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Application of Artificial Intelligence in Fisheries and Aquaculture

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Abstract

Artificial Intelligence (AI) by definition means ‘the future made from the pieces of past’. These are programs that learn new solutions through experience. AI has been implemented in a variety of fields starting from agriculture to complete automation in industries. Through AI, fisheries sector can develop rapidly and production can be quadrupled within a short period as it makes aquaculture a less labour intensive field. It can take form of any labourers at work for example feeders, water quality control, harvesting, processing etc. AI can even be used in conserving endangered species of aquatic life forms. AI helps in tracking global fishing activity and helps maintain sustainability in open sea fishery. AI helps greatly in preventing IUU fishing. In aquaculture, wastage of inputs can be managed through AI and cost can be reduced up to 30%. Thus, AI provides complete control over the fish producing systems with less maintenance and reduced input cost.

Introduction

Think of a world having robots that could independently think and work according to our needs. This is possible through Artificial Intelligence (AI) and Internet of things (IOT). It is a simulation of the thinking capability relative to humans that is programmed into a computerized device. Today, nearly 50 billion electronic devices work through IOT and a large portion of them are AI devices. Application of artificially intelligent devices has even extended towards agriculture and fisheries sector. Each and every part of the animal confinement can be monitored and required actions will be made independent of human supervision. A superior advantage of AI is that, it can learn through experience. This will help in the tremendous growth of fisheries sector as the situation of culture system changes frequently according to the surrounding. AI in fisheries not only helps in farm management, but even in open sea fishing by tracking the global fishing activity through the combination of satellite data. Fish consumption worldwide has increased four folds in the past decade. Aquaculture has become a field with increasing demand and reduced productivity. AI based technology can be a key to achieve higher production with less manpower.

AI in Aquaculture

Aquaculture is a rapidly growing sector where much technological development is still needed to improve the farming practices. Thus, it is crucial to develop the conventional farming method to increase production. AI devices are available through which we can obtain a better stable environment for the stock. Maintenance of water quality parameters will be much easier as the devices will do the job of both the supervisor and the labour in an efficient

way. Other parameters like feeding, disease diagnosis, farmer assistance etc can even be maintained through AI devices.

AI Feeding Devices

In an aquaculture system, feed costs nearly 60% of the total cost invested. Too less or too high feeding can cause several issues in the containment. Feeding less on one hand can decrease muscle conversion and at extreme cases (in shrimps) it can lead to cannibalism and mutual attack. Excess feeding on the other hand, will result in feed wastage and depletes the water quality. Measurement of appetite can help in feeding the right amount of feed at the right time. AI plays a great role in reading the fishes through vibration based sensor and acoustic signals. This will help in differentiating a hungry fish from that of a full. An Indonesian aquaculture intelligence company known as 'eFishery' has recently developed an AI feed dispenser which releases the right amount of feed at the right time. It uses various sensors to detect the appetite of the animal. The device can reduce cost of feed by about 21%. 'Observe technologies' is a company that produces AI and data processing system that measures and tracks the feeding pattern of stocks. It provides objective and empirical guidance on quantity of feed that is in need to be fed by the farmers. In Singapore and Japan, an aquaculture technology company known as 'umitron cell' produces a smart fish feeder that can be controlled by a remote. It is a data driven – decision making device that assists farmers in optimising feeding schedules. These AI feeding devices helps greatly in reducing feeding cost and maintains water quality (Figure 1).



Figure 1: eFishery AI fish feeder

AI Drones in Aquaculture

Drones equipped with sensors can collect and analyze water quality data such as turbidity, temperature, dissolved oxygen, etc. and even heart rates of fishes. These data can be easily accessed through a Smartphone connected to the drone. With a step forward, scientists developed 'shoal' - a robotic fish that helps to detect pollution

around the farm site. These robots independently swim and collect data about water quality. They can even communicate with each other using low frequency sound waves (Figure 2).



Figure 2: 'shoal' robotic fish

Prevention of Diseases

The greatest threat to aquaculture is the outbreak of diseases. AI programs can detect disease outbreaks before they happen by comparing programmed data with the collected data from the site. They are even capable of applying preventive measures. Norway's seafood innovation cluster in April 2017 launched 'Aquacloud', which is a cloud – based program that helped farmers in preventing development of sea lice in cages. This reduced fish mortality and minimised dependency on more expensive treatments.

Fish Seed Screening

Identification and selection of healthy fish seed is very important in fish farming. Often it become laborious and need to employ many workers for screening of healthy fish seed. The Kindai University's Aquaculture Research Institute, Japan is using Microsoft Azure machine learning studio to identify and remove odd – shaped fish seed from the rearing cage (Figure 3).



