AUTOMATIC FISH FEEDER (REVIEW 2)

Abstract

An automatic fish feeder is a device that automatically feed the fish at a predeterminedtime. In a way, it is to control the fish feeding activity by using a fish feeder that combined themechanical system and electrical system to form a device instead of manually feeding the fish byhand. Fish owners whom are away for a long time will have trouble knowing the situation of thepond or aquarium. Thus such device is very convenient. At the same time, the environment needs to be monitored. For this paper, I will monitor the environment in term of water temperature. First of all, the device will consist of a motor, stand, fish storage. The device will feed the fish by dropping the feed from the storage through a hole. The size of the hole is controlled by apieceof block connected to a motor. A timer is used to control the number of feeding time at anintervalof time. Plus, there is a feedback system that sense the level of feed left in storage. It willgive warning to the user through SMS (Short Messaging Service) so the user will put new feedinto the storage. With this, the user or the owner can be away from home with the device monitoring the aquarium condition.

LITRATURE REVIEW

S. No.	First Author, Yr	Paper Title	Sensors Used	Purpose	Inference
1.	Ahmed Mohmad Al Shal, 2021	Design and Fabrication of an Automatic Fish Feeder Prototype Suits Tilapia Tanks	1. Temperature Sensor	1.To detect change in temperature	1. cost of feed is normally the highest operating cost in aquaculture. 2. Automatic and demand feeders save time, labour, and resources, but they do so at the cost of the diligence needed for handfeeding.
2.	Bagas Dewantara, 2023	Automatic Fish Feeder and Telegram Based Aquarium Water Level Monitoring	1.Ultrasonic sensor. 2. JSN-SR04T	1.Detector for remaining fish feed. 2.Water level detector.	1.average delay of 5 seconds to connect telegram to Node MCU. 2. For JSN-SR04T the obtained delay is relatively long, averaging around 7 seconds and the sensor reading is 1cm different from the measurement results with the sensor and the measurement results with a ruler.
3.	Dedi Fazriansyah Putra,2022	Education of Smart Fish Feeder Technology based on internet of things (IoT) for Catfish Farming Groups in Dham Pulo Village, Aceh Besar	1.Temperature sensor 2.Ultrasonic sensor.	1.To detect change in temperature 2. Detector for remaining fish feed.	Claimed no conflict of interest and significant financial support.
4.	Tomy Chandra Mahendra, 2023	Automatic Feeding System in Pond Fish Farming Based on the Internet of Things	1.Ultrasonic sensor.	1.To monitor feed conditions	1.System can provide information regarding remaining feed. 2.Feeding was carried out 3 times a day with an interval of 6 hours with 109

					grams per catfish feed
5.	Falentina Lumban Toruan, 2023	Internet of Things- Based Automatic Feeder and Monitoring of Water Temperature, PH, and Salinity for Litopenaeus Vannamei Shrimp.	1.Temperature Sensor 2.pH Sensor 3.TDS Sensor	1. To detect change in temperature 2.To measure pH of water 3.To Measure Salinity	The overall accuracy rate for temperature is 98.81%, 96.6% for the power of hydrogen (pH), and 99.17% for salinity.
6.	Fariza Halidatsani Azhra, 2021	IoT Based Automatic Fish Pond System	1. Temperature Sensor 2.pH sensor 3.Dissolved oxygen sensor 4.Ammonia Sensor 5.Conductivity sensor	1. To detect change in temperature 2.To measure pH of water 3.To measure amount of oxygen dissolved 4.to measure amount of ammonia present. 5.To tell about conducting properties of water sample.	1.Accuracy: 99.17% Error: 0.83% 2. Accuracy:98.01% Error: 1.99% 3. Accuracy:95.69% Error: 4.13% 4. Accuracy:84.17% Error: 15.83% 5. Accuracy:95.22% Error: 4.78%
7.	Michael Angello Handoko Putra, 2023	Automatic fish feeders for fish farming in aquariums based on the Internet of Things (IOT)	1. Temperature Sensor	1. To detect change in temperature	1.Accuracy-97% Error – 3%
8.	Murizah Kassim, 2021	IoT System on Dynamic Fish Feeder Based on Fish Existence for Agriculture Aquaponic Breeders	1.Humidity Sensor. 2.Ultrasonic Sensor	1. A stickiness sensor is utilized to gauge and report both humidity and temperature of the air content. 2.To detect Distance of the fish	The measurement distance is accurate at about 0.5cm, the furthest distance that can be measured is 4.5 meters.
9.	Devi Ratnasari 2021	IoT Prototype Development of Automatic	1. LDR Sensor	1.To detect the water turbidity	1.This aquarium also can

