Chapter XII
An Ontology Supporting an On-Board Vehicle Multimodal Interaction System

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ABSTRACT
This chapter introduces a modular ontology supporting an on-board vehicle multimodal interaction system. Such a system is aimed at making road transport more efficient and effective, safer, and more environmentally friendly. The role of the ontology is that of enabling semantic interoperability in order to allow cooperation between the road infrastructure and assisting the driver to perform certain traffic related actions also increasing the infrastructure efficiency. In particular, the project is engaged in the development of applications such as intelligent speed adaptation, including static (new roads, speed limits changed by authorities), temporary (road works, schools), and dynamic (traffic responsive, road and/or weather conditions) speed limits and cooperative early information that is shared in (almost) real time among vehicles and infrastructures in critical conditions. The chapter sketches out the main issues related to ontologies and emphasize the relevance of top-level (i.e., domain independent or foundational) ontologies in order to integrate different domain models. We define five domain ontologies for
the purpose of the system: Vehicle Security, Road and Traffic Security, Meteorological, Users’ Profiles, and Travel. The last one reports concepts concerning a given travel (departure, destination, vehicle, road) and imports concepts from the other ones. We emphasize the role of ontologies in enabling semantic interoperability in such an intensive knowledge-processing contexts.

INTRODUCTION

According to the study made up by the European Commission about the future common transport policy, more than 40 thousand people die on Europe roads each year and, even if the number of fatalities is decreasing, the number of accidents with injuries (about 1,7 million) is still increasing. The costs of these accidents and fatalities in European Union are estimated to be 160 billion € per year, i.e. about the 2% of the Community’s Gross National Product.

Another key factor for EU Transport is also mobility. Mobility sector corresponds to more than 10% of gross domestic product (GDP) and employs more than 10 million people. The automobiles are the biggest contributor to mobility (80% of travel calculated in passenger/km is currently by car). Since the demand for transport services continuously, increase, related problems, such as road traffic congestion, will significantly increase by 2010. The effects of road traffic congestion are analysed in the above cited paper and their costs are calculated around the 0.5% of Community GDP; however, these costs are calculated to increase by 142% to reach 80 billion € a year, approximately 1% of Community GDP.

During the last decade, the European Commission together with automotive industries was involved in improving road safety both focusing on drivers (accident prevention and injuries reduction) and on vehicles (passive safety improving and support to active safety systems research). The above cited paper defines some recommendations with the goal to decrease by 50% the road fatalities by 2010 reducing both the number of death and injuries and the number of accidents.

The main strong contribution to this objective, along with infrastructure improvements and enforcement of current safety measures, is doubtless the use of new technologies. The idea is to exploit the benefits of information and communications technologies for safer and more efficient road transports and mobility through Intelligent Co-operative Systems.

Intelligent Co-operative Systems that are based on vehicle-to-vehicle and vehicle-to-infrastructure communications hold the promise of great improvements both in the efficiency of the transport systems and in the safety of road users. They increase the “time horizon”, the quality and the reliability of information available to the driver and they offer increased information about the vehicles, their location and road conditions to road operators and infrastructure owners.

Intelligent Co-operative Systems will build and expand on the functionality of the autonomous and stand-alone in-vehicle and infrastructured-based systems, such as Intelligent Vehicle Safety Systems (eSafety systems), including Advanced Driver Assistance Systems (ADAS), traffic control and management systems and motorway management systems (Blythe and Curtis, 2004). The benefits of the Intelligent Co-operative Systems stem from the increased information that is available of the vehicle and its environment. The same set of information can be used for extending the functionality of the in-vehicle safety systems and through vehicle-to-infrastructure communications for more efficient traffic control and management. It is therefore very important to establish a common language, in terms of ontology and vocabulary, to ensure the exchange of information between the world of on-board systems
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