Development of Fish Feeder Bot for Aquaculture

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Abstract:

The present strategy involves automatic feeding devices and, more exactly, a revolutionary automatic feeder for fish, which can be encountered in aquariums, ponds or other infrastructure where fish are confined. The fish feeder is an autonomous moving bot that routinely and periodically feeds the fish. To bring more oxygen to the water, aerators are used, and the bubbles they create efficiently keep the water of the aquarium flowing. Poor water quality will lead to a loss of benefit, poor product quality, and possible human health risks. The consistency of water is dictated by factors, such as temperature, turbidity, PH, TDS and dissolved oxygen. The smart sensor kit comprises all sensors used to assess the consistency of the water. Using the IOT cloud, the quality parameters are seen regularly through the mobile app.

Keywords:

Fish feeder, blower, aerator, sensor kit, IOT cloud.

I. INTRODUCTION

Fish is considered as the most loveable food among the people of this civilized era. Because of its high protein content and its optimal nutrients, people have more attraction in having seafood. Fish caught alone in the oceans are not sufficient to fulfil this large potential, so fish are cultivated in a well-furnished tank where they enhance. In order to ensure the health and viability of the fishes in the aquarium, it is important to provide food on a frequent and reliable basis when maintaining an aquarium. The Fish Feeder Design Bot feeds the fish semi autonomously. The fish feeder is installed to the catamaran boat, which is propelled by Two propellers. The Fish Feeder is powered by the lithium ion battery. There's a solar panel charging the battery. The weight sensor tracks the quantity of food available in the feeder tank. It's a semi-autonomous bot capable of feeding the whole Fish Tank. The aerator is fixed under the bot that is used to provide fishes with oxygen. The water quality for successful fish farming is also checked by this Bot. This Bot Uses DHT 11 Sensor to Measure the Temperature, DO Sensors to Measure the Quantity of Dissolved Oxygen Present in The Water, PH Sensor to Measure The PH of The Water, Conductivity Sensor to Measure the Amount of Dissolved Ions Present in The Water. The sensor readings are seen through the blynk IOT cloud using GSM.

II CONSIDERATION AND DESIGN OF ROBOT COMPONENTS

A. Mechanical System

Hull:

A hull is the watertight body of the boat. The hull may open at the top or it may be fully or partially covered with a deck. The hull is hollow so that it can accommodate the electrical component and other equipment of the boat.

Hull terms:

- Bow is the front most part of the hull.
- Stern is the rear-most part of the hull.
- When facing the bow, the portside is the left side of the ships.
- When facing the bow, starboard is the right side of the port.
- The waterline is an imaginary line that circumscribes the hull and corresponds to the surface of the water when the hull is not moving. The LWL's midpoint is at amidships (see below).
- It is located halfway between the forward and backmost points on the waterline.
- A baseline is a fictitious reference line on which vertical distances are measured. It is normally found at the hull's bottom.

Frame:

Frames are ribs that are mounted or sewn to the keel transversely. Frame gives mechanical support to the hull and give the ship its shape and strength. The frame is used to fit the fish feeder components and the thrust on it.

Thruster:

A bow thruster is a propulsion device that provides lateral thrust to help with manoeuvrability. Bow thrusters propel a boat's bow or stern into the water in any direction. Bow thrusters may be used as standard equipment on new vessels or retrofitted on boats larger than 45 ft.

Design Description

While designing a yacht type hull it is important to determine the length, width and depth since the other could be given as a manufacturers guide.

- Length of the hull = 520mm.
- The length is assumed by the designer depending upon the travel area.
- The scaling factors provided to determine the beam and width of the hull is as follows.
- Depth = L0.70 (referred from principles of yacht design)

By using this scale factors the beam and depth value is calculated as follows;

- Depth = 100mm

Using this basic value as primary considerations the profile is selected and designed as the hull.

As per the study from the above characteristics the following parameters are selected for the design of the hull

1. Hull profile is Shallow Arch
2. Length of the hull is assumed to be 520mm
3. Width of the hull is calculated as 160mm
4. Depth of the hull is calculated as 100mm

B. Feeding Mechanism

The feeder is the main component of this bot. The feeder tank is made up of a cylindrical hollow tube with a convergence arrangement at the rim. The feeder bot's core feature is the feeder tank. The weight sensor is connected to this feeder tank. The weight sensor tracks the quantity of feeds present in the feeder tank. The blower is mounted with a DC motor below the feeder tank. The blower blows the feed from the feeder tank to the vast distances that falls on the blower so that the feed can extend to the long range and that fish can take their food on a regular basis and efficiently.

