



# Design of Underwater Drone for Marine Surveillance

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**Abstract:** The application of underwater drones for marine surveillance has gained significant attention in recent years. These remotely operated vehicles offer a unique and cost-effective approach to monitoring and exploring the underwater environment. This literature review provides an overview of the key developments, challenges, and emerging trends in the field of underwater drones for marine surveillance. Underwater drones, encompassing remotely operated vehicles (ROVs) have witnessed significant development, evolving from simple prototypes to advanced and complicated, purpose-built vehicles. The advancements in technology have expanded their applications across diverse domains, including environmental monitoring, maritime security, scientific research, and offshore industries. Critical components of underwater drones, such as propulsion systems, sensors, communication systems, and navigation controls, have undergone substantial innovation, enabling enhanced capabilities for marine surveillance. These technological developments have been instrumental in addressing complex challenges in the underwater realm, but certain limitations, notably power constraints, communication range, and environmental impact, persist.

**Index Terms - Underwater, Marine Surveillance, Remote Operated Vehicle, Environment monitoring.**

## I. INTRODUCTION

Underwater drones, characterized by their submersible capabilities and advanced technology, represent a paradigm shift in our approach to marine environments. These remotely operated machines have the potential to revolutionize how we monitor and understand the oceans, while also addressing a myriad of challenges, from environmental conservation to maritime security. This literature review embarks on a comprehensive journey through the historical development, current applications, technological components, challenges, emerging trends, ethical considerations, and regulatory frameworks of underwater drones in the context of marine surveillance

## II. LITERATURE REVIEW

Author name Shishir Mukherjee, Maneesh C. Srivastava, Student, Department of Mechanical Engineering, Amity University year of Publish 2020, the title of this paper is Design of Underwater Vehicle [1]. This paper solved the issue regarding the design of the underwater vehicle and also explained the analysis of the vehicle. It highlights the significance of underwater vehicles in marine applications, emphasizing their roles in marine surveillance, environmental monitoring, scientific research, and offshore industries. The paper delves into the design aspects, including materials, propulsion systems, and structural components, that enable underwater vehicles to withstand the harsh underwater conditions.

Author name Ying He, Dao Bo Wang, and Zain Anwar Ali, year of publish 2020, the title of the paper is different designs and control models of remotely operated underwater vehicles. It discusses how these design choices are tailored to specific missions and the environments in which ROVs operate. Also to the design aspects of ROVs, including size, structure, buoyancy control, propulsion systems. Moreover, the paper explores the evolution of control models, including manual, semi-autonomous, and fully autonomous control, and their implications for ROV operation and versatility.

Author name Nikhil S. Mandole, Amit S. Nagare s, Dept. of Robotics, Sanjivani K. B. P., Ahmednagar, Maharashtra, India, 2022, the title of the paper is Remote Control of Underwater Drone by Fiber-Coupled. This paper delves into the innovative use of fiber optics for remote control and communication with underwater drones. It addresses the challenges associated with traditional communication methods in underwater environments, such as limited range and susceptibility to electromagnetic interference. The paper introduces the concept of using fiber optics to establish high-speed, reliable, and low-latency communication between operators and underwater drones, thus enhancing their maneuverability and data transmission capabilities.

Author name Yinghao Wu, Xuxiang Ta, Ruichao Xiao, Yaoguang Wei, Dong An, Daolang Li, year of publish 2019, the title of the paper Survey of underwater robot positioning navigation. The paper presents key findings related to underwater robot positioning and navigation. It discusses a wide range of techniques and technologies, including acoustic positioning, inertial navigation systems, Doppler velocity loggers, and underwater imaging for feature-based navigation. The paper highlights the potential applications of GPS-based underwater robot navigation, such as oceanographic research, marine biology studies, underwater archaeology, and search and rescue missions. It underscores how precise navigation is critical for these tasks, and how GPS technology plays a crucial role in achieving accurate positioning.

### III. BODY

The exploration of the underwater world has been significantly transformed with the advent of remotely operated vehicles (ROVs), which have become essential tools for marine research, exploration, and industry. In this section we will discuss the design evolution, diverse applications, technologic components, challenges, and emerging trends in underwater ROVs.

#### A. Design

ROVs have evolved significantly in their design to meet the diverse requirements of underwater missions. Design considerations encompass the selection of materials for underwater durability, the structure to withstand water pressure, and propulsion systems for precise flexibility and mobility. These design choices are instrumental in ensuring the adaptability of ROVs in harsh underwater conditions. ROV designs range from compact vehicles to large, heavily equipped machines, with each design tailored to specific missions and environments.

#### B. Applications

The applications of ROVs are as diverse as the underwater environments they explore. They have become indispensable tools for marine research, enabling scientists to study deep-sea ecosystems, marine biodiversity, and geological features. ROVs are instrumental in underwater archaeology, contributing to the discovery and preservation of submerged cultural heritage. Furthermore, they play a pivotal role in the offshore industry, assisting in underwater inspections, maintenance, and construction tasks.

#### C. Technologies

The core technologies that empower ROVs are at the heart of their success. Propulsion systems, often thrusters, are essential for precise navigation. Sensors, including sonar, cameras, and environmental monitoring equipment, provide real-time data for operators. Communication systems establish the vital link between ROVs and their operators, enabling remote control and data transmission. Navigation and control systems ensure stability and maneuverability in the underwater environment. These technologies work in harmony to deliver accurate data and facilitate mission success..

#### D. Challenges in underwater ROV operations

Despite their advancements, ROVs face distinct challenges. Chief among these is the limited range and endurance, typically determined by power constraints. Furthermore, the communication range in underwater environments can be restricted, necessitating innovative solutions. The immense water pressure in deep-sea operations poses structural and material challenges. Additionally, environmental sustainability and operational impact remain considerations for responsible ROV deployment.

#### E. Emerging Trends and Innovatives

As technology continues to advance, ROVs are evolving to meet new challenges. Artificial intelligence and machine learning are being integrated for autonomous navigation and enhanced data collection. Miniaturization and compact ROV designs are enabling access to confined spaces. Renewable energy sources are improving energy efficiency. Bio-inspired designs are enhancing maneuverability and control.

### IV. CONCLUSION

In conclusion, underwater ROVs have redefined our ability to explore, study, and work in underwater environments. Their historical evolution, diverse applications, technological components, and emerging trends reflect the ongoing commitment to unlocking the mysteries of the deep sea. While challenges persist, ROVs continue to push the boundaries of human knowledge, enabling us to better understand and preserve the fragile ecosystems and submerged heritage that lie beneath the ocean's surface.

### REFERENCES

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