDAN-KWANO-KPAKUNGU-BOSSO PAVEMENT USING INTEGRATED GPS

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ABSTRACT
The economic and population growth of the university community and Minna metropolis at large has led to an increase in the demand for an Advanced Travelers Information System. This demand has led to the study of the need to determine the travel time considering the congestion, accidents and delays among others from origin to destination along the Gidan Kwano – Kpakungu - Bosso pavement for the new level of road users in order to provide an Intelligent Transport System (ITS) using data collected by the use of GPS. This information will help a traffic manager on how to estimate travel time. The study was conducted for public transport vehicles navigating this route to serve as an improvement on the Advanced Travelers Information System (ATIS).

Keywords: *Advanced Travelers Information System (ATIS), GPS (Global Positioning System), Speed, Travel time*

1 INTRODUCTION

Advanced travellers information system ATIS is any system that acquires, analyses, and presents information to assist road users in moving from origin to destination.

Travel surveys are important tools used by transportation professionals to plan, design, evaluate and maintain the transportation system. Over the years, a variety of formats have been used for travel surveys, including mail-in paper forms, travel journal/diaries and computer-assisted telephone interviews (CATI). These methods rely on participants recalling trips completed within the past few days.

"Global positioning systems (GPS)-enhanced surveys may also provide more accurate information than conventional surveys on the start and end times of travel, detailed route travelled by the respondent and total travel time and distance." (Gonzalez *et al*., 2009)

A travel time study determines the amount of time required to travel from one point to another on a given route. In conducting such a study, information may also be collected on the locations, durations, and causes of delays. When this is done, the study is known as a travel time and delay study. Data obtained from travel time and delay studies give a good indication of the level of service on the study section. These data also aid the traffic engineer in identifying problem locations, which may require special attention in order to improve the overall flow of traffic on the route (Garber, 2010).

Factors such as congestion, accidents, unforeseen closures and wrong parking among others contribute to the congestion of the vehicular movement. Consequently, these random events results to the challenging estimation of travel time between the campuses.

The need to travel time estimate between the two campuses for day to day activities by staffs and students also prompted this research work, as the above factors are not taken into consideration while making assumption for the travel time between the campuses.

Many urban road transport systems today experience increasing congestion that threatens the environment and the transport efficiency. To tackle these problems, knowledge about traffic conditions is critical at many levels of traffic management and transport policy.

'Through information and personalized advice, individuals and fleet management companies can plan their trips more accurately and increase the efficiency of the system. For traffic management, speed information at the segment level can reveal problematic locations where new or revised traffic control schemes may be introduced to increase performance. For transport policy, network-wide travel time information provides input for travel demand forecasting and impact assessments of policy instruments.' Jenelius (2013)

The backbone of any successful Integrated Traffic Management System (ITMS) for a metropolis is reliable, accurate, and real-time data. Travel time, speed, and delay are three of the most important factors used in ITMS for quantifying, monitoring, and controlling congestion. Global Positioning Systems (GPS) have recently become available for civil engineering applications.

Measuring traffic congestion provides the data that is used in decision-making towards congestion management by documenting congestion information such as travel time, average speed, or delay time Mahmassani (2012).

'Travel time and delay data is perhaps the most important type of data used to calibrate and validate the simulation model that supports Advanced Traveler Information Systems (ATIS) and Advanced Traffic Management Systems (ATMS) strategies for road capacity enhancement, such as traffic signal optimization

and incident management on freeways and arterials.' (Jia *et al*., 2011).

Travel time, a fundamental measure in transportation, is the total elapsed time necessary for a vehicle to travel from one point to another over a specified route under existing traffic conditions. Delay on the other hand is the time lost to travel because of traffic frictions and traffic control devices. Travel time and delay studies are used to evaluate traffic conditions such as the onset of congestion along major corridors, and the impacts of developments such as transportation infrastructure, commercial, residential and industrial projects. Results are used to determine levels of service and to plan for improvements.

2 METHODOLOGY

The method used for this research is called the moving vehicle method. It was carried out in steps which consists of: Preparatory office work, Field data collection, and Post-office work.