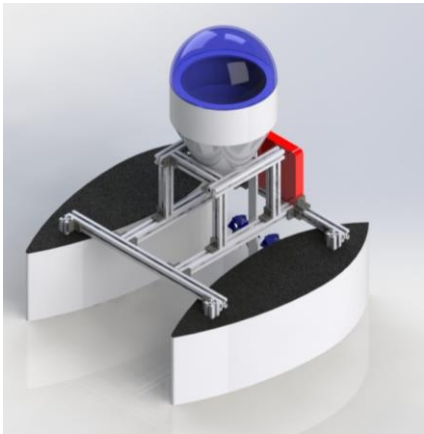

Fig: 1 Model fish feeder

C. Electrical and Electronic System

The electrical device is designed to be compact and reliable. A rechargeable 12V lithium-ion battery is used as the primary source of power for this bot due to its durability and compactness. A lightweight sheet type solar is mounted above the bot which is used to power the lithium ion battery. To control the voltage from the solar panel, a regulator is attached between the solar panel and the lithium ion battery. The voltage regulator is used to reduce 12V to 5V for Arduino. The voltage regulator circuit uses L7805 IC for voltage regulation. Two propellers are used for the bot movement. The propellers are connected to two 2200 RPM BLDC through a shaft, to make the motor as waterproof. ESP is used to control the BLDC in the propeller. ESP is an electronic speed controller which controls the speed of the BLDC motor. It converts the dc supply input to three output for the BLCD. The bot is controlled by an Arduino UNO microcontroller; the Arduino Uno uses ATMEGA328 IC. Since the Arduino can run at 5 - 12V, a voltage regulator circuit is used to decrease 12V to 5V.

D. Sensors and Microcontrollers

Sensors assist robots in perceiving their surroundings, making decisions, and acting appropriately. The temperature inside the hull is measured by a single DHT11 sensor on the designed bot. The exhauster is attached to the hull to keep the interior temperature constant. To conserve the water quality parameters for effective fish growth, a PH sensor, a DO sensor, and a TDS sensor are used to estimate the PH, Dissolved Oxygen, and Total Dissolved Solids in the water, accordingly. A turbidity sensor is used to measure the amount of TSS (Total Suspended Solids) for better fish culture. The readings from the sensors are stored in blynk IOT cloud using GSM.

Microcontroller is a controller that controls the machines according to our needs. Microcontrollers have built-in memory, input/ output pins. We use Arduino UNO as a microcontroller in this bot. As Arduino is an open source programme, it's simple to use. The Arduino UNO is based on the ATmega328.

E. Schematic and PCB

Figure 2 illustrates a graphical diagram of the fish feeder. The voltage regulator L7805 is mounted to a 12V LI ION battery to provide a continuous 5V supply to the Arduino Uno and sensors. The operating voltage of sensors used in 5V. The pH sensor signal pin is connected to analog input pin A0 of Arduino Uno. The DO, TDS and Turbidity sensors are connected to analog input pins A1, A2 and A3 of the Arduino Uno respectively. The pixhawk is a general purpose flight controller. It is used to find the vehicle state for the stabilization and to enable autonomous control. The pixhawk is interface with the Arduino Uno. Electronic Speed Controller(ESC) is used to control the movement and speed of the BLDC (Brushless DC Motor). The ground pin and the signal pin of the ESC is connected to the pixhawk. Two 2200 KV brushless DC motors are used as a propeller for the fish feeder. The BLDC is controlled by ESC. The GPS sensor is connected to the pixhawk to trace the position and location of the fish feeder.

Using conductive paths, plates, and other features engraved from one or more sheet layers of copper laminated

onto and/or between sheet layers of a non-conductive substrate, a printed circuit board (PCB) physically supports and electrically links electrical or electronic devices. The PCB design of fish feeder is shown in figure 3. The PCB is used to minimise the complexity of the circuit so that we can eliminate short circuits.

