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nrdajpapers@gmail.com

Design of Integrated ITS Solution Supporting Policing/Enforcing Traffic Regulations System

[1]Modu, M. Tijjani; [1]Sadiq, A. Goni; [2]Falmata, B. Wakil and [1]Babagana, D. Maikele

[1]Department of Electrical and Electronic Engineering, Ramat Polytechnic Maiduguri, Nigeria
[2]Department of Computer Engineering, Ramat Polytechnic Maiduguri, Nigeria | Email: modutijjani@gmail.com

Abstract: *The study designed integrated Intelligent Transport System (ITS) solution supporting Policing/Enforcing Traffic Regulations System using European ITS Framework Architecture (FRAME) Browsing Tool. The system is capable of providing the ability to analyse the image received from the Process Fraud Notifications or Detect Fraud Functions. Ability to determine the ID of the violator vehicle, and the type of fraud (violation) involved from the received image. Once the image has been analysed, the ability to send the results to the Determine Violator ID Function. The system can be able to collect the evidence of a violation of the traffic laws and regulations in a manner suitable to justify the application of a legal punishment. Also, it can be able to provide support for the enforcement of safe behaviour and vehicle priorities.*

Keywords: *Enforcing, Intelligent, Policing, Traffic and Transport*

Introduction

The Intelligent Transportation System (ITS) is a system using various technologies to improve convenience, safety and efficiency of transportation. Nowadays, the ITS systems are difficult to design, develop and deploy because of limited area for new infrastructure, complexity and diversity of systems and a problem of non-interaction between novel and existing systems. Consequently, the ITS architecture plays a role in facility related to structural and functional plans and characteristic of interaction between two or more systems. Thus, the efficiency of ITS systems depends on ITS architecture. An existing ITS architecture, Intelligent Transportation Systems (ITS) hold the promise to improve roadway congestion and transportation infrastructural management by capitalizing on information derived from traffic monitoring. The increasing requirement and public expectation for accurate vehicular traffic information to manage traffic flows has triggered the deployment of large scale traffic monitoring infrastructures. Typically, this has included the use of inductive loop detectors, microwave sensors and relatively expensive video cameras (Friesen & McLeod, 2014).

A recent study by the UK Government's Office of Science and Innovation, which studied how upcoming intelligent infrastructure would evolve to support transportation over the next 50 years looked at a range of new technologies, systems and services that may appear over that period (UK DfT, 2006). One important class of technology that was recognized as having an important role in delivering future intelligence to the transport sector was wireless sensor networks and in precise the fusion of fixed and mobile networks to aid in delivering a safe, sustainable and robust future transportation system based on the improved collection of data, its processing and dissemination and the intelligent use of the data in a fully connected environment. The important innovations in wireless and digital electronics are beginning to support many applications in the areas of safety, environmental and emissions control, driving assistance, diagnostics and maintenance in the transport domain. The last few years have seen the emergence of many new technologies that can potentially have major impacts on Intelligent Transportation Systems (ITS) (Tully, 2006). Information and Communication Technology (ICT) is considered a tool that permits safe and effective operations in freight transportation and that improves visibility, responsiveness and performance in supply chains (Giannopoulos, 2004; and Coronado *et al*., 2012).

2.0 ITS System Architectures Around the World

According to Yokota, T., and Weiland R.J., (2004), advanced countries around the world have taken the lead in establishing ITS system architectures. These comprise the U.S., the European Union, and Japan. Numerous other countries, both developed and developing, have produced their own national ITS architectures according to their level of development based on their suited architectures. Furthermore, the International Organization for Standardization (ISO) includes a working group on ITS architecture (WG1) in its technical committee on ITS (TC204).

2.1 European ITS Framework Architecture

The European ITS Framework Architecture (informally called FRAME) is a project of the EU Directorate on Information Society Technology and is one of the vital efforts of the Fifth Framework research program. FRAME, which is still in progress, will deliver a second generation architectural approach, based on the original European ITS Architecture called KAREN as shown in figure 1, (for Keystone Architecture Required for European Networks). KAREN was developed in the late 1990s (Yokota and Weiland, 2004).

