

ICT Devices: Vital Tools for Enhancing Road Traffic Monitoring

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How to cite this paper: Ekwonwune, E.N., Ngozi, N.C.A. and Eberchi, O.O. (2018) ICT Devices: Vital Tools for Enhancing Road Traffic Monitoring. *Communications and Network*, 10, 43-50.
<https://doi.org/10.4236/cn.2018.103004>

Received: March 19, 2018

Accepted: July 10, 2018

Published: July 13, 2018

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Abstract

Road Traffic monitoring involves the collection of data describing the characteristic of vehicles and their movement through road networks. Such data may be used for one of these purposes such as law enforcement, congestion and incident detection and increasing road capacity. Transportation is a requirement for every nation regardless of its economy, political stability, population size and technological development. Movement of goods and people from one place to another is crucial to maintain strong economic and political ties between the various components of any given nation among nations. However, there are different modes of transportation and the most paramount one to human beings is road transportation. Due to increase in the modes of transportation, road users encounter different problems such as road blockage and incidents. Therefore there is need to monitor users incidents and to know the causes. Road traffic monitoring can be done manually or using ICT devices. This paper focuses on how the use of ICT devices can enhance road traffic monitoring. It traces the brief history of transportation; it equally discussed road traffic and safety, tools for monitoring road traffic, Intelligent Transportation Systems (ITS) use for traffic monitoring and their benefits. The result shows that the use of ICT devices in road traffic monitoring should be a Millennium Goal for all developed and developing countries because of its numerous advantages in the reduction of the intensity of traffic and other road incidents.

Keywords

Transportation, Traffic, Monitoring, Devices, Camera, Surveillance

1. Introduction

The history of transportation is rich and evolving. Just like the computer, technological innovations have increased the speed and safety of transportation. Advances in technology have allowed people to travel further, explore more territory, and expand their influence over larger and larger areas. Even in ancient times, new tools and inventions increased the distances that one could travel. Discoveries such as foot coverings, skis, and snowshoes were example of transportation tools which aided transportation in ancient times. These discoveries, innovations and inventions were applied to transport problems, which as you may have guessed right, decreased travel time and increased the ability to move and cover longer distances as well as carry larger loads. These innovations did not stop and neither did they occur only in ancient times, in the present world the innovations continues as transport researchers are working constantly to identify new ways to reduce costs and increase transport efficiency and safety.

Transportation by definition is defined as the movement of people, animals and goods from one location to another. Modes of transport include air, rail, road, water, cable, pipeline and space. From the definition, the basic importance of transportation is movement while for human beings, it is not just for movement rather movement with benefit. The benefit can be for trade, or getting to a place as quickly as possible in emergency situations, moving heavy loads from one location to another, creating jobs, generating revenues and many more benefits you can think of. Transportation is a requirement for every nation regardless of its industrial capacity, political stability, population, size or technological development. Moving goods and people from one place to another is crucial to maintain strong economic and political ties between the various components of any given nation and among nations. How that movement takes place can be unique to location and technological development, but the most reliable and widely embraced means of transportation is road [1].

Before every other form of transportation, both humans and animals travelled on foot (animals can now be transported in other forms of transportation created by humans). However, through domestication and the use of tools, human beings learned to use animals such as horses, camels and donkeys for transportation. The wheel was invented in Iraq in 3500 BC, and was made from wood. For water transportation, a canoe-like structure was built by burning log and digging out the burned wood while the Egyptians invented the sailing boat in 3100 BC. The Romans built roads across Europe. Good roads, good architecture and good sewage ways. They (The Romans) were really that good. During the industrial revolution, the first modern highway was developed by John Loudon McAdam [2]. He achieved this by using inexpensive paving material of soil and stone aggregate and he also embanked roads a few feet higher than the surrounding terrain to cause water to drain away from the surface.

In the 17th and 18th century, many new modes of transportation were invented. Examples of these inventions are bicycles, trains, motor cars, trucks, airplanes

and trams. The first car was developed with an internal combustion engine and this happened in the year 1960. The invention of the internal combustion engine became the bases for the development of other types of transportation systems like airplanes, trains, boats and other automobiles. With the development of motor transport, there was increased need for hard-topped roads to reduce wash away, bogging and dust on both urban and rural roads, originally using cobbles-tones and wooden paving in major western cities and in the early 20th century tar-bound tarmac and concrete paving were extended into the countryside [3].

Road transportation is the most widely used means of transportation in all countries generally and Nigeria in particular due to its affordability. Because of its contribution to national growth, various measures and devices had been and are being developed to enhance its continuity, sustainability and safety. Geospatial technology is an electronic system for capturing, storing, retrieval, analyzing and displaying data related to positions on the earth. Due to increase in the modes of transportation road users encounter different problems such as road blockage and incidents. Therefore there is need to monitor users incidents and to know the causes. However, this paper will X-ray ICT devices as vital tools for enhancing road traffic to ensure easy location of vehicles and incidents on roads.

