

Role of Artificial Intelligence and Smart Fisheries: How AI and Sensors are Transforming Fish Farming

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Fish farming is changing rapidly with the use of Artificial Intelligence (AI) and smart sensor technologies. These tools help farmers monitor water quality, fish health, and feeding in real time. Smart fisheries make fish farming more efficient, reduce losses, and increase production. This article explains how AI and sensors are used in aquaculture, their benefits, and their future role in sustainable fish farming.

Keywords: Artificial Intelligence (AI), Internet of Things (IoT), Smart Aquaculture, Water Quality Monitoring, Disease Detection.

Introduction

Aquaculture is an important source of food and income for many people. But traditional fish farming methods often face problems like poor water quality, disease outbreaks, and high feed costs. Farmers also depend on manual work and experience, which may not always give accurate results. To solve these problems, modern technology is being introduced in fish farming. Artificial Intelligence (AI) and smart sensors are helping farmers manage their ponds better. These technologies provide real-time information and support better decision-making. As a result, fish farming is becoming more productive and reliable.

Smart Fisheries and Its Concept

Smart fisheries mean using advanced technologies like AI, sensors, and data analysis in fish farming. In this system, sensors are placed in ponds or tanks to collect important data such as temperature, oxygen level, and pH. This data is sent to mobile phones or computers. AI systems analyze this data and give suggestions or take automatic actions. This method is also called precision fish farming because it depends on accurate data instead of guesswork.



Figure 1. Concept of Smart Fish Farming System-Integrated smart aquaculture system showing how sensors, AI, and automation work together to support fish farming decisions.

Role of Sensors in Fish Farming

Sensors play a very important role in smart fisheries. They continuously check water quality parameters like temperature, dissolved oxygen, pH, ammonia, and salinity. These factors directly affect fish growth and survival. When any parameter goes beyond the safe limit, the system immediately alerts the farmer. This helps in taking quick action before the situation becomes serious.

Use of Artificial Intelligence in Aquaculture

Artificial Intelligence helps in analyzing large amounts of data collected from sensors. It can predict fish growth, detect



Figure 3. AI and computer vision (underwater camera) used to monitor fish behavior and detect stress or disease conditions

diseases early, and suggest proper feeding times. AI systems can also study fish behavior

using cameras and identify any unusual activity. or example, if

fish are not eating properly or showing signs of stress, the system alerts the farmer. This early warning helps in preventing major losses.



Figure 2. Water Quality Monitoring Using Sensors- Real-time monitoring of water quality parameters using IoT-based sensors in fish ponds.

Smart Feeding and Automation

Feeding is one of the most important and costly parts of fish farming. Smart feeding systems use AI to provide feed based on fish appetite. These systems use sensors and cameras to understand when fish are hungry and how much feed is needed. Automation is also used to control aerators, pumps, and water exchange systems. These systems work automatically based on sensor data, which reduces labor and ensures proper

farm management.



Figure 4. AI-driven automatic feeding system that optimizes feed usage and reduces wastage.

AI in Disease Detection and Prevention

Disease outbreaks remain one of the greatest threats to aquaculture productivity. AI integrates machine vision, environmental data, and neural network models to predict and prevent diseases.

- **Sea Lice Control:** Cloud-based AI systems analyze cage conditions to predict parasite growth and reduce mortality.
- **Fungal Disease Detection:** Artificial neural networks help identify diseases such as Epizootic Ulcerative Syndrome (EUS) at early stages.
- **Preventive Management:** Farmers can now take preventive measures rather than reacting after heavy losses occur.

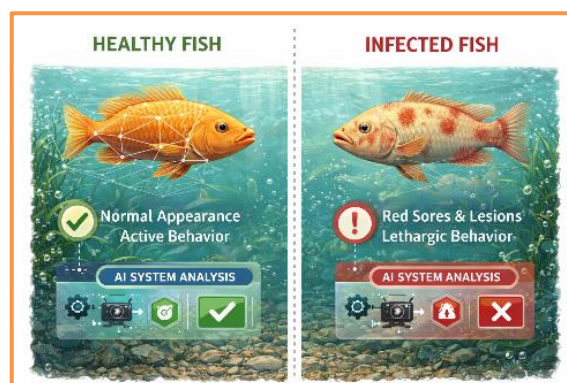


Figure 5: Comparison image showing healthy fish vs. infected fish identified through AI system.