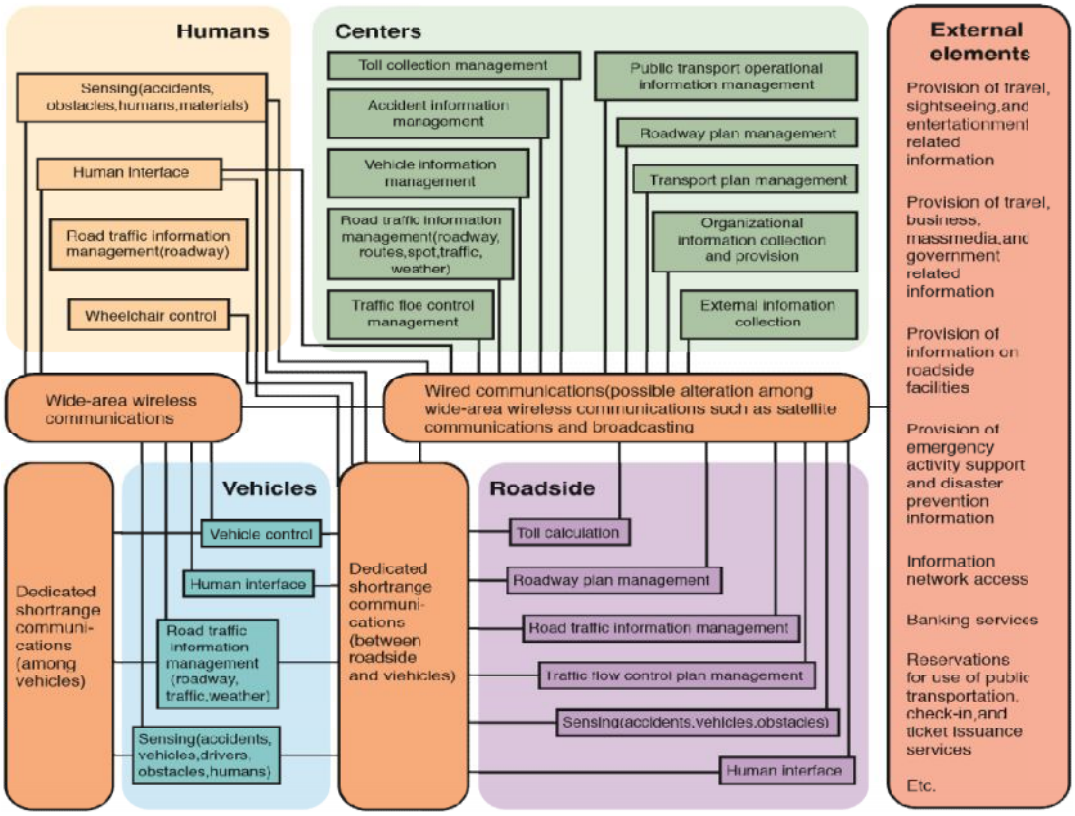

Figure 1: Subsystem Interconnect Diagram from Japanese Physical ITS Architecture
Source: Yokota, T., and Weiland R.J., (2004).
http://www.its-jp.org/english/arch_e/doc/summary.pdf, p20

2.2 U.S. National ITS Architecture

As highlighted by Yokota, and Weiland., (2004), U.S. was the first country to establish a national ITS architecture, beginning in the early 1990s. The U.S. architecture has 33 users into architecture flows. These flows and the corresponding communication requirements define the interfaces which are a main focus of ITS standards development in the U.S. (see Figure 2).

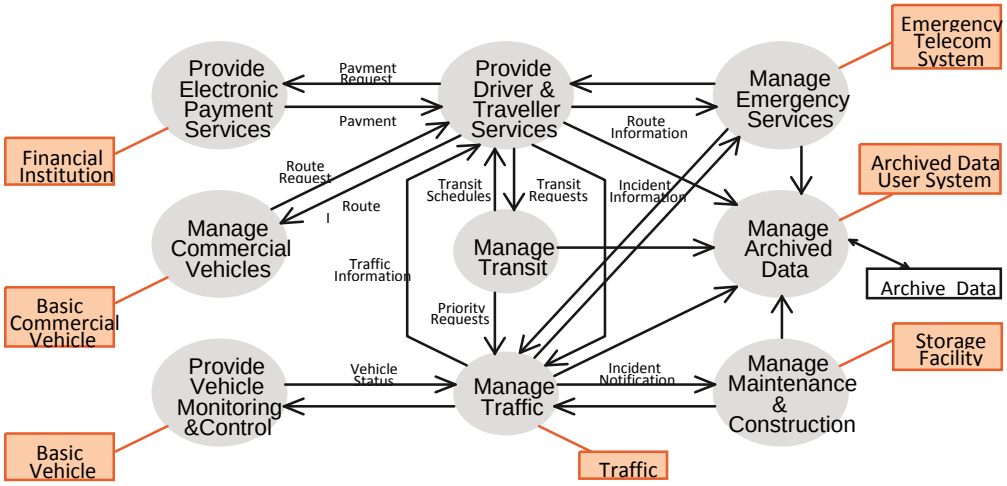

Figure 2 Very High Level Logical Architecture of the U.S. National ITS Architecture (DFD)
Source: Yokota, T., and Weiland R.J., (2004)

