



Smart Aquaponic System: Usage of Artificial Intelligence in Aquaculture

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Abstract

Aquaponics is a merging of agriculture and aquaculture culture systems that may provide a solution to overcome land and water limitations and food security. In this system Various sensors, devices, microprocessor were employed to monitor and control water quality, light intensity and fish feed. To ensure healthy growing environment for fish and plant, early warnings in form of email, text messages and notifications that are automatically sent to the user when the sensor detects any abnormal condition present in the system and rectifies it automatically making use of the artificial intelligence.

Keywords: Aquaponics, artificial intelligence, smart aquaponics system.

Introduction

Aquaponics is the hybrid of aquaculture and Hydroponics where the nutrients from the culturing are utilized by the plants and then the water is pumped back into the system followed by mechanical, chemical and biological filtration. Aquaponics is defined as the process of growing aquatic organisms and plants symbiotically (Yep and Zheng, 2019). As the need for the food is increasing day by day in order to meet the alarming rates of hunger the food sector is also increasing at a rapid pace. Aquaculture is playing a key role in meeting the demands of the on growing malnutrition. AI is a versatile tool that can be incorporated into anything which requires human supervision. The idea behind smart aquaponics system is the integration of science and technology to intervene the rearing process to enhance the production of both fishes and plants.

What is smart aquaponics system?

“It is an aquaculture-based environment monitoring system that is having a network of wireless sensors that records the environmental stimulus and responds accordingly”. This system



allows a user with a mobile device to monitor the fish farm environmental data with instant mastery and control over the various environmental data such as, temperature, dissolved oxygen, pH and water level.

The smart aquaponics system consisting integrating of seven modules:

1. **Data acquisition unit:** The data acquisition unit continuously collects data using five sensors. i.e., temperature, pH, water level, ultrasonic ranger and light sensors. Each sensor will be having a specific function and is designed to receive only particular impulse from the culture environment.
2. **Alarm unit:** Alarm unit is used to give audible and visible messages automatically once the system is under stress. Green light is displayed by the system when it is in healthy condition and red light is emitted with an alarming buzz to indicate the stress condition and denotes unhealthy condition.
3. **System rectification unit:** This system rectifies the stress that has been produced in the system and automatically corrects the abnormality by activating the respective devices. Decision to activate or deactivate the devices is determined by the central processing unit based on the collected data and user preset values. This unit is integrated with DO inflators (aerators), Heating rod, water pump and LED light for plants and Fish feeder.
4. **Central processing unit:** It receives the input signals from the sensors that are installed and process the data and gives command to the rectification unit. This is having the connection with the terminal devices and relays the actions between the sensors and the devices.
5. **Web application:** It also allows the user to timely monitor the aquaponics facilities and remotely control the devices. All the information pertaining to the system can be monitored through the web portal from anywhere and anytime.
6. **Mobile application:** All the information pertaining to the system can be monitored through the android platform using mobile application, which increases the efficiency and ease of work.
7. **Cloud server:** The cloud server is used to establish communication between the central processing unit and mobile application.

How to implement the system?

All hardware components were integrated accordingly. Each component should be carefully inspected and tested before the integration. The implemented system is evaluated by simulating different possible scenarios. For example, when the water temperature falls into an unhealthy range, the system should trigger the alarm unit to alert the user with its buzzing sound and red light and

activate the system rectification unit to rectify the problem by turning on the water heater (Figure. 1).

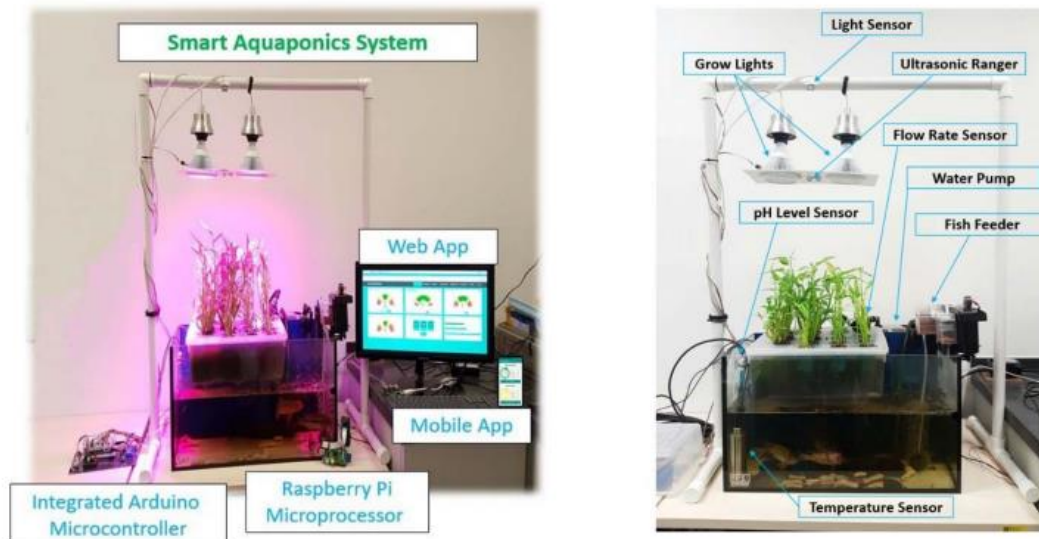


Figure 1- Smart aquaponics system (Chen *et al.*, 2015)

Advantage

- Higher productivity in limited space
- Precise monitoring
- Reduces man power
- Increases efficiency

Disadvantages:

- High capital investment
- Mode of adaptation by farmers is less
- Not versatile in nature
- Loss of integration when it is mismanaged.

Conclusion

Usage of artificial intelligence in aquaculture increase the productivity, Monitoring of stock made easy and managed precisely. The root cause of the issues can be traced easily and rectified. AI had already made significant improvements in fisheries. The scope of AI in aquaculture is also increasing day by day and it has left its trade mark significance in the area of Aquaponics.

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