

Modern Fishing Vessels and Smart Marine Technologies

S. Archana¹ and V. Durai¹

¹Assistant Professor, Department of Fishing Technology and Fisheries Engineering

Dr. MGR. Fisheries College and Research Institute, Thalainayeru

Tamil Nadu Dr.J.Jayalalithaa Fisheries University, Nagapattinam

Corresponding author: fishco.archana@gmail.com

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Abstract

The fishing industry is increasingly adopting advanced technologies to improve efficiency, sustainability, and resource management. Smart fishing technology integrates digital tools such as the Internet of Things (IoT), artificial intelligence (AI), satellite remote sensing, sensors, and electronic monitoring systems into traditional fishing practices. These technologies enable real-time monitoring of oceanographic conditions, fish distribution, and fishing operations, allowing fishermen to make informed decisions while reducing fuel consumption and operational costs. Modern fishing vessels equipped with GPS, sonar, echo-sounders, and satellite-based systems help locate productive fishing grounds and improve catch efficiency. In addition, IoT-based monitoring systems and data analytics support better fisheries management by providing accurate information on fish stocks, environmental conditions, and fishing activities. The adoption of smart technologies also contributes to reducing bycatch, preventing overfishing, and promoting responsible utilization of marine resources. Although challenges such as high initial investment and technological awareness remain, the continued development of smart marine technologies offers promising opportunities for enhancing sustainable fisheries and ensuring long-term productivity of the fishing sector.

Introduction

The fishing industry has undergone remarkable technological transformation over the past few decades. Traditional fishing methods that relied mainly on experience, seasonal knowledge and manual observation are now being supplemented by advanced digital technologies. These innovations help fishermen locate fish more efficiently, reduce operational costs, and promote sustainable use of marine resources. Smart fishing technology integrates tools such as the Internet of Things (IoT), satellite monitoring, artificial intelligence (AI), sensors and data analytics to improve fishing operations while protecting marine ecosystems. By enabling real-time monitoring of fish stocks, oceanographic conditions and fishing activities, these technologies support informed decision-making and responsible fisheries management.

Evolution of Smart Fishing Technologies

The global fishing sector faces several challenges including overfishing, habitat degradation, bycatch and illegal fishing activities. To address these issues, modern fisheries increasingly rely on digital technologies that provide real-time information on ocean conditions, fish distribution, and gear performance. Smart fishing refers to the integration of advanced technologies such as GPS navigation systems, sonar equipment, satellite imagery and IoT devices into fishing operations. These tools allow fishermen to monitor fish movement, predict productive fishing grounds, and optimize fishing techniques. As a result, fishing becomes more efficient, sustainable and economically viable.

Smart Fishing Vessels

Modern fishing vessels are now equipped with advanced electronic systems that assist fishermen in navigation, fish detection, and operational monitoring. Even small fishing boats today commonly use Global Positioning System (GPS), radar, Automatic Identification System (AIS) and echo sounders to improve safety and efficiency at sea. Larger commercial fishing vessels employ sophisticated technologies such as electronic monitoring systems, onboard cameras, and high-resolution oceanographic maps that display sea surface temperature, currents, and plankton distribution. These systems help fishing crews understand ocean conditions before and during fishing operations, allowing them to focus on target species while minimizing unnecessary effort and fuel consumption.



Figure 1. Modern fishing vessel equipped with advanced navigation and fish detection technologies such as GPS, radar, sonar, and electronic chart systems.

Internet of Things (IoT) in Fisheries

The Internet of Things (IoT) is emerging as one of the most important technologies in

modern fisheries. IoT systems consist of interconnected sensors, communication networks, and cloud platforms that collect and transmit data in real time. In aquaculture and fisheries operations, sensors are used to monitor parameters such as water temperature, turbidity, pH levels, and dissolved oxygen. These sensors transmit information to mobile applications or cloud-based platforms where it can be analyzed and monitored remotely. Such systems help fishermen and fish farmers maintain optimal environmental conditions, automate feeding processes, and improve fish productivity while reducing labor requirements.

