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REVIEW OF AUTOMATION OF AERATOR AND FEEDER FOR INLAND AQUACULTURE

A.P. Roger Rozario.

Department of Electrical and Electrical Engineering

Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu, India

S. Sathyadevi

Department of Electrical and Electrical Engineering

Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu, India

A.V. Vishnu Priyan

Department of Electrical and Electrical Engineering

Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu, India

R. Lokesh

Department of Electrical and Electrical Engineering

Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu, India

***Abstract*: Aquaculture is the fastest growing food production sector over the last few decades. It plays a key role in providing nutritional security and livelihood to many developing countries. Amongst various aquatic species grown in aquaculture shrimps plays a major role in export revenue. Monitoring and control of dissolved oxygen and feeding shrimps at the correct time and amount yields export quality shrimps and reduces mortality of shrimps. This project aims at monitoring the dissolved oxygen and regulating the feed quantity and feeding time. A dissolved oxygen sensor interfaced to a microcontroller monitors the DO level and alerts the farmer in case of abnormalities. The process of feeding is automated using a microcontroller which controls the speed and operating time of the feeder motor and which results in less wastage and accumulation of feed in water which degrades the DO content. The acquired DO values will be stored in a local database or cloud for short term and long term prediction of DO using machine learning algorithms.**

Keywords – DO sensor, Temperature Sensor, Aerator, Feeder, Arduino UNO

I. INTRODUCTION

The success of shrimp farming is influenced by feed management and environmental management. Effective feeding is appropriate and not excessive in accordance with shrimp life is an important factor. As well as the temperature and dissolved oxygen levels, it must also be maintained within the optimal range. Due to the increase of both factors, it will affect salinity, water pH, and CO2 content dissolved in water. There are many ways to lower the water temperature and increase dissolved oxygen levels, one of them is aerator. An automatic feeder is an automated feeding system where by digital control, shrimp farmer can set time and quantity of feed. In shrimp farming, feeding system works both during day and time. This proposed system is expected to overcome the problems faced by shrimp farmers associated with the limited resources in the process of monitoring and maintenance of shrimp farming. The main parameters to be monitored are the temperature and dissolved oxygen levels due to the increase of these two factors, will affect the salinity, the pH of the water, and the dissolved CO2 content in water. So, in shrimp farming, temperature and oxygen levels dissolved in water should always be maintained within the optimal range. There are many ways to maintained the range. For example, to lower the water temperature and to increase dissolved oxygen levels, we use waterwheel. In shrimp farming, waterwheels usually work continuously for 24 hours and are fully controlled by humans. But referring to the above problem, we propose the design of a compact system consisting of an automatic feeder according to shrimp age, an automatic aerator that works when the pond conditions beyond the optimal limit, and the monitoring system of pond conditions.

II. DISCUSSION

A. Aquaculture Production In The Global Context

Global shrimp production stands at 167 million t, of which 44% (73.8 million t) is contributed by the aquaculture sector (FAO, 2016). Global capture fishery is presently at crossroads with over 70% of the resources exploited and therefore aquaculture is the only option to fill up the gap of much of the future demand for shrimp. Aquaculture is the fastest growing animal food-producing sector, growing at a rate more than 7% annually. Many studies have pointed towards a positive scenario for the role of aquaculture in providing the much-needed animal protein to the world population. With a national per capita consumption of 11 kg, fish is recognized as one of the chief components in the domestic food security in India. Freshwater aquaculture is a homestead activity in several parts of the country. Besides contributing to the nutritional security, it also helps in bringing additional income to the poor rural households. Aquaculture brings about socio-economic development in terms of income and employment through the use of unutilized and underutilized resources in many parts of the country.

B. Feed Technology And Feed Management

The research done by T.Muruganantham, Dr.M.Maheswari [1] The proposed design is developed and implemented by using PIC microcontroller 16F877A.The feeding system is consists of pellet storage, control unit with PIC microcontroller and the movement of the pellet system is made by DC motor is located under the feeder system. This work mainly focused the advanced PIC based feeder system. Now the fisher man can easily identify the issues in farming area with proper food distribution system with reduction of man power and cost. The Ph level is monitored continuously and supplying the oxygen to the fish farming area. The amount of voltage is applied on the surface of the water, the fishes are coming to the top surface of the water due to this the growth of the fish is efficiently monitored. The DC motor is controlled by PWM technique the output of the Ph will be monitor with the Ph sensor and the insufficiency of the oxygen is avoided by the oxygenator.

