



An Advanced Internet of Things (IOT) - based Water Quality Monitoring Architecture for Sustainable Aquaculture Leveraging Long Range Wide Area Network (LoRaWan) Communication Protocol

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Abstract

Among all the quality determining parameters of water in pisciculture fields, Dissolve Oxygen (DO) is considered as the most sensitive one. DO level mainly fluctuate due to atmospheric temperature, fish population and growth of fish, and showering. The farmers maintain DO level by traditional methods of aeration which consume huge recurring costs for fuels or electricity. Sometimes farmers run aerator engines for extra time particularly in mature cultures, hence consuming extra fuel. Real time monitoring of DO could save such extra expenditure and could be helpful for us to minimize the risk associated with DO. This development consists of three core components: a central control center, smart sensors, and an automated switch. The control center establishes a Wi-Fi connection to the cloud, enabling remote monitoring and management. Intelligent floating sensors continuously measure crucial parameters like oxygen levels, pH and temperature. The automated switch responds to the sensor data, activating an aerator when oxygen level drops, and improving fish respiration. The integration of the system with LoRaWAN technology facilitates the remote oversight of multiple fish farms from a single location, enhancing operational efficiency and scalability.

Keywords: Dissolved Oxygen (DO); Cloud based services; LoraWAN; IoT; Pisciculture; pH; Temperature

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1. Introduction

The ever changing environment is greatly influenced by its constituent elements. Soil, air and water qualities are changing, dictating their productivity, property and usefulness to the human being. Water quality, which influences aquatic lives, is dependent on dissolved oxygen (DO), nitrogen content, salinity, turbidity, electrical conductivity(EC), pH, temperature, etc.^[1-8] The Indian economy is based on agriculture which includes crops and vegetables farming, farming of fruits and spices, farming of aquaculture products like fishes, pearls, etc. Aquaculture mainly refers to cultivating aquatic organisms that generate revenue. Pisciculture is

basically farming of fishes for human consumption. Fishes are good sources of protein that are essential for human growth and development. As reported by a popular newspaper, India's fish production rises to 14.2 million metric tons and fish consumption rises to 8.9 kg per capita (The Times of India, 19th March, 2024). This is a significant fact that pisciculture has become a popular and profit making farming activity.

The fish farming community is not expert enough to understand how to provide necessary supplements to the fish and what to do in the emergency situations. This sector is also attributed with some challenges which essentially decrease the income margin as expected in reality. Regular expenses like supply of food items to the fishes, maintaining the aqua health, fighting with aqua-borne diseases and maintaining water quality, are basic expenditure heads which are inversely proportional to their income.

Water quality monitoring is crucial in pond-based fish farming to maintain a healthy aquatic environment. Key parameters like dissolved oxygen (DO) are vital for fish respiration, while pH affects metabolic and physiological processes. Alkalinity and hardness help stabilize pH and

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