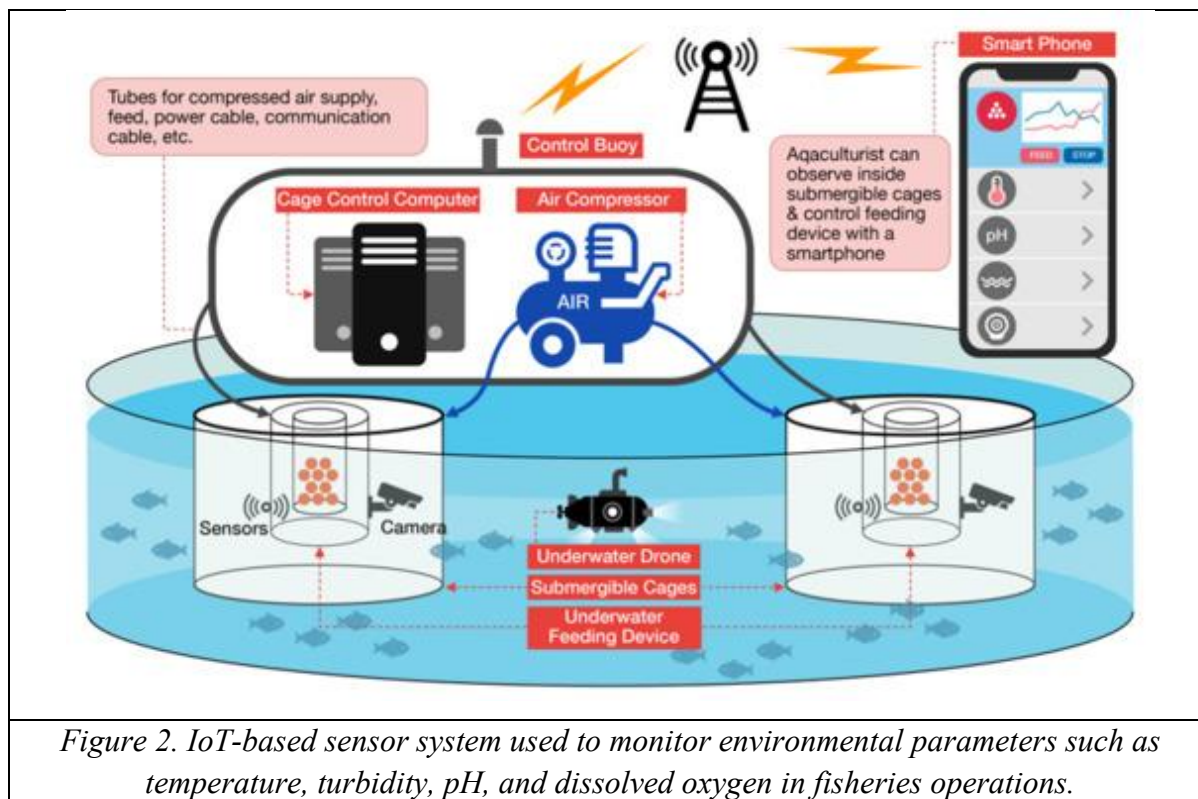


Figure 2. IoT-based sensor system used to monitor environmental parameters such as temperature, turbidity, pH, and dissolved oxygen in fisheries operations.

Artificial Intelligence and Data Analytics

Artificial intelligence and machine learning are increasingly used to analyze large volumes of fisheries data. AI-based systems can process information collected from satellites, sensors, and fishing gear to predict fish movement patterns and identify potential fishing grounds. These technologies enable precision fishing by guiding vessels directly to areas where fish abundance is higher. Additionally, AI-driven monitoring systems can identify species composition and detect bycatch, helping fishermen avoid catching non-target species and improving compliance with fisheries regulations. Such data-driven approaches enhance both economic efficiency and sustainability in the fishing industry.