The research done byFarrahi Moghaddam, R., Cheriet, M.,[2]proposed an adaptive Otsu threshold method and a linear time component-labeling algorithm to measure the number of pellets in non-uniform illumination images to reduce the influence of uneven natural illumination on the detection of uneaten food pellets, and compared it with other Otsu algorithms. The performance of the adaptive Otsu algorithm outperformed other methods. Fish food pellets can be effectively segmented and counted based on images with uneven illumination with an error of less than 8%. Later, to address uneven illumination in underwater images, proposed a study focused on the intensity histogram of local masks based on the adaptive threshold detection algorithm for underwater images of fish food. The adaptive threshold was calculated by EM-guided GMM histogram fitting. The central pixel of the mask could be compared with the threshold to generate the binary detection result, presenting improved detection accuracy.

In the study done by Skoien, K. R., Alver, M. O., Alfredsen, J. A [3]The spatial and temporal distribution of food pellets in culture cages has great significance for investigating the fish feeding behavior developed a pellet detector based on computer vision technology for accurate quantitative temporal and spatial distribution of food pellets in the cage. An underwater camera in the device detects and counts the volume of food pellets that sink through a funnel. The top and sides of the camera are closed to prevent any impact by the fish. Additionally, an image processing algorithm is used to identify the size and speed of the subsidence material and filter any interfering matter. The device is capable of rapid detection and accurate quantification, with a detection error of 1.3%.

According to the research done bySummerfelt ST, Wade EM [4] The cultured fish can be allowed to determine for themselves how much feed is made available when demand feeders are used. Demand feeders can be used to make food continuously available and allows for the fish to feed to satiation. Typically, fish fed with demand feeders consume amounts of feed similar to what they would eat. The demand feeders must, however, be readily accessible to the fish, and sufficient numbers of feeders must be strategically located around larger systems. Fish are trained to hit the trigger of a demand feeder when hungry and then become self-feeding. Some demand systems use a touch-sensitive trigger to activate some kind of mechanical delivery system. Other modifications of the demand feeder use an in-water feed tray that activates feed release as feed is eaten from the tray. Usually, all of the demand feeders are adjustable for food size and amount released per trigger activation. It takes classically about 7 to 10 days for rainbow trout to train and feeding to stabilize on demand feeders.

The research done by Said Elshahat Abdallah , Wael Elmessery [5]Two ways were used to control food provisions in this study. An opened control system based on the ATM89c51 microcontroller controlled the exact dosing based on the tank 13equirements according to the carp cycle and the other closed loop control system was determined by the conditions of water temperature, fish age, body weight and the amount of oxygen consumed. The amount of oxygen consumed by carps was the best parameter knowing fish metabolism and growth that the feeder can rely on its controlling meals provisions. The results showed minimal differences in growth ($P<0.05$) between treatments, a food saving of 25.337% (i.e. 3495.5 kg), and lower water pollution (reduced water dissolved solids and ammonium components) compared with the first automatic feeder. An embedded system based on the AT 89C51 automated the feeder. The main functions of the embedded system were to provide the monthly quantity of food that each tank required, to control the weighting mechanism and opening/closing of the motor controlled gates by using a laser wireless control.

The research done by Mona MORGAN Kasem, Rashad Hegazy[6] The aim of the present study was to develop and test a simple small-scale electromechanical mobile fish feeder to control feeding inside fish ponds. Fish feeder spreader consists of a solid frame, fish feed hopper, distributing disc with spreading fins, transmission system and electrical components.The prototype can be used to distribute fish feed material either with outlet slide setting 1(open only quarter of the outlet opening) or outlet slide settings 2 (open only half of the outlet opening), and in both cases the developed prototype can achieve good distribution pattern.

In the study done by Devi Ratnasari et al. [7] The research object is the monitoring system and aquarium tools prototype using Node MCU ESP8266.A Node MCU ESP8266 as a microcontroller and can feed the fish automatically based on the feeding schedule. This aquarium also can-do water replacement automatically if the water has turned turbid due to detection by an LDR sensor.

C. Aeration Methods

In the study done by Korrakot Aumnongpho, Wiboonluk Pungrasmi et al. [8] This work focused on the development of water treatment unit, called aeration-assisted combined nitrification and solid removal (ACNS), for compact aquaculture system. Results of preliminary study indicated that aerated filtration could extend filtration time significantly and capture more solids as compared to non-aerated filtration.Therefore, the proposed treatment unit must integrate aeration as a mean to enhance nitrification and solid removal, and combined both processes into a single unit. Herein, this paper describes the development of such unit, referred to as the aeration-assisted combined nitrification and solid removal unit (ACNS), as well as the results of ACNS evaluation during the closed-water aquaculture.

