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Review of Traffic Management Control Techniques

Amanjot Kaur*
Computer Science Department
North West Institute of Engineering &Technology, Moga, India

Dr. Mohita Garag
Computer Science Department
Principal of North West Institute of Engineering &Technology, Moga, India

Harpreet Kaur
Computer Science Department
North West Institute of Engineering &Technology, Moga, India

Abstract—Today's traffic management schemes are facing the problem of traffic congestion on roads. Traffic congestion on main roads leads to many problems such as delay in emergency services, accidents and others. Many techniques have been applied to control traffic. However, ATMS (Advanced Transportation Management System) software solutions are open source to control traffic that showed significant potential for adaptation and deployment within the California Department of Transportation (Caltrans). This paper presents survey of different traffic management techniques applied to control traffic. The aim of this paper is to explore best methods of traffic management.

Keywords—Traffic Control, IRIS, Wireless Technology, Image Processing

I. INTRODUCTION

With advancement of technology, new vehicles providing more luxury life are coming daily into market. Everyone prefers to travel by these luxury vehicles for more comfort instead of public transportation. The increasing demand of private vehicles leads to problem of more traffic on roads. Traffic congestion many times costs of someone life. Many solutions are provided by governments but these solutions are not sufficient. There should be some solution to provide ways to emergency vehicles. IRIS (Intelligent Roadway Information System) is an open source Advanced Traffic Management System (ATMS) software project developed by the Minnesota Department of Transportation[1]. It is used by transportation agencies to monitor and manage interstate and highway traffic. IRIS uses the GPL license. The researchers at the AHMCT Research Center at UC Davis used innovative, newly available, free, open-source ATMS software called IRIS as the basis for creating an enhanced transportation management system. IRIS was made freely available in 2007 [2]. Caltrans is the first transportation agency to embrace IRIS and make use of its innovative, collaborative, shared development model known as open-source. Working with Caltrans and Mn/DOT, the researchers collaboratively developed enhancements, and extended IRIS to be compatible with the Caltrans District 10 infrastructure and field devices as well as adapting it to match the district's specific nuances and operational aspects. The enhanced IRIS system was integrated with existing Caltrans hardware and software systems. Enhancements were contributed back to Mn/DOT for use by other public and private agencies. The researchers modified IRIS to assume the functions of middleware and Automated Warning System for District 10. Extensive user acceptance and operational testing were performed, leading to deployment in Caltrans District 10. Pilot testing was performed in Districts 1, 2, and 5. The Caltrans urban Transportation Management Centers (TMCs) use the Advanced Traffic Management System (ATMS) software tool, which provides real-time information on highway conditions to detect traffic incidents, manage the flow of traffic, and disseminate traveler information [3]. ATMS helps Caltrans reduce commuting times, maximize roadway capacity, and generally provide safer traveling routes. It also provides operators with unified access and control to multiple types of roadway devices rather than having to operate disparate systems. ATMS is composed of several proprietary software solutions that are expensive to acquire. The recurring maintenance costs have also been increasing. Caltrans rural districts often cannot afford the initial setup cost, let alone the recurring costs associated with development and operation. In addition, rural districts do not have the same mobility needs as large metropolitan regions and therefore do not require many of the advanced features and capabilities that ATMS provides. As a result, Caltrans rural districts have addressed traffic management by developing disparate solutions with non-uniform management, administration, and operating protocols [4].

II. LITERATURE REVIEW

In [1] The Iris/ARTES 10 programme of the European Space Agency (ESA) aims to develop a satellite system for air traffic services (ATS) and aeronautical operational control (AOC) complementing the existing and future aeronautical communications infrastructure. This paper presented the approach to and the results of the Iris communication capacity assessment conducted in the first phase of the programme [5]. The approach discussed within this paper was based on a combination of the message exchanges defined in the ldquo communications operating concept and requirements for the future radio systemrdquo document (COCR) of EUROCONTROL and FAA and realistic air-traffic scenarios. The generated voice, data and air traffic was intended for two major purposes: first to identify capacity and protocol requirements for the design of the Iris communication system and secondly as input for the system performance evaluation (2008).