The most important office work was the establishment of a data dictionary. Establishing a dictionary saved time and allowed the user to call upon the highlights already keyed into the dictionary once such was encountered. These highlights includes the causes of congestion, type of vehicle, and the control points, which are the starting and ending points of each roadway segment.

Data collected was categorized based on type of vehicles used by the school to convey students from one campus to the other. The types of vehicles were grouped into three. Which may include: bus, space bus and Marco polo.

The experimental data collection included the design of the process and data variables. First, about twenty-one kilometers long stretch of pavement spanning from Gidan-Kwano campus to kpakungu to bosso back of school was chosen, a map of which appears in figure 3. The main purpose of choosing this particular section was to monitor an existing travel route between the both campuses.

Some post-office work on the raw data was required to find the travel and delay time for each segment of the roadway traveled. This information was used in calculating mean travel speed, mean running speed, percent time in delay, in addition to travel time and total delay. The results were summarized in a spreadsheet table indicating the name of the road, its segments, study period, direction of travel, length of the segment traveled, delay source.

The data collected with the GPS device was put on the google map using map source to determine the exact routes on the map and the manual sheet was also tabulated in table 1 below, to determine the average speed and time a commuter can expect to take for the journey with respect to the type of vehicle, passenger stop and pickup time and road condition between two locations through and along the pavement.

Figure 1 shows the map source interface of a particular data collected between Gidan Kwano to Bosso campus while Figure 2 shows the map source interface. While figure 3 shows the road map of Gidan Kwano-Kpakungu-Bosso pavement and average time taken to navigate two campuses from google map and this time serves as a reference to determine the time difference of the vehicles in consideration for the study.

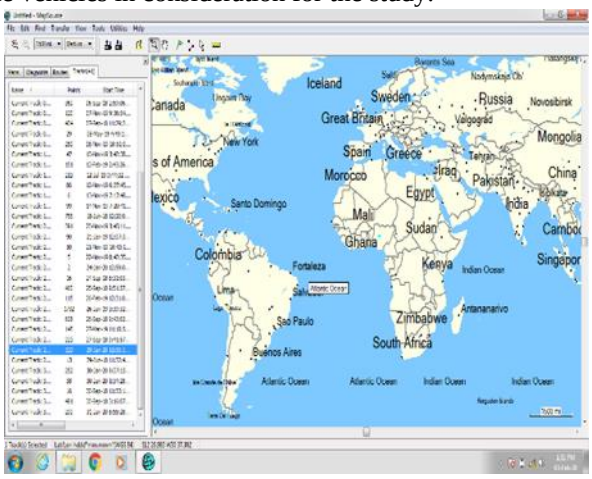

Figure 1: The Map Source Interface of GPS Data of Gidan Kwano-Kpakungu-Bosso pavement