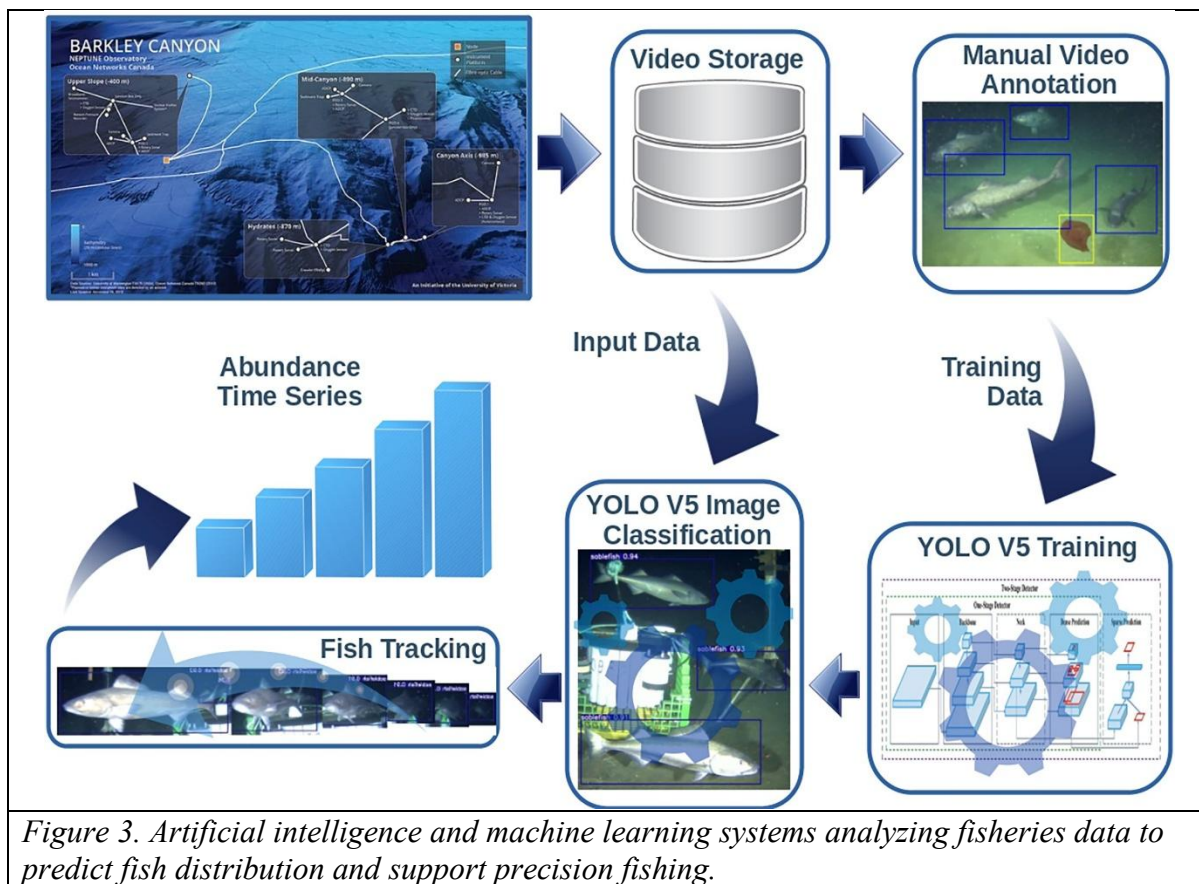


Figure 3. Artificial intelligence and machine learning systems analyzing fisheries data to predict fish distribution and support precision fishing.

Satellite and Remote Sensing Technologies

Satellite remote sensing has revolutionized the way fishermen identify productive fishing areas. Satellite imagery provides valuable information on sea surface temperature, ocean currents, chlorophyll concentration, and plankton distribution. These environmental indicators help fishermen understand where fish are most likely to aggregate.

