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Editorial

The Development and Prospects of Autonomous Driving Technology

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Autonomous driving is a topic of great interest for developers, researchers, and even automotive integrators and manufacturers. Recently, it has drastically evolved, not only due to technological advancement, but also due to the development of increasingly powerful and refined algorithms. However, autonomous driving is still a major challenge to become a daily reality. The great variety of situations, the complexity of adapting to each traffic regulation, and even the definition of driver behavior strategies suggest that we should continue looking for solutions to improve the safety and efficiency of road transport.

The challenges faced by autonomous ground navigation are very diverse. SAE classification regarding the degree of automation is widely known, where a higher degree increases the number of scenarios that the vehicle must solve. Regardless of the degree of automation, the developments applied for autonomous driving can be grouped into three broad categories: perception, decision making, and control. All of these are supported by the data provided by the vehicle's sensors and communications, which also allow cooperative driving.

In this sense, the perception of the vehicle refers to everything that involves defining a vehicle's environment model and its positioning. Likewise, decision making encompasses all those developments in behavior planning, movement prediction, or even dependence on the infrastructure to define a driving strategy.

Finally, the rapid evolution of these systems has led to field operational tests being performed and also special applications being implemented. In both cases, the problems encountered and the lessons learned can provide useful information for future developments.

This Special Issue aims to cover the most recent advances in autonomous driving and other related technologies that enable their deployment.

This Special Issue includes five papers. Considering that it is urgently needed to ensure the safe operation of autonomous vehicles, researcher must pay attention to the main challenges, such as detailed and complete perception, as well as comprehensive and reliable decision making algorithms. The first three papers are related to the first block and the other two are related to the second.

The effective detection of objects on the road under varying scenarios can considerably enhance the safety of autonomous driving. A novel computational intelligence technique with a wild horse optimization-based object recognition and classification model for autonomous driving systems is presented in Ref. [1]. The proposed technique intends to effectively identify the presence of multiple static and dynamic objects, such as vehicles, pedestrians, signboards, etc.

Modern artificial intelligence methods can produce a large quantity of accurate and richly described data, but it is necessary to organize data on a large scale in a semantic structure based on long-term data maintenance and consumption. However, there is not a universally defined strategy for building these kinds of ontologies for the automotive sector. To solve this problem, automotive global ontology, otherwise known as a knowledge organization system using a graph database, is proposed in Ref. [2].

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Citation: Clavijo, M.; Jiménez, F.; Naranjo, J.E. The Development and Prospects of Autonomous Driving Technology. *Appl. Sci.* **2023**, *13*, 5377. https://doi.org/10.3390/app13095377

Received: 22 April 2023
Accepted: 24 April 2023
Published: 25 April 2023

Furthermore, when dealing with AI, auto-labeling is one of the main challenges in many research fields, including 3D vehicle detection. Auto-labeled datasets can be used to identify objects in LiDAR data, which is a challenging task due to the large size of the dataset. In Ref. [3], a novel methodology is shown to generate new 3D-based auto-labeling datasets with a different point of view setup than the one used in the most recognized datasets, more specifically from a fixed position on the infrastructure.

In the area of decision making, two relevant problems in safe–critical scenarios are studied: take-over maneuvers and uncontrolled intersections.

Firstly, Ref. [4] presents a cross-cultural study of take-over performance in highly automated driving. As take-over performance is an important measure of safe driving, potential cultural differences could have important implications for the future development of automated vehicles. Reported differences in take-over performance between locations may indicate cultural differences in driving behavior and trust in automated driving.

Finally, Ref. [5] presents an uncontrolled intersection-passing algorithm with an integrated approach of a stochastic model with predictive control and prediction uncertainty estimation for autonomous vehicles. The proposed algorithm is designed to utilize information from sensors mounted on the autonomous vehicle and high-definition intersection maps. The proposed algorithm is composed of two modules, namely target state prediction and a motion planner.

Author Contributions: Conceptualization, M.C., F.J. and J.E.N.; writing—original draft preparation, F.J.; writing—review and editing, F.J. All authors have read and agreed to the published version of the manuscript.

Acknowledgments: We would like to all authors for their valuable collaboration and contributions to this Special Issue. All papers presented to the Special Issue passed a rigorous refereeing process as full manuscripts. The accepted papers underwent final revision and approval for publication in a second/third round of reviewing. Gratitude is owed to the international team of reviewers for their diligence in assessing the papers and their thoughtful and constructive criticism with a great effort and dedication of their time.

Conflicts of Interest: The authors declare no conflict of interest.

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