

ADVANCEMENTS IN ROBOTICS AND COMPUTER VISION: A COMPREHENSIVE REVIEW OF ALGORITHMS, PERCEPTION SYSTEMS AND APPLICATIONS

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ABSTRACT

The rapid progress in various fields like robotics and computer vision was made achievable through the support of better algorithms, sensing systems and computer resources. This paper provides a complete and very thorough description of the present day robotic systems highlighting the areas of vision based perception and human like autonomous decision making. It points out the differences between the traditional and learning based methods for object detection, scene understanding, localization, mapping and robotic manipulation. The work discusses perception systems that use together cameras, depth sensors, LiDAR and multimodal sensor fusion to improve the awareness of interaction with the environment. The most important application areas such as autonomous vehicles, industrial robotics, healthcare, agriculture and service robotics are analyzed to show the practical benefits as well as the difficulties related to the occurrence of deployment. Besides the article evaluates the issues concerning real time processing, reliability and adaptability in changing environments. In conclusion it directs the attention to the future research areas that need the development of effective perception learning, enhanced manipulation capacity and improved human robot collaboration.

Keywords: *Deep Learning, Computer Vision, Robotics, Industrial Automation, Convolutional Neural Networks (CNNs), Self-Supervised Learning, Autonomous Vehicles, Reinforcement Learning.*

1. INTRODUCTION

The coming together of computer vision and robotics has brought about a very big change that has provided the intelligent systems with different perception and interaction abilities with the surrounding complexities. The robots use the computer vision to study and understand the visual data for doing the tasks such as finding their way, recognizing and manipulating objects etc. It was not revolution as very few categories were to witness the deep learning. It was particularly in the case of CNN architectures that the development of robust feature extraction and semantic level understanding took place [1]. Getting imaging and sensing technologies such as LiDAR and stereo imaging developed at the same time led to doing more types of robotic applications like self-driving cars, factory automation and medical robotics [2].