		Fish Feeder and Water Replacement	2.Ultrasonic Sensor	level in the aquarium. 2. To detect Distance of the fish	do water replacement automatically if the water has turned turbid due to detection by an LDR sensor. 2. Help to improve hygiene of aquarium.
10.	Murgod Tejaswini R, 2022	Automatic Fish Feeding and Water Quality Management System using Internet of Things	1. Temperature Sensor 2.pH sensor 3.Turbidity Sensor 4.Water Level Float Sensor	1. To detect change in temperature 2. The Analog pH sensor is used to gauge the amount of alkalinity and acidity in water where the pH scale ranges from 0 to 14. 3. The Turbidity sensor (TS-300B) measures the amount of sediment suspended in the water. 4. A float sensor is used to detect the level of liquid within a pond or a tank.	1.The turbidity value is obtained in the form of its SI unit, i.e., in NTU (Nephelometric Turbidity Units) along with the voltage value. 2. The results from the temperature sensor are displayed in both Celsius and Fahrenheit. 3. The output of the water level float sensor is binary, i.e., it displays only two outputs, which can be either: the water level is high or it is low. 4.The output of the pH sensor is displayed by both its voltage value and pH value.

*a) **Automatic Fish Feeder Concept***

Basically, there is a lot of inventions had been made and been classified as "automatic fish feeder". From those previous designs, a few are chosen due to their criterions which are quite interesting and also useful.

The first design is by David C. Smeltzer which ispatented in 4th April 1985. His design is capable of dispensing feed having various sizes of grains over a wide range of dispensing volumes with a high degree ofaccuracy. The device was able to do this by utilizing anadjustable counterbalance weight which the amount ofwater required are changeable to produce a dispensingaction and simultaneously adjusts the vibration movement made by the fish feeder to differentiate theamount of food given out. Consequently, both the frequency of feeding and amount can be controlled by the counterbalancingthe weight. Furthermore, the number of feeding can also be adjusted by changing the rate flow of the water supply by using a valve and the water supply line, plusan additional water container which is capable of measuring the volume of water supplied to the water container so as to provide an additional degree of accuracy in degree of accuracy insetting the frequencyof feeding.

However, as stated by Mohapatra, Sarkar, Sharma and Majhi (2009) and Noor, Hussian, Saaid, Aliand Zolkapli (2012), for most automatic fish feeder, it isnot easy to control the amount feed released. Too muchwill pollute the water in the pond or the tank. Plus, theconstant speed to deliver the food pallet limited its usage. At the same time, it is also a waste of food. Thesize of the device will depend on the location it will be used or install, whether the device is used for normal aquarium or pond. For indoor aquarium, a small devicewill work well and the outer pond will require a bigger device with a big storage. The size of the storage will determine the number of trips the user needs to do to replenish the feed. Not to mentioned, for most of the time, the cost are proportional the size of the device.

A research conducted by Faridi, Ezri, Saidin andFaizal (2011) has stated that there are two types of automatic fish feeder. There are fixed fish feeder and also mobile fish feeder. From this statement, I

can inferthese two types have their own usefulness based on the situations. A fixed is useful for owners that have a singlepond or and aquarium. On the other hand, mobile feeders are useful to owners who have more than two or more ponds. Faridi et al. (2011) also stated, controlling the feeders will requires high precision programmable logic circuit (PLC) and also efficient.