This research presented an overview of the design and function of the Intelligent Roadway Information System (IRIS). IRIS provides Advanced Traffic Management System (ATMS) capabilities to the California Department of Transportation's (Caltrans) rural Districts 1, 2, 5, and 10. Most ATMS programs are not suited to rural areas and IRIS presents a low-cost alternative that provides significant operational capabilities to rural districts. IRIS was developed by the Minnesota Department of Transportation and Caltrans has submitted functional enhancements to be integrated into the official code. Full deployment to each rural district has been successful with a reduction in the number of traffic management software applications and servers in those districts (2014). The "Intelligent Container" is a sensor network used for the management of logistic processes, especially for perishable goods such as fruit and vegetables. The system measured relevant parameters such as temperature and humidity. The concept of "cognitive systems" provides an adequate description of the complex supervision tasks and sensor data handling. According to research, the cognitive system can make use of several algorithms in order to estimate temperature related quality losses, detect malfunctioning sensors, and to control the sensor density and measurement intervals. Based on sensor data, knowledge about the goods, their history and the context, decentralized decision making is realized by decision support tools [6]. The amount of communication between the container and the headquarters of the logistic company was reduced, while at the same time the quality of the process control was enhanced. The system is also capable of self-evaluation using plausibility checking of the sensor data (2011). The goal of this paper was to draw a typology of best practices in TMCs with a focus on current 3 applications and tools in key TMC function areas, and practices in data collection and 4 information sharing. A web-based survey was conducted to collect information from TMCs 5 around the country. Both fact-finding and opinion-seeking questions were included in the 6 questionnaire. This study presented an overview of TMC practices, and provided an opportunity 7 for information exchange and sharing among agencies. It also revealed some agencies' experience 8 as best-practices or innovative applications that could be useful to other agencies and lead to 9 improved performances and services. The survey also provided some perspectives in terms of 10 what applications are yet to receive more attentions, and which technology or data may have the 11 potential to be incorporated in TMC operations (2015). The main contribution of this research was to introduce traffic safety equity in transportation policy making. A modeling framework was developed that considered traffic safety equity as a focal point. The Analytical Network Process overcame the drawbacks of data intensive models that were so difficult to implement reliably in developing countries and recognizes the existence of complex interdependencies among traffic safety factors. The approach was demonstrated on the case of Tehran, Iran. In this study, seventeen transportation elements were grouped into four clusters (driver characteristics, roadway characteristics, vehicle characteristics and traffic control) to evaluate six policies. Public education and information was found to be the most effective policy to increase traffic safety, considering equity. The best equity-conscious policies are independent from physical infrastructures, household income level and household location. The proposed framework is a sound approach to introduce traffic safety equity in the traffic safety policy making process of developing countries (2016). This paper introduced an innovative distributed architecture based on a wireless sensor network (WSN) with a network coordinator providing remote and ubiquitous authentication module for managing unexpected events. The architecture was completed by a dynamic module for street priority management depending on traffic rate. Many experimental trials had been carried out considering three different levels of traffic intensity to prove the effectiveness of the proposed approach. In a street with high traffic intensity (120 vehicles in queue), the average vehicles/second rate decrease from 6.135, using a fixed cycle traffic light, to 0.365 using the introduced traffic light measurement system. Moreover, to improve the system security, a fingerprints-based embedded authentication system has been implemented as a self-contained sensor to increase the security of distributed personal data storage (2013). To address the gap between police and health department data and to determine which may be more accurate, simulation study based on the modified Smeed equation has been implemented, which delineates a non-linear relation between road traffic mortality and the level of motorization in a country or region. The goal of this study was to simulate trends in road traffic mortality in China and compare performances in road traffic safety management between China and 13 other countries (2016).

III. TECHNIQUES OF TRAFFIC MANAGEMENT

Recommender In real world there are many traffic management schemes established already. These schemes are described below:

A. **Simple Traffic Management Scheme**: - This is the simplest form of traffic management, which includes human in the system. In this scheme, a traffic officer is placed on each and every cross-section of roads; the traffic police controls flow of traffic. As shown in fig. 1, a police officer stands in middle of road and monitors flow of traffic.

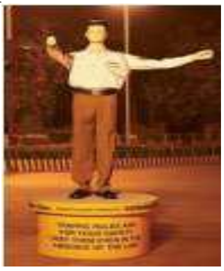

Figure 1: Traffic Police at Road Crossing

In time of congestion she/he gives signals to the vehicle driver whether to drive or stop. She/he is also able to recognize emergency case, so she/he can choose which lane needs more priority than other. This scheme is most efficient than any other technique. But as it includes human as a part of system this scheme is inadequate. Efficiency of system depends on experience and capability of the person [7].

B. Automatic Traffic Management Scheme: **-** In order to remove most weak link (i.e. human) in above system, an automatic traffic management scheme is suggested. This system includes simple three color traffic signal, which we see every day. Generally for each lane 120 seconds of green light is on. Before green light, yellow light flashes for 20 second, signifying to start your vehicle and be ready to go. For all the time red light is on, ordering each vehicle to stop. This system cannot identify emergency vehicle, it treats normal car and ambulance same way. So there are chances of delay in emergency services. Drivers disobeying signal rules are also headache, sometimes they causes serious accidents [8].

Figure 2: A Sample Traffic Signal

C. Intelligent Traffic Management Scheme based on Image Processing: **-** This scheme includes cameras, which are meant to measure length of traffic in the system. Cameras are mounted on a high pole so they can cover long distance. Video footage covered by camera is analyzed by a computer chip in order to detect object (i.e. car, truck, etc.) on road. Different object detection techniques are being used now days. Cameras are also useful in detection of violation of traffic laws [7].

D. Intelligent Traffic Management Scheme using Wireless Technologies: **-** In this scheme, emergency vehicle and traffic signal are equipped with wireless antennas and receiver. As emergency vehicle come near to an inter-section, it broadcast a signal, to notify traffic signal its presence. As soon as traffic signal receive signal from emergency vehicle it gives green light to that particular lane, in which emergency vehicle is coming [9].

E. IRIS (Intelligent Roadway Information System): **-** IRIS is an open source Advanced Traffic Management System (ATMS) software project developed by the Minnesota Department of Transportation. It is used by transportation agencies to monitor and manage interstate and highway traffic. IRIS uses the GPL license. Advanced Traffic Management System (ATMS) software tool, which provides real-time information on highway conditions to detect traffic incidents, manage the flow of traffic, and disseminate traveller information. ATMS helps to reduce commuting times, maximize roadway capacity, and generally provide safer travelling routes. It also provides operators with unified access and control to multiple types of roadway devices rather than having to operate disparate systems. ATMS is composed of several proprietary software solutions that are expensive to acquire. The recurring maintenance costs have also been increasing [10].

IV. CONCLUSIONS

In this paper, various traffic management techniques have been studied. The survey of various traffic management schemes concludes that different techniques having own advantages and disadvantages. The study shows that traffic management using IRIS system is suitable for implementation. However this method has some drawbacks that can be overcome by adding some other features.

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