Applications of Smart Technologies

AI and sensors are used in many areas of fish farming. They help in maintaining water quality by adjusting aeration and water flow. They also help in detecting diseases at an early stage by analyzing fish behavior and images. These technologies can estimate fish size and growth rate, which helps farmers decide the right time for harvesting. They also improve the use of resources like feed, water, and energy.

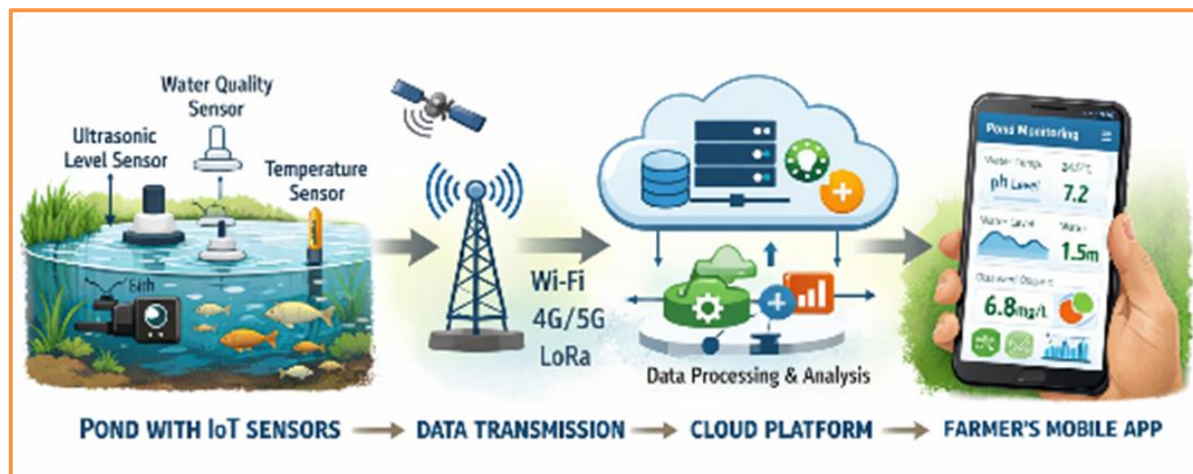


Figure 6. Applications of AI in Fish Farming. Flowchart showing applications: water quality → disease detection → feeding → growth monitoring → harvesting.

Benefits of Smart Fisheries

Smart fisheries provide many advantages to farmers. They increase fish production by maintaining ideal conditions. They reduce feed costs by avoiding wastage and improve fish health through early disease detection. They also reduce labor work and save time. These systems help protect the environment by reducing pollution and improving resource use.

Challenges in Adoption

Even though smart fisheries have many benefits, there are some challenges. The initial cost of installing sensors and AI systems is high. Farmers may also need training to use these technologies effectively. In some rural areas, internet connectivity and technical support may be limited. However, these challenges are gradually decreasing with technological progress.

Future Scope of Smart Fisheries

The future of fish farming looks promising with the growth of smart technologies. New developments like drones, robotic systems, and advanced data analysis tools are being introduced. These innovations will make fish farming more precise and efficient. Smart fisheries will play an important role in meeting the increasing demand for fish while protecting natural resources.

Conclusion

Artificial Intelligence and smart sensors are bringing a big change in fish farming. They help farmers monitor their farms, reduce risks, and increase profits. Smart fisheries make aquaculture more scientific and reliable. In the coming years, these technologies will become more common, helping farmers improve productivity and sustainability.

References

1. Boyd, C. E. (2020). *Water quality: An introduction*. Springer.
2. FAO. (2022). *The State of World Fisheries and Aquaculture 2022*. Food and Agriculture Organization of the United Nations.
3. Zhang, D., Chen, Y., & Wang, X. (2019). Application of artificial intelligence in aquaculture: A review. *Aquaculture International*, 27(5), 1465–1483.
4. Rath, A., & Kumar, P. (2021). Smart aquaculture system using IoT and machine learning. *Journal of Aquaculture Engineering and Fisheries Research*, 7(3), 145–156.

5. Badiola, M., Mendiola, D., & Bostock, J. (2012). Recirculating aquaculture systems (RAS) analysis. *Aquacultural Engineering*, 51, 26–35.
6. Rahman, A., et al. (2021). Machine learning for fish disease detection using image processing. *Computers and Electronics in Agriculture*, 187, 106268.
7. FAO. (2020). *Blue growth initiative: Sustainable fisheries and aquaculture*.