DESIGN AND DEVELOPMENT OF AN IoT-ENABLED SMART FEED PELLETIZING MACHINE FOR AQUACULTURE

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Fish farming, Feed Pelletizing Machine, IoT Automation, Blynk IoT Platform and Small-Scale Aquaculture

Introduction:

Aquaculture is one of the fastest-growing sectors in food production, contributing significantly to global nutrition and food security. With the increasing demand for fish and fish-based products, efficient feed management has become a crucial factor in ensuring sustainable aquaculture practices. Feed accounts for a major portion of production cost, and its quality directly affects fish growth, health, and overall yield.

Traditional methods of feed preparation are often manual, labour-intensive, and inefficient. These methods lead to inconsistent pellet sizes, poor feed quality, and higher wastage. Small-scale farmers, especially in rural areas, face difficulties in accessing advanced pelletizing machines due to their high cost and complexity. Additionally, manual feeding practices can result in 30–40% feed wastage and uneven growth of fish.

With the advancement of technology, the Internet of Things (IoT) has emerged as a powerful tool in modern agriculture and aquaculture. IoT enables real-time monitoring, automation, and efficient control of systems, reducing human effort and improving productivity.

This project focuses on designing and developing an IoT-enabled smart feed pelletizing machine that integrates mechanical pellet production with automated control. The system is designed to be cost-effective, reliable, and suitable for small-scale farmers. By combining automation with mechanical efficiency, the project aims to improve feed production quality, reduce wastage, and enhance aquaculture productivity.

Objectives:

The main objective of this project is to design and develop an efficient and affordable fish feed pelletizing machine integrated with IoT technology. To develop a mechanical system capable of producing uniform feed pellets.

1. To develop the Fish feed palletizing machine

2. To integrate IoT technology for real-time monitoring and control
3. To study the performance evaluation of Fish feed palletizing machine

Methodology:

1. The methodology of this project involves both mechanical design and IoT-based automation. Initially, the requirements of small-scale aquaculture farmers were analysed to identify the challenges in feed production. Based on this, a conceptual design of the pelletizing machine was developed.
2. The mechanical system consists of a motor, shaft, pulleys, rollers, and a die plate. The motor drives the shaft through a belt and pulley arrangement, which rotates the rollers inside a drum. The feed mixture is compressed and forced through the die plate to form uniform pellets.
3. The machine frame is fabricated using mild steel to ensure strength and durability. All components are assembled carefully to maintain alignment and smooth operation. Testing and calibration are performed to ensure proper pellet formation and machine efficiency.
4. For automation, an ESP32 microcontroller is used as the central control unit. A Real-Time Clock (RTC) module enables scheduled operation of the machine, while an ultrasonic sensor monitors water levels for safety. Relay modules are used to control the motor through a DOL starter.
5. The ESP32 hooks up with the Blynk cloud using a unique authentication token when there is Wi-Fi available. The system pushes data in the form of water-level information, motor ON/OFF status, and records of run time to the Blynk dashboard. By default, any manual START or STOP commands issued through the mobile app override the RTC-based schedule. Status indicators update live following feedback from the relay-controlled DOL starter. Additionally, Blynk automatically logs events on switching along with runtime history over cloud storage, which gives way to performance tracking and diagnostic review. Even in an offline mode, the whole machine keeps working through RTC and sensor logic.

Result and Conclusion:

1. The developed smart feed pelletizing machine successfully produces uniform and high-quality pellets suitable for aquaculture. The integration of IoT technology enhances system performance by enabling automated operation and real-time monitoring.
2. The machine reduces manual effort significantly and ensures consistent feed production. The use of sensors and scheduling improves operational efficiency and minimizes wastage. The system operates reliably even in rural conditions with limited resources.
3. The project demonstrates that combining mechanical design with IoT automation can provide a cost-effective solution for small-scale farmers. It improves feed quality, reduces labour dependency, and enhances overall productivity.

In conclusion, the developed system is an efficient, practical, and scalable solution for modern aquaculture needs.

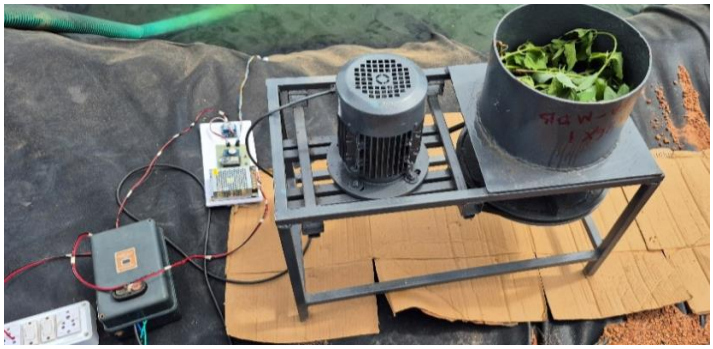

Figure 1: Machine Performance

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Future Scope:

The future scope of this project includes:

1. Use of solar power to improve sustainability in rural areas.
2. Integration of additional sensors for monitoring water quality & Movement parameters such as pH, temperature and Water flow sensor.
3. To Integrate smart aquaculture setup inspired by polyhouse concept.
4. Better and improved interface for controlling system.