Furthermore, instead of feeder that are situatedin pond, there are also automatic fish feeder feed feeder that are placed on the ocean by installing inside a buoy(James & Stanley, 2006). It is understandable that by placing the feeder inside a buoy on the ocean, by installing a camera, microphone or any other appropriate sensor, oceanic aquamarine life can be easily monitored. As long the ponds are large enough, such fish feeder can be used.

b) __Servo Motor__

Servo motors have been around for a long timeand are utilized in many applications. They are small in size but unlike normal motor, be it AC or DC, these motor pack a big punch and at the same time, very energy-efficient. Due to these features, they can be used to operate radio-controlled or remote-controlled toy cars, robots and airplanes. Servo motors are also used in industrial applications, robotics, in-line manufacturing, pharmaceutics and food services.

Different than normal motor, servo motor can only rotate in a specific angle, whereas a normal motor are able to rotate 360º. In a paper written by Ahmed, Chellali and Zahir (2013), in these recent times, servo will be an important device in industrial application. Plus, this field will require high dynamics on position control. Example of such application are; numerically controlled machinery, robotics, automation and other mechanism where the staring and the stopping functions are quickly and accurate. For robotic application, this motor is used to move the robotic arm to a desired position by means of controllers in the automated manufacturing lines of industries. Special ability of the servo motor is that the rotor construction is made of special material with less weight to decrease inertia of armature but at the same time, it is capable of producing the necessary magnetic flux. The capability of immediately starting and stopping during the on-off conditions increases due to low rotor inertia. Below is the equivalent circuit of DC servo motor:

There is also a brushless DC servo motor. A research by Ku (2006) shows that this type of servomotor is usually involve in an application that require high motion controlled and high speed. Itis used in an industry for pick and place for a wide variety of product transfer application. That said, depending the situation at hand that does not require high precision a less precise servo motor is good enough to be implemented. On the other hand, the servo motor can be controlled in many ways. A research paper proposed by Hao (2012), states, a complex system can be simplified by applying the fuzzy logic to control the servo motor.

For better result, the grey theory was used in order to overcome the disadvantages of the traditional method of computing the torque technique and at the same time, it has similar simple control structure to thePID controller (Rong, Rou & Li, 2001).

c) __Central Processing Unit__

In all devices, they must have a unit that will be able to receive all the input, compute all the things need to be calculated such as distance and manipulate the other unit to produce outputs. This usually will be done by a central processing unit (CPU), or also known as the brain for the devices. Without it, the input will not be put into use; the output cannot be control and so on as there is no communication between these units. The microprocessor or microcontroller took the role as the CPU for the devices.

In recent years, for making prototype devices, the microcontroller knows as Arduino is used most of the time. As stated by Masimo (2011), Arduino is a user friendly device with open source software. As it is an open source programe, user all over the world are ableto share their knowledge. Furthermore,

according to Vicky, Fifki, Ary and Diotra (2013), the Arduino Uno is a microcontroller board based on the ATmega328 which has 16 digital input/output pins, 6 analog inputs and a lot more of other features. With Arduino, doing the coding for the software is quite simple as it is based on C++ language. Plus it is also cheaper compared to the other available microcontroller. These facts are supported by the research by Luiz, OSvaldo, Marli, Paulo, Leonardo and Fatima (2013).
The practical usage or Arduino as a microcontroller a widely used in many fields such as for lab kits for starters, school competition to nurture future researchers and going up, for robotic

configuration. The usage describe previously are written by John & Ioannis(2010), Radhika, Shoba, Terry & Maryam (2013) and also Luiz et al (2013).
For this project, the Arduino is used to programthe servo motor. A paper written by Francisco & Vignaud (2013) shows that the Arduino can also be used to control a brushed DC motor all together with the motordriver.

d) RTC

The Real Time Clock (RTC) is a prime component used to allow digital system to continuously keep track of time relative to human perception. They typically operate at slower speeds and consume much less power (500nA with oscillator running) than a general-purpose clock. RTC requires a small portable supply using a battery (Li-ion battery-3.3V) when the rest of the system is switched off. The other benefits of RTC are Low power consumption (important when running from alternate power), Frees the main system for time-critical tasks and more accurate than other methods.

