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Aqua Fusion Farms: Smart Synergy of Fish and Greens

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ABSTRACT

The global aquaculture production also increased by year after year. The world is growing global population and increase about food production. The concept of aquaponics is a recycling ecological panting and breeding mode. It combined hydroponics and recirculating aquaculture to realize water resource and nutrient recycling, ow pollution and high productivity. Aquaponics system is couple aquaculture with horticulture. The aquaculture is facing a lot of issues of disease, climatic change, stocking density, water quality problem, soil degradation, and etc… The aquaponics system is fish production and plant production in closed loop system. This system is the fish waste is used to fertilize the plants and can save up 90-95% of water. Water is important for this system. . The plants receive their nutrients, and the fish receive oxygen from plants. The plants, fishes,and bacteria in this system entail a level of water, temperature, pH, and dissolved oxygen for fish growth and health. The smart aquaponics system is a technological point of view, wireless digital farming technique an automated system. The IOT technology a monitor the soil moisture, temperature, light, pH, and water quality, fish health through a web interface from ant remote location. These systems used as advanced technologies like the Internet of Things (IoT), solar energy, and Artificial Intelligence (AI) and sensors for increased proficiency, productivity and decrease the manpower.

Keywords: Aquaponics, use of AI and IoT, Hydroponics, automated technology.

Introduction:

Aquaponics is a sustainable farming system. They combine aquaculture and hydroponics. This is less water than conventional farming. . This system is producing fishes and plants. Water is a common medium for three living organisms: fish, plants, and bacteria. . Most commonly

observed and monitored parameters like water quality, nutrient level, temperature, environment conditions, fish growth and plant growth. For aquaculture purposes, some parameters commonly monitored such as pH, temperature, DO, ammonia, nitrate, nitrite, turbidity, water flow, nitrogen cycle, fish growth and feeding rate. For hydroponics, some of the parameter's control and monitor such as plant growth, plant size and bed temperature, leaf nutrient level, photosynthesis growth and fruit condition. The aquaponics system controlling the environment is manual, automated, or combination of manual and automated.

Aquaponics system:

The aquaponics system can combine the armature and hydroponics to cultivate both plants and fish. The modern system can have started in the 1970s and 80s. Common variety of fish can be cultured, like carps, catfishes and tilapia. The feed waste and fish waste can produce ammonia. The waste matter, ammonia and uneaten fish feed flow through the biofilter. The biofilter can be directly into the media used to grow the plants. The nitrifying bacteria convert ammonia into Hittite and nitrate, and forms of nitrogen stimulate the plants for growth.

Use of IoT AND AI:

The modern world is used for AI-related working and farming systems. The aquaponics is manually monitored, and maintenance is difficult. Alternative IoT and others can be used for this system. This AI and IoT is an automatic and stable operation. The automation is an optimist process such as climate control, water quality analysis, fish health monitoring, disease surveillance and remote access with reducing operational cost and easy monitoring. This system can use various electrical sensors to monitor the parameters, the most common parameters like water and temperature, humidity, pH, dissolved oxygen, light intensity, and ultrasonic level sensors to monitor water level and plant height. The sensor data was used to control the environment like climate control, aerator control, water pumps, and automatic feeding for fish. IoT sensors can promptly detect an imbalance in nutrient level or a fluctuation in water quality and alert operators to take corrective actions. The aquaponics operators can harness real-time data, automate system control, optimize component performance and data driven decisions, making them more efficient.

Remote sensors monitoring and management:

IoT sensors remote monitoring can operators with the ability to access and analyze the data from anywhere. Place. These sensors can also control the automatic feeding, and water level

control the remote locations. Automated system and control IoT sensors to adjust the water flow, aeration, nutrient doing, feeding system, filtration and its also control for AI. This is reducing the labour and high-level controlling, minimize the human error etc.

Growth monitoring for plant and fishes:

The AI ad IoT manage the nutrient for water and fishes. The correct level of nutrients in water to ensure the plant growth and fish growth. The AI IoT helps the nutrient management for recommended data on water quality parameters like pH, DO, ammonia nitrate, temperature, and nitrite. The nutrient imbalanced the AI and IoT is manage the parameters and manage the nutrients.

Water quality control and monitoring:

The aquaponics system, water is important for the growth of fish and vegetables. The water is polluted, causing disease to fish and vegetables. The water quantity change is caused by various parameters like feeding density, growth rate, food intake, fecal waste, and environmental changes. . These parameters are monitor and adjust the parameter to control the water quality and provide the healthy environment for fish and plant growth. The water quality parameters like pH, salinity, phosphate, nitrate, ammonia, and DO. The parameters affecting water quality in the hydroponic system and aquaculture system. These parameters are controlled and monitored and used for fish and plant growth. The remote is monitoring the temperature, humidity, and soil humidity in this system with smartphones and control of the IoT system. The sensor's saved data were stored a variety of connection technologies and SD cards, Google spreadsheets, and a loud platform.

