جامعة عبد المالك السعدي
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Université Abdelmalek Essaadi

Pole for Doctoral Studies
Center for Doctoral Studies
Sciences and Technology and Medical Sciences

ANNOUNCEMENT OF DOCTORAL THESIS DEFENSE

Mr. Omar BOUAZIZI

Will present his research work with the aim of earning a Doctorate

Doctoral program: Engineering Sciences and Techniques
Discipline: Electrical Engineering
Specialty: Electronics, Computer Science and Artificial Intelligence
On 25/07/2025 at 10H00 at the Othman El Filali Meknassi Conference Room at ENSA Tangier.
Under the theme

Study and Optimization of Object Detection and Classification Algorithms for Road Scene Analysis using a Monocular Camera: Application to Traffic Sign Detection.

Front of the jury composed of:

First Name & Last Name	Establishment	Designation
Pr. Yassin LAAZIZ	ENSA Tangier, Abdelmalek Essaadi University	President
Pr. Hajji BEKKAY	ENSA Oujda, Mohammed Premier University	Reviewer
Pr. Abdeljabar CHERKAOUI	ENSA Tangier, Abdelmalek Essaadi University	Reviewer
Pr. Aziz EL JANATI EL IDRISSI	ENSA Tangier, Abdelmalek Essaadi University	Reviewer
Pr. Zine El Abidine ALAOUI ISMAILI	ENSIAS Rabat, Mohammed V University	Examiner
Pr. Abdelhak EZZINE	ENSA Tangier, Abdelmalek Essaadi University	Examiner
Pr. Aimad EL MOURABIT	ENSA Tangier, Abdelmalek Essaadi University	Supervisor

Research Laboratory: IDS Research Team, ENSA of Tangier, Morocco

Abstract

This thesis is part of the Active Driver Assistance in Urban Environments (AA-CMU) project, funded by CNRST, which aims to create a low-cost driver assistance system for urban areas. The system uses only one camera instead of multiple sensors, making it cheaper and easier to install widely. This single-camera approach helps reduce accidents and improve road safety in cities. The AA-CMU system is specifically designed for Moroccan roads and driving conditions. Unlike other commercial systems that use general models, this system accounts for local factors like road layouts, traffic patterns, and Moroccan road signs. This local customization makes the system more effective for drivers in Morocco's urban environments.

The research is structured around three main axes. The first axis involves an in-depth exploration of the most effective methods for classifying, detecting, and tracking objects within the road environment. This includes the design and optimization of advanced algorithms that enable accurate object identification and tracking in real-time. We employed various techniques for analyzing video streams, focusing on enhancing the robustness of our system against fluctuating lighting conditions and complex urban environments. Experimental results indicate that deep convolutional neural networks (Deep CNN) significantly outperform traditional methods, demonstrating superior accuracy and reliability in object detection tasks. The second axis of research is dedicated to the development of a comprehensive system for detecting and classifying road signage using a database specifically created for urban scenes in Morocco. This work involved the establishment of a dedicated and well-annotated database that captures the diverse array of signage encountered in Moroccan cities. Additionally, we implemented advanced text recognition techniques to read the text on detected signs, which further enhances the system's accuracy and effectiveness in real-world scenarios.

The third axis addresses the critical challenge of distance estimation using a monocular camera. Accurately estimating distance is essential for implementing Advanced Driver Assistance Systems (ADAS) with a single camera setup, as traditional systems often rely on multiple sensors for this purpose. In this thesis, we developed a novel method for estimating distance based on sequences of images captured by the monocular camera. This method effectively overcomes the limitations associated with conventional camera systems, enabling more reliable distance measurements.

Finally, the thesis culminates in the hardware implementation of the developed algorithms on a low-cost platform that meets the necessary computational and real-time requirements for effective system operation. We investigated various platforms based on GPUs and FPGAs, ultimately selecting NVIDIA platforms for their optimal balance of performance and cost-effectiveness. The experimental results obtained from our implementation demonstrate the feasibility and effectiveness of the proposed system, highlighting its potential to significantly improve driver assistance capabilities in urban environments and contribute to safer driving experiences.

Through this research, we aim to provide a comprehensive solution that not only addresses the technical challenges of driver assistance systems but also aligns with the specific needs of urban drivers in Morocco. The findings of this thesis contribute valuable insights to the field of intelligent transportation systems and pave the way for future advancements in driver assistance technology.
Keywords: ADAS, Road Safety, Embedded AI, Road Object Detection, Deep CNN.