Figure 3: Manual Fish Seed Screening

Routine Check-up of Stocks

Vision based sensors on AI devices makes it possible to analyze the swimming pattern, size, injuries etc on the cultured animal. These data are preserved in order for comparison in future. 'Xpertsea' is an aquaculture innovation company that offers an AI device called 'Xpercount' which applies machine learning and camera to weigh, count, image and size shrimp in seconds. These collected data are analysed for detecting the periodic health of stock (Figure 4).



Figure 4: 'Xpercount' AI device

AI in Shrimp Farming

Eruvaka, an Indian company provide AI-based solution to the shrimp farmers in the aspect of real-time monitoring of water quality and voice call alert, Appetite based intelligent feeder and automatic control of aerators. Now about 1,000 hectares of shrimp farms spread across Surat, Goa, Andhra Pradesh and Pondicherry, Eruvaka's products have been installed and farmers are availing AI-based solutions for shrimp culture.

AI Smartphone Applications

AI Smartphone applications can help greatly in assisting farmers for testing water quality and predicting diseases. 'Aquaconnect', an Indian aquaculture technology start-up created a mobile application called 'FarmMOJO' which helps shrimp farmers to analyze water quality and predict diseases. Through these applications, farmers can prevent diseases even before the outbreak starts. Periodically, pictures of shrimp diseases, parasite etc are uploaded into the app by the farmers and the developers. Using these pictures, the program can learn about the diseases and preserves it for future use.

AI in Fish Processing

Processed seafood always has a higher demand. Fish and shrimp processing facilities has developed to a level where automated robots do the work more accurately with less time thus, increasing the production by several

folds. Cutting, filleting or cleaning the products can be done through programmed AI robots with much accuracy towards size, shape and hygiene. Quality control and grading can be done through AI programs equipped with visual image sensors and cameras. After grading, the processed foods can even be packed and transported through AI robots. This makes zero labour cost and needs no human supervision. 'Marel' is an Iceland company which produces machinery required for fish processing. They have produced AI based robots that could do all the works that are needed to be done in a production facility, starting from cleaning, filleting and till packing (Figure 5).



Figure 5: An AI fish filleting unit

Block Chain Technology in Shrimp Supply Chain

Walmart Inc announced a pilot blockchain technology for end-to-end traceability of shrimp exported from Andhra Pradesh to United States. It was aimed at strengthening the shrimp supply chain and enhancing food traceability and transparency for consumers in the United States.

AI in Open Sea Fisheries

The majority of fish that we consume comes from open sea fishing. Due to increasing population and demand, overfishing and poaching have increased within a short time. Illegal, unregulated, unreported (IUU) fishing have increased to a great extent. Traditionally to stop this, some organisations have hired observers at high cost in order to monitor fishing activities on ships. But in locations like arctic, the climate and area made it difficult for observers to track IUU vessels. AI plays a great role in these areas. Through satellite and AI programs, fishing vessel can be monitored by image recognition and automatic review of video footages. This will help to reduce IUU fishing and restore wild population.

An independent organisation called 'Global fishing watch platform' collaborated with Google, Oceana and Sky truth (a digital mapping non-profit organisation) to combine AI and satellite data for understanding the fishing activity all over the world. This collaboration made it possible to track IUU vessels, poaching, overfishing and at – sea transshipments

(moving goods from one ship to the other) in a more precise way. Through AI monitoring, it is possible to collect data on size of fishing vessel and types of gears used for fishing.

AI in Conservation of Endangered Fishes

Due to human activities, the population of aquatic animals is reducing rapidly. Many conservation efforts are made and yet open sea makes it difficult for humans to monitor them. Through vision sensors and cameras, AI drones can track endangered fishes and analyze their habitat much faster than humans. Larger fishes like sharks, Humpback whales can be tracked by setting up transmitters on their fins. This helps in studying the behaviour of the organism much easier and conserves the Better (Figure 6).



Figure 6: Tagging a shark with transmitter

Advantages of AI in Fisheries

It helps to manage aquaculture in a much efficient way and maintains high accuracy in prediction of disasters (disease outbreak or depletion of water quality). AI can be utilized

in all the aspects of fisheries science, starting from hatcheries and ending at packaging in the processing units. This improves production and reduces wastage of inputs. The AI system can provide wide range of solutions through experience.

Disadvantages of AI in Fisheries

Even though AI is more advantageous, it has some disadvantages too. Investments on AI are much higher and many can't afford it. Maintenance of AI system has high cost too. And another great disadvantage of AI is that, it creates unemployment for the labourers. This could end up as an advantage for the farmer but the people who depend on fisheries employment will suffer.

Conclusion

Even though AI is developed, complete automation is not available yet. Scientists are working on technology that can work without human interference in the process. AI aquaculture farms can be maintained and managed in a much easier way with nearly 95% accuracy in operations. Production of aquaculture goods can increase rapidly if AI is used in a proper way. Thus, unlike any other sector, application of AI seems to be unavoidable in the further development and intensification of fisheries and aquaculture.

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