Arduino UNO Microcontroller Based Automatic Fish Feeder

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ABSTRACT

Over the years fish keeping for aesthetic purposes in aquariums has grown in popularity. Automatic fish feeders are electronic devices capable of dispensing fish food at preset intervals. They consist of timing circuitry to keep track of time and a trigger or switch to activate the dispensing mechanism which usually employs a motor. The amount of food dispensed is controlled by the to-and-fro movement of the motor depending on the time of release of food and closure. Automatic fish feeders relieve the fish owner of the routine task of fish feeding, and often come in handy when the fish owner is busy or out of town. All the owner needs to do is ensure there is enough feed in the tank. This study centers on the design and construction of an automatic fish feeder from readily available materials. A microcontroller is used for the timing and the motor goes through to and fro movement.

(Keywords: Arduino UNO, automatic fish feeder; aquarium; fish ponds; feeding)

INTRODUCTION

Humans have kept fish over thousands of years for commercial, research, and aesthetic purposes. These fishes are kept in aquariums, ponds, and other containments and require regular feeding (Ogunlela and Adebayo, 2016). Traditional feeding techniques involve the fish owner manually dispensing the food at regular intervals. Fish owners can forget to feed the fish at the right time and also may inaccurately give the proper quantity of food.

Automatic fish feeders are electronic devices that can efficiently dispense fish food at preset intervals. All the fish owner needs to do is pour feed into the storage tank of the feeder and the feeding is handled by the auto feeder (Anyadike, Eze and Ajah, 2010).

Fish feeders are normally fastened to the wall of the tank just over the water. They consist of a hopper which is loaded with dry food. The hopper tapers downward and is able to discharge its contents at the bottom. A timer which rotates the hopper at regular intervals (dispensing food in the process), and a method of setting the interval between feeding and the amount of food dispensed. The dispensed food just drops to the water surface and the fish feed from there. The automatic feeder is a good accessory to have as an aquarist because maintaining an accurate schedule for fish is not easy as the aquarist may forget or might need to travel (Nasir et al., 2016).

Automatic feeders are in existence but they are expensive and not readily available in many developing countries. Another feeder that exists is the mechanical feeder which is highly in demand. The feeding mechanism is activated by the fish hitting a lever or panel to allow the food to drop. In this case it takes time for the fish to learn the action of the feeder and once they do they keep on feeding because fish like most other animals feed whenever food is available and this leads to over feeding and pollution of the aquarium as it is the most prominent sign of over feeding (Nasir et al., 2016).

Automatic feeders still stand out as the best option for feeding fish to replace the manual method and with the low cost of microcontrollers it is also the cheapest and the most accurate method (Nasir et al., 2016). This application of technology is new dimension in this part of the world as fish feeder are not widely used neither are most people aware of their existence. This study covers the design and implementation of an automatic fish feeder from readily available materials. The mechanism and technology

employed in this feeder can be upgrade to cater for fish farming on large scale. Home aquarists can lead busy lives, and may be away for long stretches due to vacations. It is often difficult to maintain a regular feeding schedule. However, the fish require regular care in order to remain healthy. The fish should be constantly fed small amounts at regular intervals; or there can be significant loss of fish due to starvation. Too much food in the water can easily clog up important filters, and cause you to spend more time cleaning your aquarium tank. Thus, recruiting a reliable helper becomes necessary to ensure that the fish are properly fed when the owner isn't present.

An automated system must be able to be controlled or adjusted by the user according to their demand and needs. The word "automatic" implies that the feeder should be able to be operated without supervision of human at least at certain interval of time. There are many different designs and brands on automatic fish feeders in the market, but some limitations on the existing fish feeders need to be improved. Therefore, some improvement or new invention needs to be developed to solve these problems. However, when it comes to a total cost of this design, it is a bit expensive as this invention requires higher cost of parts. Usually aquaria have their automatic fish feeder that use to give food to the fish by following the timer that is set by the user (Nasir et al., 2016). However, the problem with an automatic fish feeder is that there is no feedback system to control the amount of fish food in the aquarium. Automatic fish feeders release food in the aquarium when the time is due without checking any remaining food in the aquarium.

