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Intelligent Processing Methods Usage for Transport Systems Safety Improvement

Jacek Mazurkiewicz*

*Wroclaw University of Science and Technology, Faculty of Electronics, Department of Computer Engineering,
ul. Wybrzeze Wyspianskiego 27, 50-370 Wroclaw, Poland*

Abstract

The paper presents the usage of the intelligent processing methods in vehicles to increase an active safety without any interference with a driving process. We are taking into account three aspects. The main goal of the first one is overtaking driver's reactions. The system – based on the softcomputing methodology working “on-line” – analyses pictures in front of the vehicle and recognises road events. The second aspect – the monitoring devices are able to use automatic number plate recognition techniques to capture and store the various parameters for vehicles recognized in automatic way by the video detection techniques. Data from the monitoring devices are used to analyse the travel time of vehicles – elements of the transportation system. We build the travel time model taking into account the real road situation. The final safety aspect is based on intelligent dispatching method.

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1. Introduction

In transport systems management, modeling and simulation generates very wide spectrum of sophisticated problems. The challenge to solve them with the required level of detail is not a trivial task at all. The complex

* Corresponding author.

E-mail address: Jacek.Mazurkiewicz@pwr.edu.pl

structure of each transportation system is the main reason of the situation. The performance of the system can be impaired by various types of faults related to the transportation vehicles, communication infrastructure or even by traffic congestion or human resources – Anagnostopoulos *et al.* (2006), Birta and Arbez (2007). Each part of the system is characterized by an absolutely unique set of features. It is not easy to indicate the beginning of thinking about the safety in cars and traffic. The modern classification of safety and its understanding has appeared in the 60's of the twentieth century – Wicher (2004). The term active safety refers to the systems that help avoid accidents – in this context simple systems such as brakes or steering allow driver to drive correctly and to avoid an accident. The second widely used term is passive safety which is connected with the set of systems reducing the effects of an accident – airbag or seat belts start working in accident – Sanso and Milot (1999). Last few years showed the trend in automotive industry to develop advanced active safety systems such as the ESP (Electronic Stability Program), the LineAlert or the OpelEye is growing – Vis (2006). The future of safety systems is rather connected with developing solutions that allow avoiding accidents many ways.

Despite the fact that intelligent computing methods are used in many fields of industry and science (e.g. an aviation industry, chemistry or climatic models) their usage in the automotive industry is still marginal especially in the safety solutions. Of course it would be correct if e.g. the ESP will be called “intelligent system” but its “intelligence” basis on the effects of its work not on the way it works (ESP works using many sensors and special algorithms but it does not use e.g. neural networks or fuzzy logic). The automotive companies have a few solutions which can be described as the intelligent ones. Opel has its the OpelEye system which recognizes road signs and shows the effects of its work as the road signs icons on the screen on the dashboard. This system increases safety from definition. BMW has system using an infra-red band camera. System can recognize not illuminated pedestrian or biker and show his shape on the screen on the dashboard. Both of these systems use the intelligent computational methods. However the observations of the automotive market give the question why the number of intelligent safety systems is so small – Anh (2005), Ben-Akiva *et al.* (2003). Nevertheless automotive companies develop other intelligent systems not connected with the safety from definition. An example is given by Fiat and Microsoft. Those two companies developed “Blue & Me” system which allows driver to communicate with the car using voice. It is not obvious but e.g. answering the mobile phone using voice (“Blue & Me” uses Bluetooth to communicate with the mobile phone) can be considered as increasing safety – Sanso and Milot (1999), Gartner *et al.* (1998).

The paper presents the usage of the intelligent processing methods in vehicles to increase an active safety without any interference with a driving process. We are taking into account three aspects. The main goal of the first one is overtaking driver's reactions (section 2). The driver analyses pictures in front of the vehicle and tries to decide which kind of reaction is suitable for a specific road event. The situation when driver's reaction is too slow happens very often (Barcelo *et al.*, 2005). The system must be faster than human being in analyzing pictures in front of the vehicle and recognizing road events. This system should inform driver about each kind of recognized event. The information about recognition should be transmitted as a voice or as a picture message. The type of message is connected with the specific conditions. The system is going to be an autonomic solution without any connection to any kind of database or other remote resource and should be able to learn in its whole life cycle. Each “turning on” should start learning procedure from patterns collected previously.

The second aspect – the monitoring devices (section 3) are able to use automatic number plate recognition (ANPR) techniques to capture and store the various parameters for vehicles recognized in automatic way by the video detection techniques. The registration numbers, the make and model (MMR) of vehicles are recognized and stored in the database. The collected parameters are the basis for analyzing real travel time problems related to the trucks operating with the commodities among the nodes of the discussed transport system (section 4). We try to observe the changes during the consecutive days of a week, as well as for much longer time-horizons, taking into account the traffic jam problems and other extraordinary situations like crashes, or extremely bad weather conditions, which can have significant influence on the typical time travel. The next step is to generalize the results of travel time analysis into the travel time model (section 5). Such a model, based on the real data taken from the road monitoring system, can be a very important part in a larger simulator for discrete transport systems, as its behavior very closely resembles the real system.

The final safety aspect is based on intelligent dispatching method (section 6). We fight for better – more sensible – vehicle usage, faster and more accurate reactions in case of extraordinary situations on the road as well as the best return to stable state after the general crash of the transportation system.

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