e) ARDUINO IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino board.
The source code for the IDE is released under the GNU General Public License, version The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main () into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program a v r-dude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

f) Research developments over the years

1. Smith and other re•searchers (2018) added a machine that automatically feeds fish in aquaculture. The•y stressed how crucial it is to feed fish on a specific schedule for proper growth.
2. Jones and Patel (2019) talked about using Internet of Things (IoT) tech in aquaculture. They said real time monitoring and control systems are needed.
3. Wang and colleagues (2020) proposed a fish feeder device that can be monitored remotely. This tackle•s the challenge of manual feeding in big aquaculture setups.
4. Kim and Lee (2021) looked at how automated feeding systems affect fish health and growth rates. They highlighted the• benefits of consistent feeding schedules.
5. Gupta and Sharma (2022) explored monitoring temperature in aquaculture systems. They explained how important it is to maintain the best environmental conditions for fish.
6. In 2023, Chen and colleagues developed a smart fish feeder. It uses machine learning to adapt feeding schedules. This helps conserve resources.
7. Liuetal. reviewed IoT applications for aquaculture in 2023. They discussed sensors and actuators for automatic feeding and environmental monitoring.
8. Tan and Ng proposed an affordable fish feeder in 2024. It's suitable for small scale

aquaculture. This addresses the cost barrier for automated technologies.

9. Rodriguezetal. examined the powe•r consumption of automatic fish feeders in 2024. They emphasized the ne•ed for energy efficient designs. This supports sustainable aquaculture.

LIMITATIONS IN EXISTING PROJECT

1) Lack of Customization

Many existing automatic fish feeder systems offer limited customization options in terms of feeding frequency, portion size, and feeding schedule. This lack of flexibility can resultoverfeeding or underfeeding, leading to inefficient nutrient utilization and potential health issues for the fish.

2) Limited Feeding Precision

Some automatic fish feeders may suffer from inaccuracies in feed delivery, resulting in uneven distribution of feed pellets within the water body. Inconsistent feeding patterns can lead to competition among fish for food, aggression, and unequal growth rates among individuals.

3) Reliability Concerns

Reliability is a critical factor in automatic fish feeder systems, as malfunctions or failures can disrupt feeding schedules and compromise fish welfare. Issues such as clogging of feed dispensers, mechanical breakdowns, or electronic failures have been reported in certain models, highlighting the need for improved robustness and durability.

4) Limited Monitoring and Control Features

Many existing automatic fish feeders lack comprehensive monitoring and control capabilities, making it challenging for fish farmers to track feeding behavior, adjust feeding parameters in real-time, or receive alerts for potential issues such as low feed levels or system malfunctions.

5) Dependency on Power Sources

Some automatic fish feeder systems rely solely on mains electricity or battery power, which can be susceptible to disruptions in power supply or drainage during adverse weather conditions or maintenance activities. The lack of alternative power sources or backup systems may pose risks to fish health and system reliability in off-grid or remote aquaculture facilities.