2. Theoretical Review

The paper is centered on those vital ICT devices that will enhance road traffic monitoring, but before delving into the topic let us look at the word traffic. According to the [4], traffic is defined as the number of vehicles moving along roads, or the amount of aircraft, trains, or ships moving along a route. Traffic is defined as vehicles or people in the vehicles, a delay that involves transportation or movement through a designated location. Examples of traffic are people driving in cars, a heavy delay in a rail road system and how many hits a website gets daily. It can also be defined as the passage of people or vehicles along routes of transportation.

Therefore, Traffic on roads may consist of pedestrians, ridden or herded animals, vehicles, streetcars, buses and other conveyances, either singly or together, while using the public way for purposes of travel [5]. As world population continues to increase and automobile manufacturers are still in business, definitely the number of vehicle road users will increase. Vehicles which are used for road transportation will need access roads where they will be driven. The question now becomes, what happens when almost all road users are travelling on one route? Your guess is as good as mine, there will be congestion. Almost all the road users will be competing for space, and because there may be no alternative route, the traffic creates a gridlock which in turn results in other possible road incidents like crime and accidents. To minimize the possibility of such even playing out, a lot of factors must be put into consideration.

2.1. Road Traffic Safety

Safety is the state of being “safe” (from French *sauf*), the condition of being

protected from harm or other non-desirable outcomes. **Safety** can also refer to the control of recognized hazards in order to achieve an acceptable level of risk. Road traffic safety involves methods and measures for reducing the risk of death and injury on roads. The following measures can be taken to ensure road safety.

- 1) Create alternative routes. The key factor will be to create as many alternative routes as possible.
- 2) Employ traffic wardens. Another factor can also be the employment of traffic personnel to monitor and control traffic.
- 3) Laws can also be put in place to regulate and prosecute traffic offenders as well as instruct that special vehicles like trucks travel through a dedicated route because of their size.
- 4) Sidewalks, curbs and traffic signals should be installed on the roads.
- 5) Speed limits should be observed in different areas, a recommended limit should be specified for different types of roads.
- 6) Installation of Variable Message Sign to guide traffic in motorways.
- 7) Vehicles experiencing a breakdown or another emergency can stop in the emergency lane.

Road traffic crashes are one of the world's largest public health and injury prevention problems. The problem is all the more acute because the victims are overwhelmingly healthy before their crashes. According to the World Health Organization, more than one million people are killed on the world's roads each year. A report published by the WHO in 2004 estimated that some 1.2 million people were killed and 50 million injured in traffic collisions on the roads around the world each year [6].

[7] stated that while there is a growing need for highway traffic monitoring, the problems in this area are not appreciated by the general public. In his opinion, the maintenance of existing infrastructure in a safe condition is dependent on traffic monitoring because road infrastructure will be difficult to maintain if there is no record and understanding of how highways are used.

2.2. Tools Use for Road Traffic Monitoring

Monitoring is the act of observing and checking the progress or quality of (something) over a period of time; keep under systematic review. Since it has now become obvious that road accidents occur on road. Effective monitoring of road activities and users can be used ensure the safety of road users. Before the introduction of devices which aid in traffic monitoring, traffic monitoring and control has been the responsibility of the police, traffic wardens and other traffic monitoring agencies. The introduction of Information Communication Technology (ICT) into road traffic monitoring will improve the efficiency of human road traffic monitors and ensure the safety of road users. [1] stated that there are lots of factors which are responsible for the increase of road transport. Some of the factors he identified are as follows, transformation of rural areas, construction and rehabilitation of roads, establishment of more industries and increased welfare package. He pointed out that it is the increased growth in road vehicles

that is responsible for a system which will assist in navigation, ease congestion and make road transportation safe and reliable. **Figure 1** shows some of the tools used for traffic monitoring.

2.3. Intelligent Transportation Systems (Its) Use for Traffic Monitoring

Information technologies are represented in all fields of society and science, including the traffic and transport. They are the base of intelligent systems. Traffic and transport are areas that are directly related to the spatial relations, in terms of which they are no longer able to manage efficiently or maintain the system without adequate infrastructure and database GIS (Geographical Information System) character [8].

Intelligent transportation systems (ITS) are advanced applications which without embodying intelligence as such, aim to provide innovative services relating to different modes of transport and traffic management and enable various users to be better informed and make safer, more coordinated, and smarter use of transport networks. The directive of the European Union 2010/40/EU, made on the 7 July, 2010 defined ITS as systems in which information and communication technologies are applied in the field of road transport, including infrastructure, vehicles and users, and in traffic management and mobility management, as well as for interfaces with other modes of transport [9].

