جامعة عبد المالك السعدي
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Pole for Doctoral Studies
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ANNOUNCEMENT OF DOCTORAL THESIS DEFENSE

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Will present here 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

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Under the Theme

Development of Deep CNN Networks for Embedded Lane and Pedestrian Detection Functions in an Active Driver Assistance System for Urban Environments

Front of the jury composed of :

First Name & Last Name	Establishment	Designation
Pr. SARSRI Driss	ENSA of Tangier, UAE	President
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Abstract

This thesis is part of the Active Driver Assistance in Urban Environments (AA-CMU) project, which is funded by the CNRST. The main objective of this project is to create an affordable embedded system that assists drivers in urban and peri-urban areas, thereby greatly improving road safety and lowering the risk of accidents. A significant innovation of this system is its exclusive use of a monocular camera, which simplifies hardware requirements and enables large-scale implementation. This strategy not only enhances accessibility but also meets the pressing demand for effective driver assistance solutions in densely populated urban environments.

Focusing on the monocular camera, this work centers on the development of two fundamental functions for the AA-CMU system: lane detection and pedestrian detection.

Monocular Lane Detection: The first function, lane detection, is crucial for maintaining safe driving behavior. This topic has been extensively addressed in the literature, particularly through conventional image and video processing algorithms. Recently, the development of deep convolutional networks (CNNs) has opened new possibilities for using monocular cameras in lane detection. This process primarily relies on semantic segmentation networks, although achieving precise semantic segmentation poses significant challenges, especially in road scenes where pixel information can blend into a noisy background. Several networks reported in the literature, such as U-Net and ENet, have shown effectiveness in this domain, balancing accuracy and speed. Our approach is based on an ensemble model that combines an SCNN (Spatial Convolutional Neural Network) and a transformer. We demonstrate that by leveraging the strengths of both networks, we can enhance detection accuracy while maintaining an acceptable model size and speed for real-time embedded applications.

Monocular Pedestrian Detection: The second axis of research focuses on pedestrian detection. Pedestrians are among the most vulnerable road users, making their accurate detection vital for any driver assistance system. Many architectures presented in the literature do not support real-time operation on standard platforms and are not compatible with the development of a low-cost platform like AA-CMU. To address this, we developed DSR-YOLO, a pedestrian detection network that tackles critical challenges such as scale variations and complex backgrounds. Built on the lightweight YOLOv8n architecture, it incorporates DCNv4 modules to enhance detection rates and reduce missed detections by effectively learning key pedestrian features. A new head component enables detection across various scales, while RFB (Receptive Field Block) modules improve accuracy for smaller or occluded objects. Additionally, we enhance the initial C2f layers with a modified block that integrates SimAM and DCNv4, reducing background noise and sharpening focus on relevant features. A second version of the C2f block, using SimAM and standard convolutions. The WIoUv3 loss function was employed to minimize regression loss associated with bounding boxes, further boosting performance.

By incorporating these two essential functions, the AA-CMU system seeks to establish a thorough driver assistance solution that improves safety on urban roads. The results and methodologies presented in this thesis will advance intelligent transportation systems, showcasing the viability of affordable and effective solutions for enhancing road safety in urban settings.

Keywords: ADAS, Road Safety, Embedded AI, Pedestrian Detection, Lane Detection