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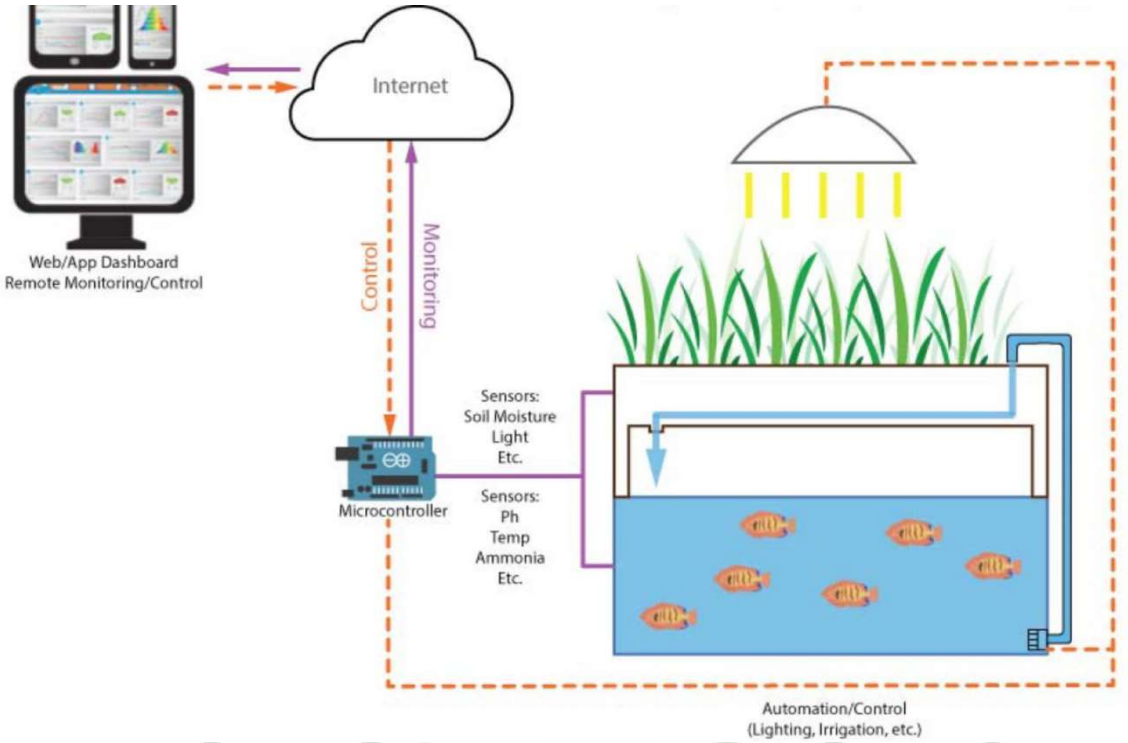

Source: (Manju et al. 2017)

Automated feeding system and monitor:

AI couple IoT sensors can monitoring the feeding time, feeding rate, fish health, and control the over feeding, excess feed waste etc. The collected data can understand fish health and detect the issues like ammonia and nitrite poison for fishes and can control the disease or abnormal condition. AI can alternate the aquaponics system for video and image from fishes and plants growth. The analysis of feeding data, growth condition, environment condition, nutrition content and machine learning AI can help the make a feed formulation or adjust the feeding time and feeding schedule based on collected data.

Hydroponics (plant growth) :

The modern AI and IoT can optimize the plant size, plant growth and nutritional rate for the system. By continuous monitoring the plant health such as leaf disease, leaf nutrient level, chlorophyll content, leaf color, root health and photosynthesis activity. The AI can monitor the all factors of plant growth and adjust the nutrient level, light density, water level, an environmental condition. IoT sensors can monitor the plant water level, moisture level land circulation pattern of water to ensure the plants growth and plant health.

IoT Sensors and communication technology:

IoT used this aquaponic system, the tree components used to monitor and control the whole system. The sensors, controllers, and network communication interface. The different sensors available, the industry can choose for this based on project. The sensors can generate the electrical singles to the controller. The controller tells what electrical signals translate. The communication interface connected to the internet to the controller. The data handling and storage can allow to remotely monitor and control the aquaponics forms.

Use of AI in aquaponics system:

The recent years, use of machine learning and AI related technology focus on aquaponics system to improve the plant growth and fish growth. The machine learning can used to analyze data from image . The sensors can be measure the temperature, DO, pH, and nutrient level and water quality. The AI can be used for classifying the plant growth stages, estimating fish size and growth, plant and fish diseases.

Disease detection and control:

Plant and fish disease is created the big problem and losses the investments for the aquaponics system. The early detection of disease is important to control the disease. The machine learning can detect by analysis the plant growth pattern, fish behaviour, leaf colour, fish growth, feeding rate and etc.

Conclusions:

The smart aquaponic system an innovative ans sustainable aquaculture approach to fish production and hydroponics with an advance technology. The AI and IoT is focused on identifying the parameters like water and temperature, humidity, pH, dissolved oxygen, light intensity, plant growth pattern, fish behavior, leaf color, fish growth, feeding rate. The solar and wind can reduce the energy costs. IoT and AI can gather the data and analyze the data and better decision making. The advanced technology such as IoT sensors, automated control system and data analysis. This system an promote the resource conservation, production increase, minimize the climate impacts.

Reference:

- Shafeena, T. "Smart aquaponics system: Challenges and opportunities." *European Journal of Advances in Engineering and Technology* 3.2 (2016): 52-55.

- Channa, Abdul Aziz, et al. "Optimisation of small-scale aquaponics systems using artificial intelligence and the IoT: current status, challenges, and opportunities." *Encyclopedia* 4.1 (2024): 313-336
- Anila, Mundackal, and Olawande Daramola. "Applications, technologies, and evaluation methods in smart aquaponics: a systematic literature review." *Artificial Intelligence Review* 58.1 (2024): 25.
- Haryanto, et al. "Smart aquaponic system based Internet of Things (IoT)." *Journal of Physics: Conference Series*. Vol. 1211. IOP Publishing, 2019.
- Taha, Mohamed Farag, et al. "Recent advances of smart systems and internet of things (iot) for aquaponics automation: A comprehensive overview." *Chemosensors* 10.8 (2022): 303.