For this study we designed the automatic fish feeder with feedback system so the amount of food in the aquarium is controlled. Our aim is to construct a cheap and easy to use automatic fish feeder for aquaria that can be upgraded for fish ponds. We intend to provide an accurate feeding schedule for fish using Arduino as a timer. We also ensure accurate motor rotation by using server motor. Moreover, we want to maintain a clean well aerated food pellet for indoor aquaria.

This work has prospects to break ground in the manufacturing sector considering the increasing popularity of fish farming. This could contribute to the nation's income via production and sales of such devices. Also it will reduce unemployment as it will empower the youth towards good and lucrative handiwork.

REVIEW OF RELATED WORK

There are a lot of inventions that have already been made and been classified as "automatic fish feeders". From those former designs, a small number are selected based to serve as useful yardsticks for this study. David C. Smeltzer was the first person to design a fish feeder and was patented in April 4th, 1985. His design has the capacity to dispense feed at different sizes of grains over a wide range of dispensing volumes with a high degree of accuracy. The device was able to achieve this by using a regulating counterweight weight required for the volume of water, which were changeable to produce a dispensing action and simultaneously adjusts the vibration movement made by the fish feeder to differentiate the amount of food given out. Consequently, both the frequency of feeding and amount can be controlled by counterbalancing the weights (Aderolu et al., 2010). Furthermore, the number of feedings can also be adjusted by changing the rate flow of the water supply by using a valve and the water supply line. An additional water container which is capable of measuring the volume of water supplied to the water container provides an additional degree of accuracy in setting the frequency of feeding.

However, as stated by Mohapatra et al. (2009), and Noor et al. (2012), for most automatic fish feeders, it is not easy to control the amount feed released. Too much will pollute the water in the pond or the tank. Plus, the constant speed to deliver the food pellets limited its usage. At the same time, it is also can waste food. The size 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 an aquarium, a small device will work well while out-door ponds will require a bigger device with larger storage. The size of the storage will determine the number of trips the user needs to do to replenish the feed. Costs also tend to be proportional to the size of the device.

Tadayoshi (2003) developed an automatic fish feeder which had the capability of sensing uneaten feed. Wilson (2000), invented a semi-submersible fish feeder for use in fish farms and aquariums which provides a feeding chamber that floats below the surface of water and thereby enables edible materials such as food or medicine to be more controllably and evenly distributed to fish. A buoyancy aid and ballast chamber allows the depth of the feeding chamber

within the water to be controlled. The feeding chamber is typically a volume of edible material enclose by a net through which fish can eat. Typically, the feeder is provided with a location marker means which makes it easier to locate the feeder in a volume of water. This design was not totally submersible as only the dispensing unit was beneath the water surface.

Research conducted by Shaari et al. (2011) has stated that there are two types of automatic fish feeders: fixed fish feeders and mobile fish feeders. A fixed fish feeder is useful for owners that have a single pond or/and aquarium. On the other hand, mobile feeders are useful to owners who have two or more ponds. Shaari et al. (2011) also stated, controlling the feeders will require a high precision programmable logic circuit (PLC) for efficiency. Furthermore, instead of feeders that are situated in ponds, there are also automatic fish feeders that are placed *in situ* by installing inside a buoy (Stanley and James, 2006). It is understandable that by placing the feeder inside a buoy on the ocean or in a freshwater aquaculture pen, by installing a camera, microphone or any other appropriate sensor, aquatic life can be easily monitored. As long the impoundments are large enough, such fish feeder can be used for aquaculture/mariculture applications.

MATERIALS AND METHODS

This section deals with the theory of some of the components used as well as the design and implementation of our automatic fish feeder.

Design Procedure

The design procedure adopted in this study has a modular approach. The study design can be broken down to two main phases: the hardware and the software phases. The hardware aspect was also carried out in two phases: the electronics and mechanical sections.

The materials required are very simple where the device is mostly constructed by using plastic. This is because the body of the device needs to be highly stable to hold all the electronic components. There are many types of materials can be used to make a robot body, for example, wood, metals, glass and other suitable materials. Each of these components has their own advantages and disadvantages and they are normally selected based on the type of work to be done. In this study, plastic is selected due to its light weighted and is cheap. The block diagram of the system is given below.

