ADDRESSING THE NEW NORMAL AND THE FUTURE OF TRANSPORT: THE FUTURE OF TRANSPORT DATA COLLECTION USING FLOATING CAR DATA

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ABSTRACT

The COVID-19 pandemic has impacted many sectors in countries, and transport is one of them. Due to the new normal of staggered working systems, traffic congestion still proves a problem. Nonetheless, transport institutions should work tirelessly to improve the transport network by reducing travel time, reducing GHG emissions, and ensuring safety. However, traffic data is an essential entity to enhance the transport system. The essay aims to present the future of transport data collection using Floating Car Data (FCD). The data is highly available and quite affordable. Using such data helps prevail over the lack of other data collection systems, which prove expensive. The essay further illustrates the relevance of such data stipulating its advantages and disadvantages. Also, a discussion on the application of FCD follows, citing some research studies conducted in transport management. The essay concludes by asserting the use of FCD in developing countries to aid traffic management systems. It also recommends further studies in traffic management using FCD and transport institutions in respective countries to possess their FCD collection system to analyse the traffic independently.

1. INTRODUCTION

During the recent COVID-19 pandemic, every aspect of life was affected, including the transport sector. Traffic-related problems like congestion varied greatly depending on the different stages of severity of the pandemic response. The working environment has adapted to different systems to allow work to continue in alignment with the restrictions imposed during the pandemic. These systems included people working from home, from the office, or a hybrid approach, with employees working both from home and the office. Given the significant changes to the work environment particularly, the impact of the pandemic on the transport sector was palpable. Fewer vehicles are travelling to work due to working from home becoming the norm.

We need to measure the change in traffic level to plan for the future of the transport sector, especially if this future will have significantly different travel patterns to pre-pandemic patterns, referred to widely as the “new normal” of the transport sector. Therefore, a need to monitor the traffic system for the efficient optimisation of the road network still exists. Furthermore, we make proposals for mitigation measures by monitoring the transport system. This overall monitoring leads to the road network's management by reducing greenhouse gas (GHG) emissions, ensuring safety, and reducing travel time.

55% of the world's population – 4.2 billion inhabitants – live in cities today. By 2050, nearly 7 out of 10 people will reside in the cities due to the expected increase in the trend of urban population (World Bank, 2020). Africa, the fastest and youngest region, has the highest urban growth rates globally (World Bank, 2020). As the population increases, the demand for transport, including motorists, cyclists, and pedestrians, will boom. Consequently, an increase in the number of cars on the transport infrastructure will become inevitable. This upsurge causes traffic issues like congestion on major roads in the cities, even though the last two years have significantly reduced traffic volumes due to the COVID-19 pandemic.

As we return to normal working conditions, economic activities and various institutions will continue to be clustered in particular areas; specifically, the Central Business Districts (CBDs) of cities, leading to travel to and from that area being exorbitant during peak hours. This increase in travel movements leads to economic, social, and environmental devastations due to long travelling hours and high emissions of gases (Koźlak & Wach, 2018). In addition, there is an expectation of traffic in cities worsening as the pandemic subsides, making the need to measure traffic movement ever more important. Unfortunately, there is a lack of modern systems in developing countries that can monitor traffic on most road networks, including devices such as cameras and radar systems. In these instances, probe vehicles can effectively provide much-needed traffic data.

Therefore, this essay briefly introduces the application of Floating Car Data (FCD) to analyse traffic problems for future transport. It seeks to bridge a gap between the unavailability of traffic statistics and the desire to improve the road network by the relevant stakeholders. Current methods used to analyse traffic are time-consuming, resource-intensive, and may yield subjective results. Utilising FCD for traffic analysis has been widely researched and promoted as a feasible alternative to conventional methods in addressing transport problems in big cities. However, FCD has received little attention in most developing countries in Africa despite its potential. Yet, traffic data is paramount to envisage the causes of problems in the road network.

2. LITERATURE REVIEW

2.1 Relevance of Floating Car Data (FCD) in Analysing Traffic Trends

Recently, researchers have gained interest in analysing traffic-related problems using Floating Car Data (FCD), also referred to as Probe Vehicle Data. The FCD system uses the Global Navigation Satellite Systems (GNSS) situated in vehicles or mobile phones to provide information on the position and speed of cars (Messelodi et al., 2009). The moving probes in this regard act as sensors. From this information, traffic engineers can extract essential parameters regarding the transport system from the control centres of the GNSS. Some researchers regard FCD as a cooperative system utilising the vehicle to infrastructure (V2I) system since the installed GNSS in vehicles provides information to the control centres (Stahlmann et al., 2011). Cooperative systems can help improve overall traffic efficiency, safety, and travel comfort. FCD in traffic studies also serves as an Intelligent Transportation System (ITS) technique because of the technology employed in collecting data (Mfenjou et al., 2018).

The application of ITS can help to provide a safe and efficient transport system. ITS incorporates technologically advanced methods in the transport sector to allow transport institutions to manage traffic better and enable road users to experience the best mobility (Sun & Boukerche, 2021). ITS, in general, has gained a lot of momentum in many developing countries. However, many African countries have lagged in ITS applicability. Evaluating traffic conditions to support measures in addressing problems in the traffic stream needs readily available traffic data (Sharif, Li & Sharif, 2019). Pfoser (2016) states that FCD provides real-time and historical data. The latter evaluates roads' current Level of Service (LOS) and enables system performance and analysis of traffic trends that aid transport planning. Whereas the former provides the travel times that help in rerouting dynamics and real-time management of traffic systems.