3.0 Bus Priority Architecture: A London case study

According to Grant-and Usher (2014), the leading city in UK in growth and implementation of bus priority at traffic signals is London. decentralised communications system with priority requests from the bus to the traffic signal controller via the roadside beacon is used. Again, this method was preferred because:

i) the communication process was already developed from the Automatic Vehicle Location (AVL) centre to buses and allowed bus priority requests to communicate similarly;
ii) the London system uses 'precise' bus location for priority relatively close to the junction because of high bus journey time variability AVL beacons could then replace the transponder/bus detector system); and
iii) no communications existed, nor were considered necessary between the AVL and Urban Traffic Control (UTC) centres. Figure 1 shows the AVL based bus priority architecture in London see figure 3.

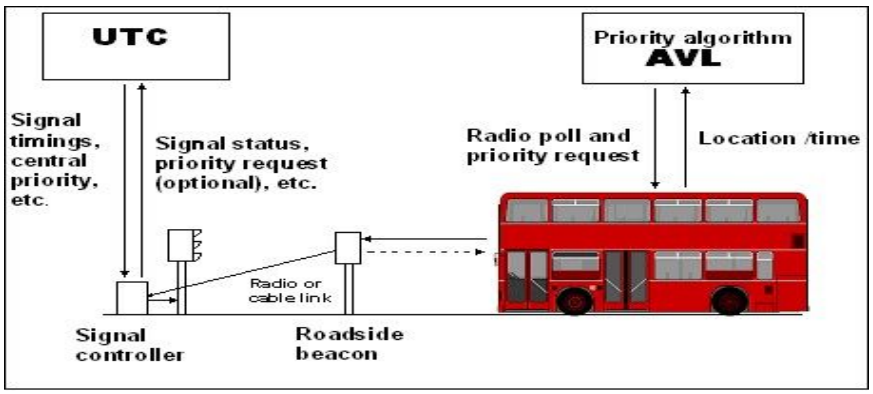

Figure 3. AVL based bus priority architecture in London

4.0 Methodology

European ITS Framework Architecture (FRAME) Browsing Tool was used to design Policing/Enforcing Traffic Regulations system as shown in figure 4. The system is capable of providing the ability to analyse the image received from the Process Fraud Notifications or Detect Fraud Functions. Ability to determine the ID of the violator vehicle, and the type of fraud (violation) involved from the received image. Once the image has been analysed, the ability to send the results to the Determine Violator ID Function.

The system checks the compliance of the recorded images with the established rules both in real-time and/or off-line. For Vehicles that can be identified, the system extract from the store of User's Registration Data the information needed to check that the user is whether allowed to behave as in the recorded image. For Vehicles that cannot be identified, the system requests it from the Identify Violator Function, sending it an image of the violator extracted from the response. The system use information sent by functionality in the Manage Freight and Fleet Operations Area. Therefore, the system applies the rules more or less strictly according to guidelines sent by functionality in the Manage Traffic Function Area. Upon detection of a fraud, the ability to send the associated elements to the Process Fraud Notifications Function.

The system selects the Law Enforcement Agency(ies) concerned by the fraud (violation) from the data received. If necessary extract information on previous offences from the store of Violations Data, receiving the data in the first other input data flow. Send a data flow to check that the detected violation is not the result of instructions sent to Drivers, and abandon the creation of the prosecution file at this point. The system fills the prosecution file using the format required by the Law Enforcement Agency identified. Send the prosecution file to the Law Enforcement Agency using the third trigger output data flow. Send the prosecution file and all the associated elements to the Fraud Function, using the second trigger output data flow. if the fraud concerns freight vehicles and has been detected by the functionality in this Area, send the elements to the Manage Freight and Fleet Operations Area, using the first trigger output data flow.