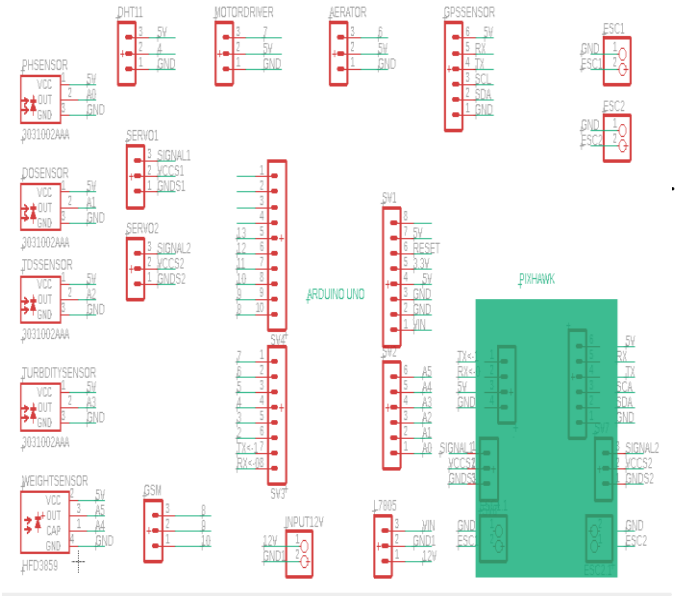

Fig.2 Graphical diagram of the fish feeder

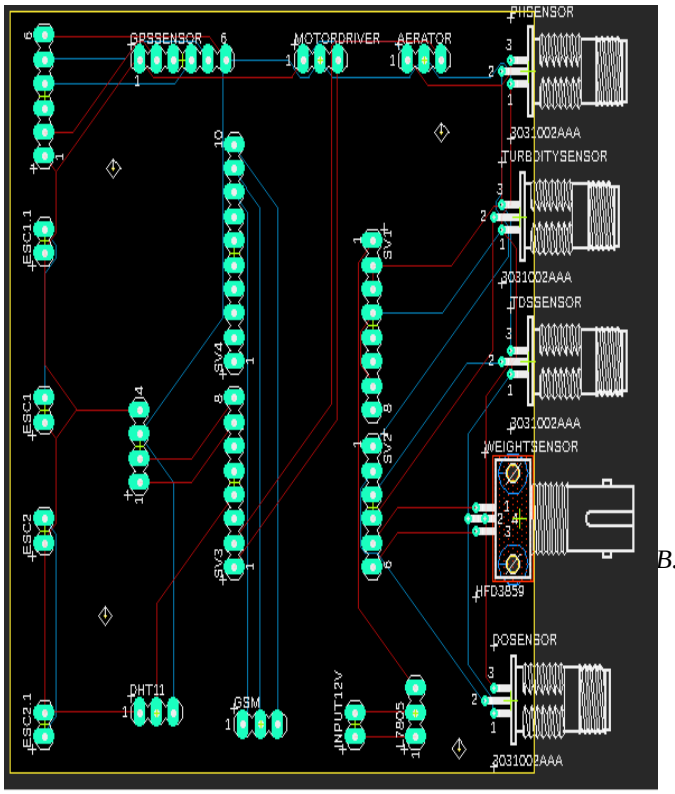

Fig 3 PCB design of fish feeder

F. Fish feeder navigation system

As the most of the fish feeders are moveable, the proposed fish feeder can move through the fish cultivating tank. The overall movement of the fish feeder is regulated by two propellers. The propellers are attached to 2200 RPM brushless DC motors. The BLDC motors are powered by a 12V battery and it is controlled by ESC and pixhawk. The direction of the fish feeder is controlled by two rudders and two servo motors. The servo motors used are a 5V operated and 90 degrees rotatable. The servo motors and the rudders are connected through a curved structured iron pin. automatic movement of the fish feeder is controlled by a pixhawk. Pixhawk is the autopilot flight controller.