There are different ITS designs and they vary in technology and application, from basic management systems such as car navigation; traffic signal control systems; container management systems; variable message signs; automatic

Detection and Monitoring Solutions for Road Traffic Applications:





 <p>FC-Series Thermal imaging cameras for traffic monitoring</p> <p>The FLIR FC-Series cameras are equipped with a maintenance-free uncooled microbolometer detector that produces accurate images on which the smallest detail can be seen.</p> <p>EXPLORE ▶</p>	 <p>D-Series ITS Thermal Traffic Cameras In Outdoor Dome Enclosures</p> <p>D-Series thermal imaging cameras make it possible to observe traffic clearly in total darkness and in bad weather. The D-Series outdoor dome enclosure provides precision pan/tilt control.</p> <p>EXPLORE ▶</p>	 <p>PT-Series ITS Multi-Sensor for Traffic Monitoring Applications</p> <p>PT-Series ITS thermal imaging cameras allow you to monitor traffic clearly in total darkness, in bad weather and over a long range. Its pan/tilt mechanism gives operators accurate pointing control while providing fully programmable scan patterns.</p> <p>EXPLORE ▶</p>	 <p>AID Boards Multi-functional video detection boards</p> <p>VIP boards integrate automatic incident detection, data collection, recording of pre and post incident image sequences and streaming video in one board.</p> <p>EXPLORE ▶</p>
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Figure 1. Graphical example of tools use for traffic monitoring. Retrieved from <http://www.flir.com/traffic/display/?id=67443>.

number plate recognition or speed cameras to monitor applications, such as security CCTV (close circuit television) systems; and to more advanced applications that integrate live data and feedback from a number of other sources, such as parking guidance and information systems; weather information; bridge devising systems; and the like. Additionally, predictive techniques are being developed to allow advanced modeling and comparison with historical baseline data. Some of these technologies are discussed in the following sections.

1) Variable Message Signs (VMS)

VMS are key elements of dynamic traffic management systems. It is an electronic traffic sign which is often used to give travelers information about special events, as shown in **Figure 2**. The VMS displays information which informs, warn, and guide the motorists on highways and expressways depending on the traffic situation. They do this by providing highly visible and concise information to drivers which keeps them better informed, thereby helping to reduce traffic congestion and journey times while lowering pollution levels from queuing traffic, as shown in **Figure 3**.

2) Traffic Light Control System

A traffic light or traffic signal is a signaling device which is placed on a road



Figure 2. Graphical example of VMS. Retrieved from https://en.wikipedia.org/wiki/Variable_message_sign#/media/File:Variable_message_sign_with_travel_times_on_I-70_West_north_of_Evergreen_CO.jpg.



Figure 3. Illustration of the use VMS in enhancing in road traffic monitoring. Retrieved from <https://www.siemens.co.uk/traffic/en/index/productsolutionservices/signs.htm>.

intersection or pedestrian crossing to indicate when it is safe to drive, ride or walk, using a universal color code (usually red, yellow and green) [10]. With the growing number of vehicles, the traffic congestion and transportation delay on urban arterials are increasing worldwide; hence it is imperative to improve the safety and efficiency of transportation [11]. That is why improve traffic light control system is essential. In Nigeria, the traffic lights for vehicles commonly have three main lights, a red light that means stop, a green light that mean go and yellow that means ready to stop. However for the pedestrians, there have only two lights, a red light and a green light that mean go and stop respectively. The traffic lights have given many benefits to all road users. Besides reducing the number of accidents, it made the traffic flow smoothly and possibly could save people time.

3) Container Management System

Container management system is a system of knowing that X containers are required at time Y in quality Z at one or a number of specified locations, and that they are in place in the proper quantity and at the right time to meet the requirement. The Container Management System (CMS) is powered by Container chain Solutions. It is a web-based application that enables users to view and perform transactions anywhere anytime. This solution was implemented about several years ago in Australia and was adopted by all container depots across the country, and it is supported by about 57 shipping lines [12].

4) Speed Cameras

Speed camera is a camera at the side of the road that takes pictures of cars that are going faster than is legally allowed [13].

Speed cameras are those cameras used to some gathering data for experts to analyze, others helping police catch criminals and manage traffic flow. They are also used to monitor your speed and record your car's number plate. There are various types of speed cameras: Gatos speed cameras, Mobile, HADECS 3, Siemens safe zone, SPEC2, VECTOR. Truvelo, Truvelo D-Cam, Speed curb, Variable, Traffic light, peek, DS2M, Watchman and spike.

5) Close Circuit Television (CCTV)

Close circuit television (CCTV) is also known as video surveillance. It is the use of video cameras to transmit a signal to a specific place. They are often placed on top of traffic signals and along busy roads as well as at busy intersections of the highway. Video surveillance using CCTV is explosively popular for recording traffic patterns for future study and observation or monitoring traffic and issuing tickets for moving violation.

3. Aim and Objectives

The aim of the research work is to identify ways ICT devices can enhance traffic monitoring in order to reduce some the problems road users encounter. The objectives of the study are:

- 1) To examine ways these devices capture real-time data;

- 2) It critically looks road traffic safety and measures for reducing risk on roads;
- 3) Benefits of some of these devices were considered.

4. Methodology

The materials used on the study included those gotten from researched works, primary and secondary sources of data and information and the WEB. Such materials included oral interview, articles, personal observations etc.

5. Conclusion

This work has identified the ICT devices and applications as vital tools that have enhanced road traffic monitoring. It also highlights the importance and contributions of the use of ICT devices and technologies in the administration of traffic monitoring and road safety as well as the sensitization of road users and improvement of quality of life of the general public. The implementation of the use of ICT devices in road traffic monitoring should be a millennium goal for all developed and developing countries because of its numerous advantages in the reduction of the intensity of traffic and other road incidents.

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