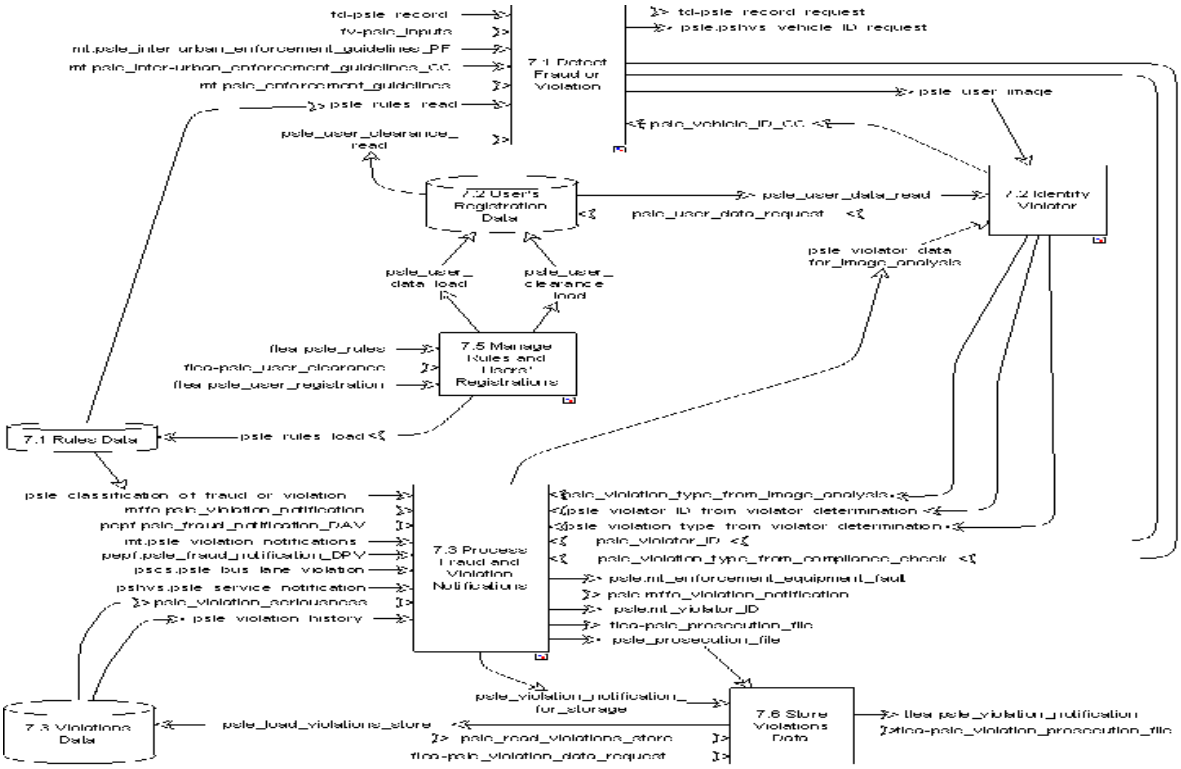

Figure 4: ITS solution supporting Policing/Enforcing Traffic Regulations System

This Function shall be capable of providing the following facilities:

1. The ability to obtain the identity of the violator, i.e. the person who has committed the fraud (violation), from the store of User's Registration Data using the identification of the violating Vehicle as the reference for the data.
2. The ability to send this extracted information to other functionality in the Provide Support for Law Enforcement Functional Area.
3. As part of the management process, provide specified contents of the store to the Law Enforcement Agency (ies) terminator upon reception of a specific request.
4. The ability to send the file containing all the elements necessary for the prosecution of the violator to the right Law Enforcement Agency.
5. As part of the process of preparing the file, the ability to check that the violation is not the result of an instruction that has been given to and acknowledged by a Driver.
6. The ability to also send the resulting file, plus all the elements received, to the functionality that stores fraud notifications.
7. For violations detected directly by other functionality in this Area, and concerning freight vehicles, the ability to also send all the details of the violation to functionality in the Manage Freight and Fleet Operations Area.

Conclusion

Policing/Enforcing Traffic Regulations system was designed using European ITS Framework Architecture (FRAME) Browsing Tool and the following conclusions were drawn:

d) The system shall enforce the traffic laws and regulations of the region automatically (where possible).
e) The system shall be able to collect the evidence of a violation of the traffic laws and regulations in a manner suitable to justify the application of a legal punishment
f) The system shall be able to provide support for the enforcement of safe behaviour and vehicle priorities.
g) The system shall not obstruct or slow down traffic in any way, except when it is part of access control.
h) The system shall be able to communicate with Police Command and Control Systems.
i) The system shall be able to collect evidence on vehicles that commit traffic signal violations.
j) The system shall be able to collect evidence on vehicles that exceed a local (variable) speed limit.
k) The system shall be able to identify the cargo being carried by a heavy goods vehicle automatically.

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