III RESULTS AND DISCUSSION

Operation of bot

The fish feeder is powered by a 12V lithium ion battery, which is connected to a thin sheeted solar panel. Voltage regulator circuit is used to reduce the 12V input to 5V for microcontrollers. The voltage regulator circuit uses L7805 IC to regulate the 12V supply to 5V. The main theme of the fish feeder is to regularly feed the fish. As a result, the feeder bot periodically feeds the fish through the blower, which will blast the feeds that land on it for a long range. The blower is powered by a DC motor. The DC motor is operated at 5V. The DC motor gets water proof by separating the motor from propellers by shaft. The weight sensor under the feeder tank measures the amount of feeds present in the feeder tank in kilograms. When the feeds in the feeder is below the certain limit, the feeder will intimate the user to fill the feeder tank. Since the aerator is installed under the feeder, it aids in the addition of oxygen to the water by moving the water from the surface to the deep of the tank. The aerator also helps in movement of feeder. Bot's movement is controlled by two 2200 RPM BLDC motors and two rudders. Two ESCs are used to control the BLDC motor. Two servo motors control the rudders. A pixhawk, which is a flight controller, controls the bot's movement. The sensor kit uses IOT to update the user's water parameters. The pH, DO, TDS, and turbidity of the water are all tracked using the blynk IOT cloud. The data is sent to IOT via GSM after the readings from the sensors are fed into the microcontroller Arduino Uno. When the amount of dissolved oxygen present in the water is reduced to a certain level, the aerator will turn on to increase the amount of dissolved oxygen in the water. These sensor data are seen in IOT cloud through a graphical representation for our better understanding. The DHT11 sensor in the sensor kit measures the inner temperature of the sensor kit. Whenever the temperature rises to above 100 degrees Celsius the exhauster fan in the sensor kit runs to reduce the temperature for the better performance of the sensors.

B. Performance evaluation of bot

The overall performance of the fish feeder is discussed in this part. The choice of catamaran shape for the base of the feeder pays the best performance. As catamarans typically have less hull volume, smaller displacement, and shallower draft than monohulls of comparable length. The combination hulls have lower hydrodynamic resistance than equivalent monohulls, requiring fewer propulsive power from sails or engines.

Fig: 4 shows the domains in the fish feeder bot.

The lithium ion battery is used because of its less weight and its rechargeable character. The feeder tank is placed between the two catamaran shapes so the feeder can effectively feed the fish, the feeder tank is cylindrical in shape, so the feeds can easily be dispatched. The aerator set up effectively adds the oxygen to the water. The sensor kit monitors the water parameters for better growth of fishes. The fig: 5 shows the pH readings of the water parameters. Fig: 6 represents the Dissolved oxygen present in the water. Fig: 7 Graph represents the Turbidity of the water. Fig: 8 Graph represents the temperature in the sensor kit. Fig: 9 Graph shows the weight of the feeder tank (i.e. amount of feeds present in the feeder).

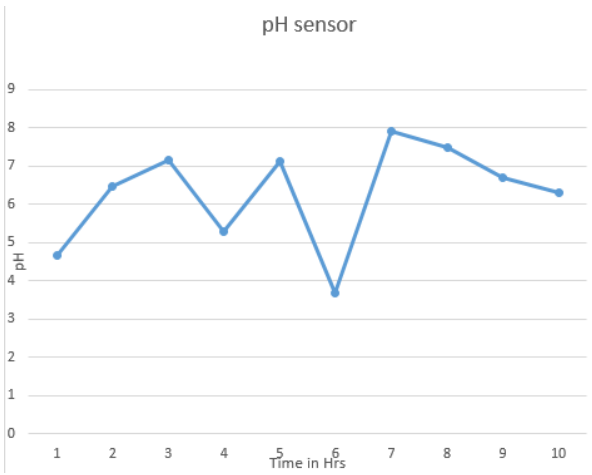

Fig: 5 Graph represents the pH of the water.

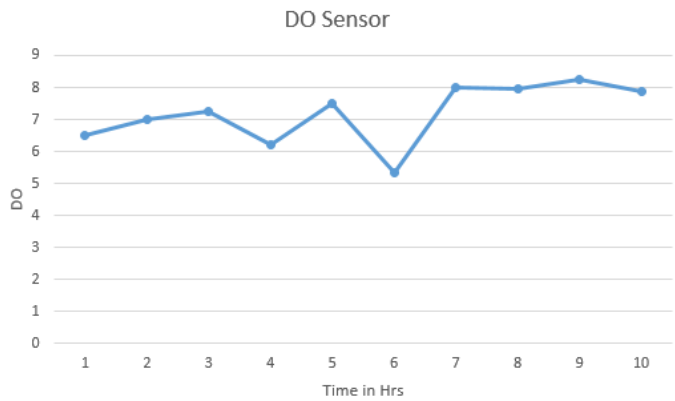

Fig: 6 Graph represents the Dissolved Oxygen present in the water.