In the study done by Claude E. Boyd [9] The aim of the present study was to develop a 33-cm diameter air diffuser was installed in the bottom of a 3.28-111 deep bore hole in **the** bottom of a 350-m2 pond. Water depth above the diffuser surface was 4.34 m. Air was supplied to the diffuser at 158 L/minute and a pressure of 4.86 **m H_20.** The apparatus was highly effective in transferring oxygen lo the water. Standard oxygen transferring efficiency was 28.790, and the standard aeration efficiency, based on air delivered power. **Was** 6.37 kg **O_2 K_W.hr.**

D. IOT and Sensor Based Inland Aquaculture

In the study done by*Sohail Karim* [10]In this study, we proposed an Internet of Things (IoT) based smart aquaculture model that will measure water quality (pH, water level, temperature, turbidity and motion detection of fish) for aquaculture. In this work uses low cost and short range wireless sensors network module to monitor and control aquaculture in real-time. Water recycling mechanism also proposed to reduce the amount of aquatic waste materials. By using this system parameters of water are monitored continuously using a serial port which reduces internet consumption, transmitted data regularly with small latency with error free and ensures survival of aquatic life also ensures the quality of growth and increases the economic benefits of aquaculture. The system also detects the movements of fish in the pond.

The research done by B Yoshitomi et al. [11] The title of this project is "Image processing-based creation of an automated feeder." The suitable feeding logic was designed and placed in a computer with an image processing board utilizing these trial results. A video camera captures a fish picture, which is then evaluated by a computer. The position and center of gravity of each fish are then determined to estimate the feeding activity of the fish.

In the study done by Sajal Saha et al. [12] A computer with an integrated circuit. The Raspberry Pi, which has an embedded Wi-Fi module, is employed in this system as a data processing and storage device. This project creates and executes a one-of-a-kind IoT-based aquaculture monitoring system. For convenience, Wi-Fi and the Internet are merged in this system. This research identifies a method for producing better results at a lower cost than other current solutions.

According to the research was done by kajal Jadhav et al. [13] The project aims to automate the system and to ensure that human efforts are minimized by using the controller Node MCU has an inbuilt Wi-Fi module which helps in internet connectivity. The system utilizes the hardware which includes servo motor, ultrasonic sensor, Lm35 sensor and Node MCU, when the connections are done and Wi-Fi is connected, then the amount of feed is controlled.

In the study done by Devi Ratnasari et al. [14] The research object is the monitoring system and aquarium tools prototype using Node MCU ESP8266.A Node MCU ESP8266 as a microcontroller and can feed the fish automatically based on the feeding schedule. This aquarium also can-do water replacement automatically if the water has turned turbid due to detection by an LDR sensor.

In the research proposed by H Hendri et al. [15] The main component of controlling all component and program in this tool is Arduino Mega 2560. Turbidity sensor serves as a detector of water turbidity in an Aquarium, this sensor will send a signal to the Arduino Mega 2560 microcontroller. By doing this project will make activity in feeding the fish and detect turbidity of water be more effective more efficient and easier than manually.

In this paper done by M. A. Ali et al. [16] TheArduinoNano is a low cost and small size microcontroller board of the Arduino family. The AT mega 328 has 2 KB of SRAM and 1 KB of EEPROM, Servo motor, Keypad, LCD and tiny real-time clock module (DS3231). In this development, we would enhance the features by implementing IoT to send an alert message when the storage is empty or at critical temperature and pH level of tank water.

The research done by Emmanuel Gbenga Dada et al. [17] The Arduino UNO Microcontroller Based Automatic Fish Feeder is the subject of this project. Arduino UNO Microcontroller, LCD RTC Module, and servo motor are the parameters used. These criteria will ensure that the fish is fed at the appropriate time by the fish owner. The fish owner may relax, knowing that the fish will be fed at the appropriate times.

According to the research was done by Wahyu Pribadi et al. [18] The main microcontroller module on the robot, the Arduino Mega 2560, serves as the system's controller. A waterproof DC motor is a motion actuator that pushes the robot, with a servo motor controlling the direction of driving. The application for Android smart phones has an automated feed dosage system depending on the fish's age and a database that stores feed history data.

In the study done by Dr. T. Joby Titus et al. [19] In an aqua monitoring system, the colour of the water is watched using a web camera attached to a Raspberry Pi, and the picture is analyzed to determine whether we need to recycle our water. If the extracted output is green, the pump for water recycling will be activated. The web application will be updated often with the aggregated data from the sensors.

The research done by Kasda et al. [20] This study led to the creation of an automatic fish feeder system with a remote control that is both cost-effective and portable. With a remote control as a controller, the barge boat served as a fish food sender to a huge fish pond. This remote-control technology allows farmers to feed fish automatically and evenly in the Centre and corners of fish ponds, preventing economic losses such as food waste, which can degrade water quality and pollute water.

