Chapter 3

Advances in Marine Animal Detection Techniques:
A Comprehensive Review and Analysis

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ABSTRACT

Technological advancement has now allowed researchers to overcome barriers that exist in the research of marine animals. While traditional methods provided limited insights and relied heavily on sound signals, the advent of sophisticated image and video- capturing devices has made it possible to collect data on marine animals in their natural habitat. This has allowed research into the detection and classification of marine animals underwater to rapidly rise in the last few decades. Computer vision and deep learning have given unprecedented results in this field in recent years yielding efficient results with low computational power. This chapter discusses the trends in the evolution of techniques used in underwater marine animal detection. This chapter also serves as a valuable resource in the field of marine research for researchers and practitioners alike to better understand the capabilities and limitations of specific areas. It will help in the further enhancement of techniques in the area of marine animal detection.

1. INTRODUCTION

Almost 75% of the world is comprised of water which is a major natural resource. The water and ocean ecology plays a vital role in sustaining humans on Earth. The ocean itself is a subject of study to a multitude of disciples. Marine animals play a vital role in the global ecosystem, and the existence of diverse marine life around the globe makes the task of research and automation in this area an arduous one. Several factors pose a challenge in the detection and monitoring of marine animals such as the vastness of the ocean, the underwater environment, the variables of weather and the cryptic nature of marine species. Human activities and the exploitation of water bodies in recent years have affected marine ecology.

With pollution affecting the water bodies over different parts of the world, several marine species remain unaccounted for on the status of their existence. As an important element of world ecology and as a source of food, health, and life for marine animals, a need to protect these natural resources has given rise to several systems and technologies. This need has attracted numerous research from multiple disciples to focus on marine life and its ecology. With the development of machine learning and the introduction of several deep learning algorithms, several technological advances are continuously being made in this area of uncertainty and the unknown, which not only aims at the protection of marine life but also looks into the study of marine data to avoid disasters by detecting anomalies in water bodies by setting up monitoring systems with deep learning capabilities.

This chapter provides a comprehensive overview of the research on marine animal detection, comparing recent techniques used in the detection and monitoring of marine life. It chronologically arranges the various techniques used over time to provide a picture of the progression in this field. While there have been developments with acoustic and eDNA survey methods, this chapter focuses on computer vision and deep learning methods used to detect underwater marine life. It also compares the datasets used for the research.

The chapter begins by discussing the challenges of marine animal detection, which include the vastness of the ocean, the challenging underwater environment, and the cryptic nature of several marine species. It then provides an overview of the different types of marine animal detection methods. The chapter then focuses on computer vision and deep learning methods for marine animal detection. It discusses the advantages of these methods, such as their ability to automatically detect and classify marine animals in underwater images and videos. It also discusses the challenges of using these methods, such as the need for large and well-labeled datasets. The chapter then compares the datasets that are used for marine animal detection research. It discusses the different types of datasets available, such as

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