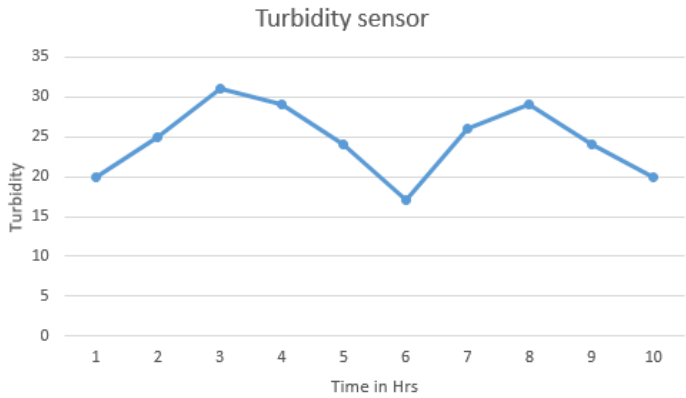

Fig: 7 Graph represents the Turbidity of the water.

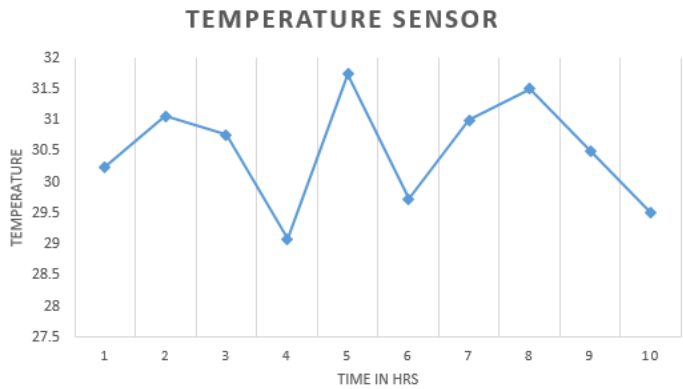

Fig: 8 Graph represents the temperature in the sensor kit.

C. Challenges and recommendation

The feeding capacity of the fish feeders is limited by the size of the feeder tank. It can be scaled up through the weight sensor at the bottom of the feeder tank. The place to fix all the sensors in the feeder tank takes much time. But finally a kit where all the sensors are kept and made water proof to avoid sensor damage. Fixing the aerator at the bottom in the beginning causes the lack of stability of the feeder. But finally the correct position and the angle is fixed to maintain the stability of the fish feeder. The first version of the bot is a remote controlled bot. But now the current version of the bot is a semi-autonomous bot that can run by pixhawk.

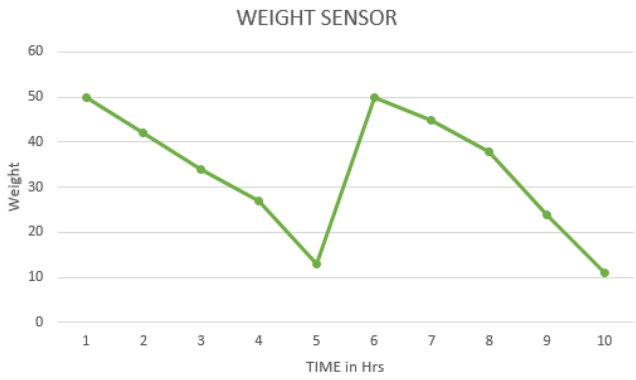

Fig: 9 Graph represents the weight of the feeder tank (i.e. amount of feeds present in the feeder).

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IV CONCLUSIONS

The fish feeder bot is designed, fabricated and tested. It is a catamaran shaped boat fitted with a hollow cylindrical feeder tank. It regularly feeds the fishes. The sensor kit regularly monitors the water parameters and updates the data in the blynk cloud. The aerator fixed will continuously add oxygen to the water. The fish feeder plays an important role in maintaining the water quality and feeds the fish regularly. The fish feeder diminishes cash as well as time just as an ideal opportunity for the client. It uses a 12V lithium ion integrated battery, and lasts for 5 hours of ceaseless working.

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