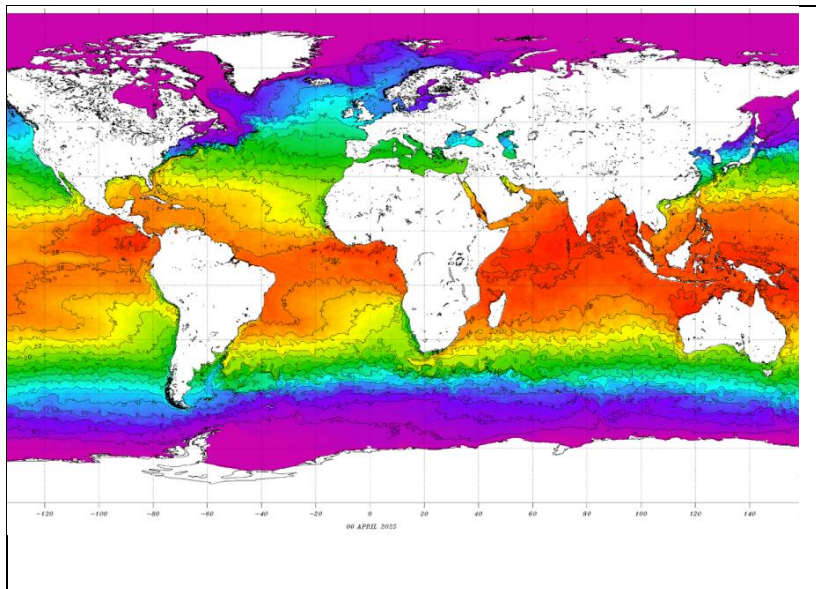


Figure 4. Satellite-derived oceanographic data such as sea surface temperature and chlorophyll concentration used for identifying potential fishing grounds.

By interpreting satellite data and oceanographic maps, fishermen can significantly reduce the time spent searching for fish. This not only increases catch efficiency but also lowers fuel consumption and operational costs. Furthermore, satellite-linked devices attached to fish

aggregating devices (FADs) allow fishermen to track fish schools and estimate fish biomass remotely.

Electronic Monitoring and Fisheries Management

Smart monitoring technologies play an important role in fisheries governance and sustainability. Electronic monitoring systems installed on fishing vessels collect data on catch composition, fishing effort, and vessel movements. This information supports scientific research and stock assessment by providing accurate data on fish populations and fishing activities. Improved data collection also helps regulatory authorities ensure compliance with fishing regulations and prevent illegal fishing practices. Additionally, electronic monitoring promotes transparency in the seafood supply chain and strengthens sustainable fisheries management.

Benefits of Smart Fishing Technologies

The adoption of smart fishing technologies offers several advantages for fishermen, fisheries managers, and marine ecosystems.

Key benefits include:

1. Improved fishing efficiency and reduced search time
2. Lower fuel consumption and operational costs
3. Better monitoring of fish stocks and ocean conditions
4. Reduction in bycatch and protection of endangered species
5. Enhanced compliance with fisheries regulations
6. Improved data collection for fisheries management

These benefits demonstrate how technology can transform the fishing sector into a more sustainable and efficient industry.

Challenges and Future Prospects

Despite the advantages of smart technologies, several challenges remain in their implementation. High equipment costs, limited technological knowledge among fishermen, and lack of infrastructure in small-scale fisheries can restrict adoption. Furthermore, managing and interpreting large volumes of data requires specialized skills and technical expertise. However, with continuous technological advancements and increased government support, smart fishing technologies are expected to become more accessible and affordable in the future. The integration of AI, big data analytics, robotics, and advanced sensor networks will likely play a crucial role in shaping the next generation of sustainable fisheries.

Conclusion

Smart fishing technologies represent a significant step toward achieving sustainable fisheries and responsible marine resource management. By combining digital technologies such as IoT, satellite monitoring, artificial intelligence, and electronic monitoring systems, the fishing industry can improve efficiency while minimizing environmental impacts. Modern fishing vessels equipped with advanced technologies allow fishermen to make informed decisions, reduce operational costs, and ensure compliance with fisheries regulations. As technological innovation continues to advance, smart fishing practices will play a vital role in securing the future of global fisheries and ensuring the sustainable utilization of marine resources.