In the research proposed by Audelon et al. [21] The system was created using an Arduino Microcontroller by the researcher. The Arduino Mega 2560 is used to connect the sensors. Water Temperature, pH Level, Dissolved Oxygen, Water Level, Turbidity, and Ammonia are all monitored and checked. The NodeMCU will collect data on water parameters and send it to a computer through a Wi-Fi connection, where it will be stored in a database. It has also been demonstrated that the designed system can feed the fish at a time selected by the user.

The research done by B Yoshitomi et al. [22] The title of this project is "Image processing-based creation of an automated feeder." The suitable feeding logic was designed and placed in a computer with an image processing board utilizing these trial results. A video camera captures a fish picture, which is then evaluated by a computer. The position and center of gravity of each fish are then determined to estimate the feeding activity of the fish.

The research done by Lorena Parra et al. [23] We offer a method that automatically changes the amount of feed dispensed in this study. The system does this by detecting when feed reaches the drainage system. A CMOS sensor is used to detect the stream. The histograms are created from the data collected by the CMOS sensor. We can detect a link between the quantity of pixels with a given brightness value and the existence of feed after analyzing them.

In the study done by Yolanda M et al. [24] Based on the analysis of high-resolution satellite pictures, this research describes a system for locating potentially suitable areas for inland aquaculture in Mexico. The fact that the generated maps are geocoded and accessible as information layers for use in a geographic information system is a critical feature of discovering aquaculture-suitable areas.

According to the research done by Analene Montesines Nagayo et al. [25] The design, building, and implementation of a water recirculation system, an aqua cultural control and monitoring system, a solar energy conversion system, and cooling and heating systems are all part of this multidisciplinary research. Waste product management and water recycling processes are provided in the design and construction of the aquaculture tank and hydroponic beds.

The research done by Lorena Parra et al. [26] They assessed the various possibilities for sensing each variable in relation to the aquaculture sensors' requirements. Thermistors, thermocouples, and RTC all appear to have comparable benefits when it comes to temperature monitoring. The optical approach, on the other hand, appears to be the best alternative for dissolved oxygen measurement. Optical techniques are the most often used for turbidity measurements, whereas inductive coils are a promising choice for conductivity measurements.

In the study done by Linhui Wang et al. [27] In this research use unmanned aerial vehicles (UAVs) and a wireless sensor network (WSN) to design a new ground water quality parameter and a drone spectrum information acquisition approach, as well as propose a novel dynamic network surgery-deep neural networks (DNS-DNNs) model based on multi-source feature fusion to forecast dissolved oxygen (DO) and turbidity (TUB) distribution in inland aquaculture areas.

This paper was done by Sopan Sarkar et al. [28] This research focuses on the development and deployment of a unique LASER-based security system for inland aquaculture, such as shrimp and prawn farms in Bangladesh. The requested work has been completed and tested in the actual world. In comparison to other current systems in Bangladesh, the system proved adequate in terms of both cost and security. With minor modifications, the security system may be applied in various sectors such as perimeter security in banks, businesses, museums, and so on.

According to the research was done by Lorena Parra et al. [29] We provide a set of sensors for monitoring water quality and fish behavior in aquaculture tanks during the feeding process in this research. Physical sensors and basic electrical components form the foundation of the WSN. Water quality data, tank state, feed dropping, and fish swimming depth and velocity may all be monitored using the suggested system. A sophisticated algorithm is also included in the system to decrease energy waste when delivering data from the node to the database.

This paper was done by Lorena Cornejo-Ponce et al. [30] The cultivation of river shrimp was carried out in this study with the use of intensive solar radiation for the long-term growth of the Camarones, a Chilean community. This project incorporates three primary components: an aquatic recirculation system, solar water treatment, and a photovoltaic plan system, to provide an integrated system that ensures Camarones' long-term viability. When reusing, the most essential thing is to achieve zero liquid discharge, and by adding value to the trash, this project becomes sustainable and environmentally benign, fulfilling all of the circular economy's concepts and tactics.

III. CONCLUSION

This technique will aid in improving shrimp aquaculture production while minimizing losses. There is no need to keep an eye on the system because everything is automated. Farmers do not need to be concerned about the water's environmental characteristics since adequate sensors are utilized to monitor them and an aeration procedure is employed to keep them in check. This technique will save time and money for the farmer, allowing him to avoid negative repercussions. Because the feeder motor speed is determined by the feed size, the meal will reach all of the shrimps in the case of a feeder. If there is too much feed in the water, the feed will dissolve and the water will become filthy. As a result, the feeder will automatically ON and OFF based on the time set by the delay time. This will reduce the amount of feed used as well as the amount of energy used. Farmers do not need to be concerned about any irregularities because the entire procedure is automated. Instead of leaving the aerator running for 24 hours, this automated system will turn it on and off as needed. When compared to a manual aeration system, this technology will save more energy.

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