Robust Underwater Object Detection with Autonomous Underwater Vehicle: A Comprehensive Study

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ABSTRACT

Underwater Object Detection had been one of the most challenging research fields of Computer Vision and Image Processing. Before Computer Vision techniques were used for underwater imaging, all the tasks associated with object detection had to be done manually by marine scientists making the task one of the most tedious and error prone. For this case, Underwater Autonomous Vehicles (UAV) has been developed to capture real time videos for specific object detection. Using different hardware improvements and using many varied forms of algorithms, classification of objects, mainly living objects had been carried with different AUVs and high-resolution cameras. Conventional object detection methods of Computer Vision fail to provide accurate detection results due to some challenges faced underwater. For such reasons, object detection underwater needs to be robust, real time and fast also being accurate, for which deep learning approaches are introduced. In this paper, all the works here all the trending underwater object detection techniques are discussed in details and a comprehensive comparative study is carried out.

CCS CONCEPTS

• Computing methodologies → Computer vision tasks• Computing methodologies → Image processing • Computing methodologies → Vision for robotics

KEYWORDS

Underwater Object Detection, Deep Learning, ImageEnhancement, Image Processing and Underwater Autonomous Vehicle.

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1 Introduction

Underwater imaging poses as one of the most challenging domains of research due to some well-known challenges and constraints of the underwater environment. Images taken underwater have poor illumination, color degradation, dominance of blue light, haziness and unwanted obstacles making imaging and analyzing of the images difficult. Earlier researches pointed out that, mainly two forms of detection types are present for detection of underwater objects. Firstly, the detection of underwater objects that are moving on its own in real time and the second is detection of moving objects from frames extracted from videos. Both these types are of importance due to lack of good quality real time data that are required for processing. This paper will discuss some important approaches based on deep learning and conventional methods that will be used to carry out detection of underwater objects. Through this review, a comparison between conventional methods and deep learning methods is discussed that will provide a good stepping stone for further researches. For real time object detection, specific object tracking algorithm needs to be incorporated and several segmentation methods are required to find the Object of Interest (OOI) where detection and movement of AUV can be carried out at the same time. In several experiments by D. Lee et al. [7] and Aneta Nikolovska [3] and Guo-Jia Hou et al. [12] man-made objects are used to test real time object detection where images are taken as the input for classification. Here the processing time is fast, but still this method is not ideal for very dynamic environment and has low accuracy even though both works in real time, fast and robust. For real-time object detection techniques, underwater image segmentation and detection is very challenging, so several algorithms such as discriminative regional feature integration by Yafei Zhu et al. [5], background modelling using multi-feature integration framework by Srikanth Vasamsetti et al. [4] and blob analysis by Hailing Zhou et al. [11], color restoration algorithm by D. Lee et al. [7] to counterfeit color degradation, Constant false Alarm Rate and MBES by Aneta Nikolovska et al. [3] to detect OOI in dynamic underwater environment are used in previous researches. For removing haziness in real time underwater images,