Driver Information System: A Combination of Augmented Reality, Deep Learning and Vehicular Ad-hoc Networks

Lotfi Abdi, Aref Meddeb

National Engineering School of Tunis, University of Tunis El Manar, Tunisia
Networked Objects Control, Communication Systems (NOCCS) Laboratory

Objectives

The main goal of our research is to design novel cooperative driver information system by combining new paradigms of dedicated wireless communications, Augmented Reality, and deep learning-based machine vision for identifying and recognizing road obstacles types, as well as interpreting and predicting complex traffic situations:

- A new Augmented Reality Head-up Display (AR-HUD) approach to create real-time interactive traffic animations was introduced in terms of types of traffic signs, rules for placement and visibility, and projection of these on an in-vehicle display.
- A unified framework for joint object detection and semantic segmentation, which combines concepts from deep Convolutional Neural Networks (CNN) for object detection on one hand, and fully-connected CRF graphical model for segmenting and labeling, on the other hand.
- A framework for inter-vehicle video communications over VANET to enhances the driver's visibility and supports the driver's overtaking decision in the challenging situation of overtaking a vision obstructing vehicle.

Introduction

In recent years, the use of the automobile as the primary mode of transportation has increased significantly and driving has become an important activity of daily life. Today, due to the rapidly-growing number of vehicles, road accidents constitute the eighth leading cause of death. With the technological advances in the areas of mobile computing, wireless communications, and remote sensing, Intelligent Transport Systems (ITS) have recently emerged as a promising technology that will enable the deployment of diverse safety, traffic efficiency, and infotainment applications.

Driving is a complex, continuous, and multitask process that involves driver's cognition, perception, and motor movements. Research in perceptual and human factors assessment is needed for relevant and correct display of this information for maximal road traffic safety as well as optimal driver comfort. Drivers must keep their eyes on the road, but can always use some assistance in maintaining their awareness and directing their attention to potential emerging hazards. In order to improve driving safety and minimize driving workload, our research focused on combining a vision-based system and a wireless based system to provide accurate real-time information about neighboring vehicles.

Methods

In order to propose a visualization metaphor adapted to the driving situation, it is necessary to know what is the current situation and what the driver looks at. We proposed a cooperative information system by combining the new paradigm of dedicated Augmented Reality Head-up Display technologies and deep learning based machine vision for identifying and recognizing road obstacles types, as well as interpreting and predicting complex traffic situations.

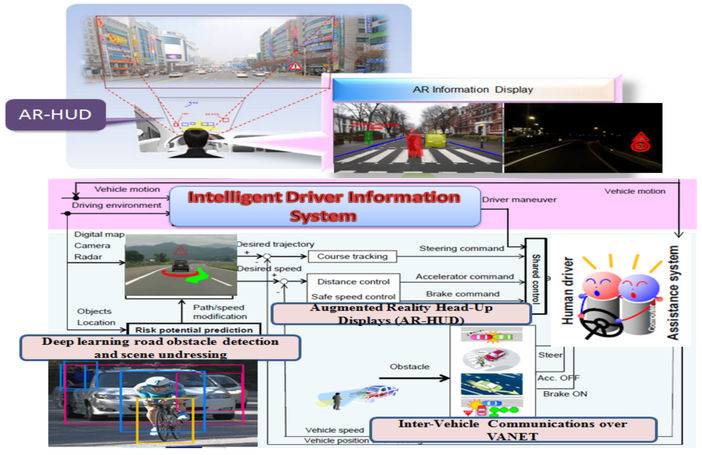


Figure 1: Cooperative Driving Information System

Important Result

By combining several technologies that are available for next-generation vehicles, we show that it is possible to design novel cooperative driving systems and enhance ITS by superimposing surrounding traffic information on the users view and keep drivers focus on the road.

Results

Our implementation is based on the open source Caffe deep learning, OpenGL and OpenCV Library.

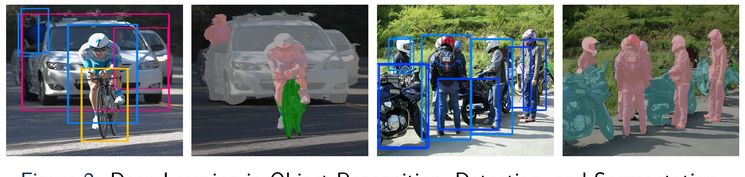


Figure 2: Deep Learning in Object Recognition, Detection, and Segmentation



Figure 3: In-Vehicle Augmented Reality Traffic Sign Recognition Systems



Figure 4: Wayfinding and Navigation Aids

Safety of the driver is greatly improved with the navigation and directions projected onto the screen. This will increase safety on the roads and build trust in existing vehicle systems and new driving features such as automated driving.

Conclusion

The implementation of communication and information technologies to improve transport systems will profoundly impact the transport sector's ability to actively and positively contribute to achieving sustainable mobility. We have shown throughout our work that indeed it can improve intuitive cognition of a driver and reduce the distraction of a driver through experimentation. This system envisions the usage of vehicular communications coupled with computer vision and AR-HUD to provide information about neighboring vehicles, which is useful to avoid road accidents in low-visibility situations. With the promise of increased safety and an enhanced driving experience, these technologies will have to overcome serious technical and regulatory challenges, needing continuous evolution over the next decade.

Contact Information

- Email: lotfiabdi@hotmail.com
- Phone: + (216) 22528241