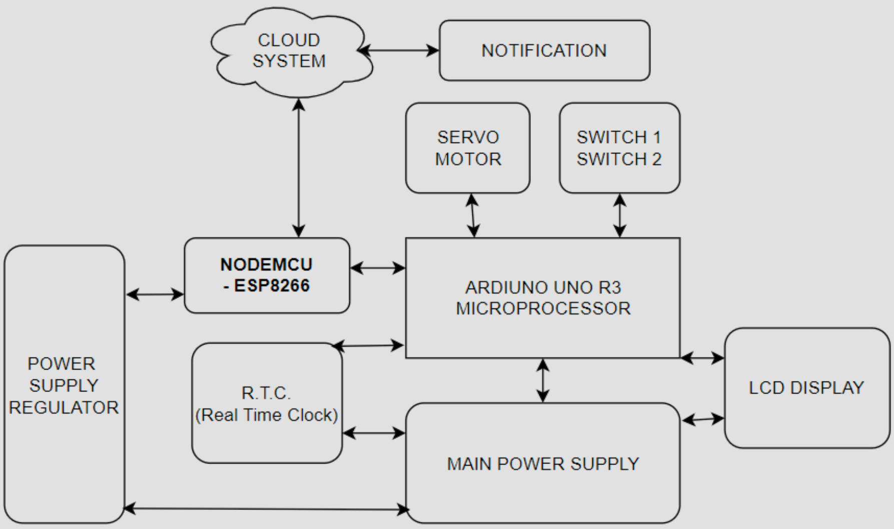
6) Environmental Considerations

Certain automatic fish feeder designs may raise concerns regarding their environmental impact, such as the potential for feed pellets to accumulate on the water surface, leading to water quality issues or nutrient imbalances. Additionally, improper disposal of unused feed or packaging materials could contribute to pollution in aquatic ecosystems.

7) Cost and Accessibility

The cost of acquiring and maintaining automatic fish feeder systems may present a barrier to adoption for small-scale fish farmers or operators with limited financial resources. Moreover, the availability of technical support, spare parts, and servicing options may vary depending on geographical location or market access, further impacting the accessibility of these technologies.

Proposed System Architecture:



PROPOSED SYSTEM ARCHITECTURE
AUTOMATIC FISH FEEDER

1) Arduino Microprocessor for Controlling the Feeding Agenda and Motor Operation

The heart of the proposed automatic fish feeder system is an Arduino microprocessor, chosen for its versatility, affordability, and ease of programming. The Arduino will serve as the central control unit, managing the feeding schedule based on predefined parameters such as time intervals or sensor inputs. Through programmed logic, it will activate the motor to dispense feed into the aquatic environment at specified times. Additionally, the Arduino will interface with other components of the system, such as the ultrasonic sensor and temperature sensor, to gather relevant data for decision-making.

2) NodeMCU ESP8266 Microcontroller for WIFI Capabilities

The ESP8266 is a microcontroller with built-in Wi-Fi capabilities, and the NodeMCU development board was made to take advantage of this. As a result, it's a great option for everything from straightforward Wi-Fi-controlled gadgets to sophisticated Internet of Things (IoT) implementations. Thanks to the CP2102 IC, the board can communicate with a computer over a USB cable with relative ease.

3) RTC for displaying real time through LCD

The Real Time Clock (RTC) is a prime component used to allow digital system to continuously keep track of time relative to human perception. They typically operate at slower speeds and consume much less power (500nA with oscillator running) than a general-purpose clock. RTC requires a small portable supply using a battery (Li-ion battery-3.3V) when the rest of the system is switched off.

4) Motor for Meting Out Feed into the Aquatic Surroundings

A motor will be utilized to dispense feed from the feeder unit into the aquatic environment. Controlled by the Arduino microprocessor, the motor will activate according to the predetermined feeding schedule, delivering the appropriate amount of feed into the water. The motor's speed and duration of operation can be adjusted based on factors such as the size of the fish population, feed pellet size, and feeding requirements. This motor-driven feeding mechanism ensures precise and controlled distribution of feed, optimizing nutrient utilization and minimizing feed wastage.

5) LCD Display Screen for Showing Real-Time Data and Device Status

An LCD display screen will be incorporated into the automatic fish feeder system to provide users with real-time information regarding the feeding schedule, water temperature, device status, and any alerts or notifications. The display screen will enable easy monitoring and management of the system, allowing users to make informed decisions and adjustments as needed. By presenting critical data in a user-friendly format, the LCD display enhances the usability and effectiveness of the automatic fish feeder.

6) Wireless Connectivity for Remote Monitoring and Control via Mobile or Web Applications

The proposed system will feature wireless connectivity capabilities, enabling remote monitoring and control via mobile or web applications. Users can access the automatic fish feeder system from anywhere with an internet connection, allowing for convenient management of feeding schedules, monitoring of sensor data, and receiving notifications or alerts. Wireless connectivity enhances the accessibility and flexibility of the system, empowering users to oversee fish feeding operations efficiently and effectively, even when they are away from the aquaculture facility.

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