



AI-Based Management System for Sustainable Tilapia Farming in Freshwater

Company Overview

Grand Innovative Ground S.P.C. is a one-person company specialized in developing applications, software, digital platforms, smart robots, database and server management, and archiving. The company employs experienced technical and administrative staff with over 15 years of diverse experience in programming, process automation, and deep learning (artificial intelligence). The company has extensive expertise in preparing government software for ministries and authorities in the Sultanate of Oman. Recently, it launched several mobile tourism applications and web applications for government services, and Dakhtari Virtual Clinic for chronic diseases, operating on automation and artificial intelligence. Currently, it is finalizing an AI-based management system for sustainable tilapia farming in freshwater.



Introduction About the Company

The project offers an integration of artificial intelligence, real-time environmental sensing, microcontroller-based automation, and smart water purification designed specifically for the sustainability of tilapia farming in freshwater farms. While aquaculture is already a widely practiced technology globally, particularly in the Middle East, North Africa, and Asia, this project stands out with specialized, thoughtfully designed, and automated features that address environmental and resource challenges in arid and hot regions .

Success of the project in Middle East and Asia countries

What truly makes this project innovative is its scalability, expandability, and energy efficiency, as it adapts to a wide range of farm sizes and types, seamlessly integrates with solar and electric power, and provides remote access via mobile and cloud dashboards. These capabilities enable the invented devices to operate effectively even in remote locations or off-grid areas, making it the ideal solution for aquaculture across diverse terrains in those regions .

Project Summary

The project provides a fully intelligent and scalable system for aquaculture management, specifically designed to optimize tilapia farming. By integrating computer vision, artificial intelligence, and Internet of Things technologies, it automates key operational processes such as feeding, growth monitoring, health assessment, and environmental management. The system also overcomes limitations of traditional fish farming practices by delivering data-driven functions that enhance efficiency, sustainability, and productivity .



Project Components

a) Environmental Sensors

The project incorporates a comprehensive set of automated sensors integrated into the feeding device. These sensors continuously measure key environmental parameters to ensure real-time monitoring of the tank environment, thereby safeguarding fish health, enhancing water quality, and mitigating risks of disease or stress within the aquaculture system .

1. Includes sensors for pH, temperature, dissolved oxygen, ammonia, and turbidity.
2. Provides continuous water quality data to the central system.
3. Integrates with alert systems and environmental actuators (e.g., ventilation equipment and pumps).



b) Central Middleware System

The primary role of the system is to collect data from automated environmental sensors in fish ponds and make computed decisions, including calculating fish biomass and detecting fish ecology to identify infectious and non-infectious diseases in the ponds . It also enables automation for discharging water and harmful waste to restore aquatic environmental balance. Furthermore, it manages decisions for water discharge and refilling—from the fertilizer pool to the impurity filtration tank, through a filtration and fertilizer isolation system, and culminating at the freshwater station .



c) Biomass Underwater Drone

After obtaining the optimal growth decision from environmental sensors and the feeding decision from the central middleware system, the camera-equipped Underwater Drone captures detailed vital data on fish length and width across all pond areas using computer vision and algorithms. It estimates the total fish biomass and sends it to the central middleware system, which uses this data for automated computation to determine the correct feeding quantity and real-time feeding schedules

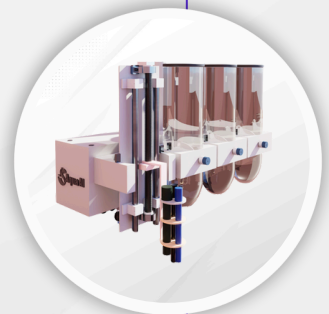


d) Automatic Feeding Device

After the central middleware system schedules the correct feeding quantity and determines the real-time timings, this information is sent to the feeding device, which consists of feed distribution dispensers as follows:

1. The first dispenser provides minced food for larvae and fingerlings.
2. The second dispenser provides protein-coated food for mature and larger fish.
3. The third dispenser is for chemical treatment for all sick fish.

Each delivers the appropriate feed quantity based on biomass data received from the central middleware system .



e) Disease Detection Underwater Drone

After receiving risk alerts from environmental sensors and the central middleware system deciding on immediate intervention with the disease Underwater Drone, the camera-equipped submarine provides comprehensive visual coverage of the fish across most pond areas. It captures high-resolution images and video footage from multiple angles, enabling in-depth analysis of fish behavior and health. It also detects actual fish movement and compares it to standard patterns trained in the AI model .