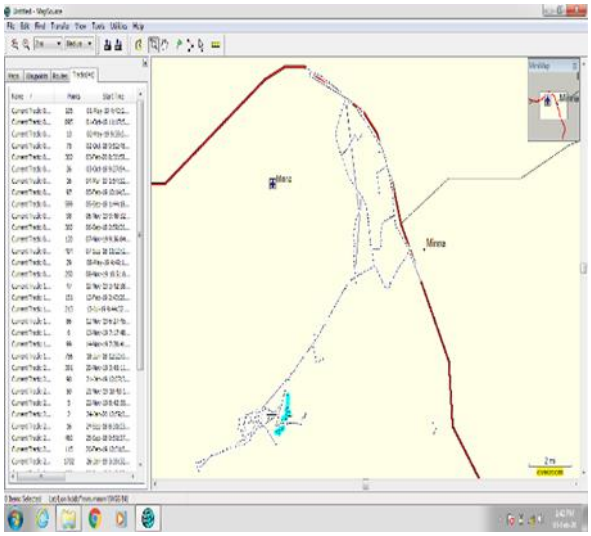

Figure 2: The Map Source Interface while Locating the Pavement

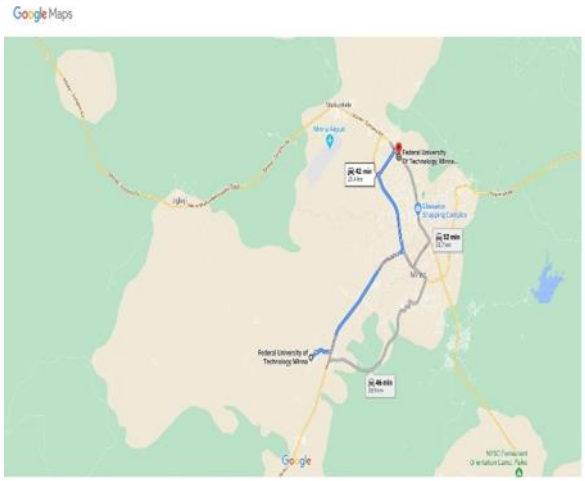

Table 3: The Google Road Map of Gidan Kwano-Kpakungu-Bosso Pavement

2.2. Data Collection Periods

The data was collected at different periods but at least three days data collection for each period. After gathering these data, it was analyzed to determine the average travel time using a mass transportation means of conveyance also answers the question of factors that could be responsible for time spent in delays.

During the period of the data collection it was discovered that there was delay which was caused by internal and external forces.

Internal forces being the kind of delays caused by passenger attitude, driver reaction time and the external forces being the congestion on the road.

3 RESULTS AND DISCUSSION

Table 1 shows the recorded time taken by each of the vehicle type and the days of the movement. From the table it can be deduced that there were days with lower travel time value while there were days with higher time, this could be due to the delay factors afore mentioned

TABLE 1: THE MOVING TIME OF THE VEHICLES ON EACH RECORDED TRIP

The Vehicles Moving Time (s)			
Date	**Bus**	**Space Bus**	**Marcopolo**
29/01/2020	43.11	39.32	41.11
29/01/2020	37.11	38.11	66.15
30/1/2020	40.24	40.24	45.10
30/1/2020	39.08	39.08	49.39
31/1/2020	45.59	42.22	42.33
31/1/2020	39.15	37.53	45.36
3/2/2020	43.51	45.09	43.48
3/2/2020	39.20	35.41	37.27
4/2/2020	40.49	37.15	48.08
4/2/2020	43.10	40.05	54.32
5/2/2020	46.21	42.50	50.25
5/2/2020	43.30	40.39	49.35
6/2/2020	42.20	42.43	47.37
6/2/2020	38.22	38.14	46.31
7/2/2020	50.12	38.26	49.12
7/2/2020	46.01	47.42	53.1
Bus Average	42.29	40.21	48.01

In Table 2, the average of travel time for each of the days was calculated using the mean of each trip by different vehicle type to see the relationship between the vehicles timing and the existing timing using the formula below:

$$\Delta T = \frac{t_b + t_s + t_m}{n} \qquad (1)$$

The equation 1 above shows the formula for calculating the figures in table two below. Where ΔT is the mean of each day, t_b is the time travelled by bus, $t_s$is the time travelled by space bus, t_m is the time travelled by marcopolo and n is the number of vehicle type used which is 3.

This calculation was done by calculating each of the time and dividing it by the number of trips recorded.

TABLE 2: AVERAGE OF THE TRAVEL TIME PER DAY

Date	**Time Average (s)**
29/01/2020	41.18
29/01/2020	47.12
30/1/2020	41.86
30/1/2020	42.52
31/1/2020	43.38
31/1/2020	40.68
3/2/2020	44.03
3/2/2020	37.29
4/2/2020	41.91
4/2/2020	45.82
5/2/2020	46.32
5/2/2020	44.35
6/2/2020	44.00
6/2/2020	40.89
7/2/2020	45.83
7/2/2020	48.84

4 CONCLUSION

This study involving the use of integrated GPS and analysing with map source shows the average time taken to traverse the two campuses following the Gidan Kwano- Kpakungu- Bosso pavement using the school bus (mass transit). This study has provided guidance for Advance Travellers Information System (ATIS) improvement. It was seen that the average time for each day from the study is close to the given travel time from the map and additional sample size and vehicle type and improved passengers' attitude may be required to improve the model performance and reduce associated errors.

The number of passenger, passenger attitude, driver attitude and model of vehicle could be an influence on the time taken by each vehicle to complete a trip

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