FCD has recently become readily available due to an increasing number of e-hailing companies like Uber, Bolt, DIDI, and In-driver (Manav, 2020). That is due to the influx of smartphones on the continent of Africa, whose penetration rate was 43% in 2017 (Africanews, 2017). Other service providers for FCD include TomTom, Google, and INRIX. They mainly obtain their data from Global Positioning System (GPS) installed in commercial and government vehicles and from mobile phones. These companies share their data with traffic engineers and urban planners to enable them to restructure particular systems on the road network to improve mobility. Likewise, Uber has an Uber Movements service that allows data sharing, similar to the previously mentioned companies. Therefore, utilizing such available data could enable transport planning authorities to monitor the overall traffic system and hence engage promptly to mitigate the problem.

2.2 Advantages and Disadvantages of Floating Car Data (FCD)

Among the advantages of FCD are:

- Probe vehicles are efficient in detecting spatial resolution congestion, although stationary detectors outperform them in terms of temporal resolution (Kessler et al., 2018).
- FCD renders transport data highly available due to limited data from roadside sensors (Loo & Huang, 2021).
- FCD can provide real-time traffic information and large amounts of data over a long time period (Cohn & Bischoff, 2012).
- The penetration rate to achieve satisfactory results is 5% -10% of the total vehicles on the road network (Sunderrajan et al., 2016). That fortifies the viability of FCD in obtaining reliable conclusions.
- FCD also provides a random sample set for the entire urban road network and is readily available at a low cost from reliable sources (Liu et al., 2017).

In contrast, the disadvantages may include:

- The data collection frequencies need high spatial resolution capacity. Therefore, FCD is better suited for large-scale monitoring and traffic management (Kessler et al., 2018).
- The Probe data can sometimes incur GNSS position inaccuracies (Liu et al., 2017) and map matching errors on the corresponding road segment (Keler, Krisp & Ding, 2017). The distortion of the spatial positions may be due to high buildings, elevated road infrastructures, and tunnels.
- Cohn & Bischoff (2012) indicated that FCD has no direct relationship to traffic density and traffic flow.
- Most vehicles equipped with GPS happen to be taxis and trucks of commercial companies in certain systems. These tend to drive slowly hence not a representative of the traffic on the road (Treiber & Kesting, 2013:8).

2.3 Applications of Floating Car Data

2.3.1 Road Network Performance Analysis

Monitoring the road network is vital for traffic engineers to evaluate the performance of the transport system, helping to redesign different elements of the network. For example, the engineer may be able to identify the bottleneck in the network. FCD allows for analysis before and after a mitigation measure has been deployed. The analysis offered by FCD includes operational assessment measures like speed, congestion, incident analysis, and special events. Colombaroni, Fusco & Isaenko (2020) used the FCD to evaluate driver behaviour and the theoretical safe speed on the road. This analysis is relevant to many developing countries where traffic accidents are prevalent due to poor roads. Therefore, analysing the FCD helps extract features in the road network that need improvement and adjusting the speed limits for a particular section of the road.

2.3.2 Transport Planning

Substantial evidence is needed for transport planners to pursue any improvement strategy on the road network. Transport planners can use FCD for infrastructure prioritisation, rating any particular element in the road network that improves transport, using, for example congestion rating according to road class. Mei et al. (2019) used the Bayesian approach to estimate the queue length at an intersection using FCD. This approach can enable relevant stakeholders to predict the impact of an intersection on triggering congestion upstream and on adjacent roads. Also, the approach renders a reactive measure in combating the propagation of queues on junctions. Travel time surveys also enable route planning to be pursued. Additionally, FCD illustrates the Origin and Destination relations and matrices (Vogt et al., 2019). The matrices facilitate traffic engineers and planners in the event of infrastructure development.

2.3.3 Forecasting and Estimation

FCD enables the study of traffic growth used to estimate and predict traffic parameters, for example, congestion. Keler, Krisp & Ding (2017) generated congestion propagation polylines. These polylines can indicate where the traffic congestion originates. Also, the estimation and modelling enable route choice analysis for traffic simulations (Cohn & Bischoff, 2012). Dabbas, Fourati & Friedrich (2021) conducted a study on route choice modelling where they used FCD to estimate the route choices on different spatial scales. Furthermore, FCD enables emissions modelling. The estimation and forecasting of greenhouse gas emissions in an area help to reduce the impact caused (Chen et al., 2016). Therefore, the formulation of necessary precautions by the transport managers becomes indispensable.

2.3.4 Real-Time Application

FCD plays a pivotal role in the traffic management system at traffic control centres, enabling remote control systems such as adaptive signal control and information dissemination to travellers in real-time. Routing details and congestion management can also be reliably made available to the travellers on the route if FCD is used to gather data. Speed reductions and the increased travel time reported by probe vehicles enable traffic managers to extract information to warn the travellers of the expected delays in real-time (D’Andrea & Marcelloni, 2017).

3. CONCLUSION AND RECOMMENDATIONS

In conclusion, there are many studies on the application of FCD; however, very few have been applied in Africa. Yet traffic-related problems in African cities are still rampant. The emergence of FCD enables the evaluation of traffic studies, thus improving the road network in African cities. Furthermore, FCD is available from well-established companies; hence, the pursuance of mitigation measures that ensure an efficient, reliable, and safe transportation system is possible. Also, many African countries do not have Traffic Management Centres (TMC), and Intelligent Transportation System (ITS) has not evolved, apart from in a few countries such as South Africa, Ethiopia, and Nigeria.

This essay recommends in-depth research on FCD in African cities. Other countries' use of this dataset implies that African cities can also endorse FCD. FCD can enable to solve some of the traffic-related problems. Another recommendation is that road authorities in charge of transport establish data collection protocols from probe vehicles. Additionally, the institution could own a decentralised traffic management system where relevant bodies interact on a given platform to control the traffic in the city.

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