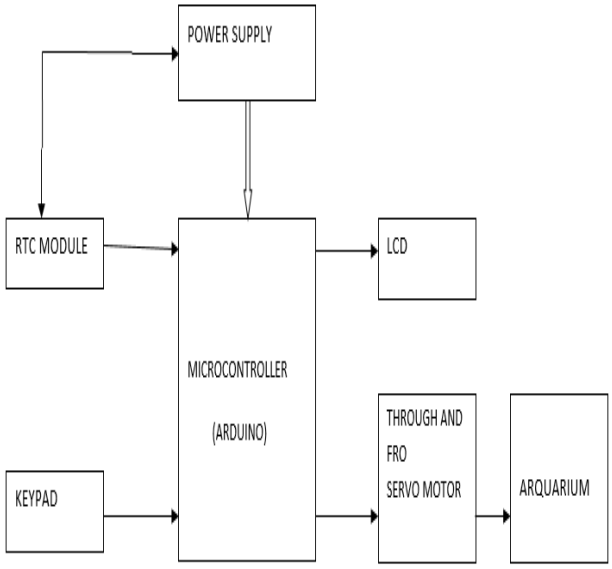

Figure 1: Block Diagram of System.

Materials Used

A summary of the materials used in the realization of the study is given in Table 1.

Table 1: Materials Used.

S/NO	MATERIALS USED	QUANTITY
1	Transformer	1
2	Rectifier diode	4
3	Capacitor	2
4	RTC Module	1
5	Push buttons	4
6	16*2 LCD	1
7	Tram (NPN) BCS547	1
8	Relay	1
9	Microcontroller ATMEGA 328	1
10	16MHZ	1
11	22Pf	1
12	LED	1
13	Resistors 10K	6
14	Through and fro servo motor	1
15	Cylindrical tin container	1

Circuit Diagram

This module of the electronic section controls the operation of the auto feeder. It has ATmega328

microcontroller at its core. The PIC handles interval timing, through and fro servo motor and amount dispensing. The circuit diagram is shown in Figure 2 below.

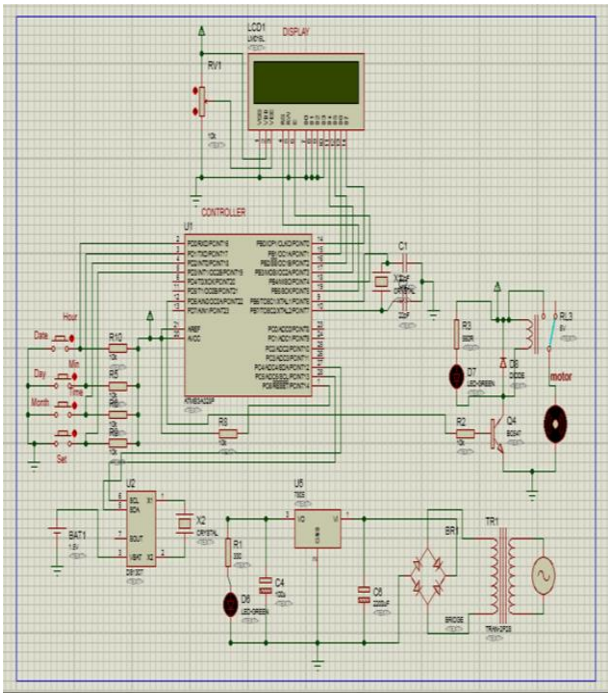

Figure 2: Circuit Diagram.

The AC supply form the power source feeds the transformer which steps down the voltage. Normally voltage of an AC current is always high, say 220V. The transformer then steps down the high voltage to 5V that will run through the system. The voltage will go through the full bridge rectifier, which rectifies the voltage from AC to DC. It then goes through the capacitor to get rid of the ripples in the voltage. The voltage regulator 7805 regulates the voltage to remain at 5V. From the circuit we used the LED that indicates a steady 5V. But we know that the LED has a lower voltage. The resistor is used to step down the voltage to a lower voltage to be able to power the LED.

DS1307 is what keeps track of the year, month, day and the time. The crystal provides the frequency to drive the clock. We have push buttons that adjust the clock's time, year, month and day. The PIC or ATmega328 contains the coding that runs the program, it controls the through and fro movement of the servo motor with the timing directed through the DS1307. The LCD displays the time of this clock. The through and fro motor dispenses the food, based on the time programmed in the microcontroller.

Software Phase

The software code was written in C programming language and was burnt to the microcontroller using the. The code is based on the flow chart given in Figure 3.

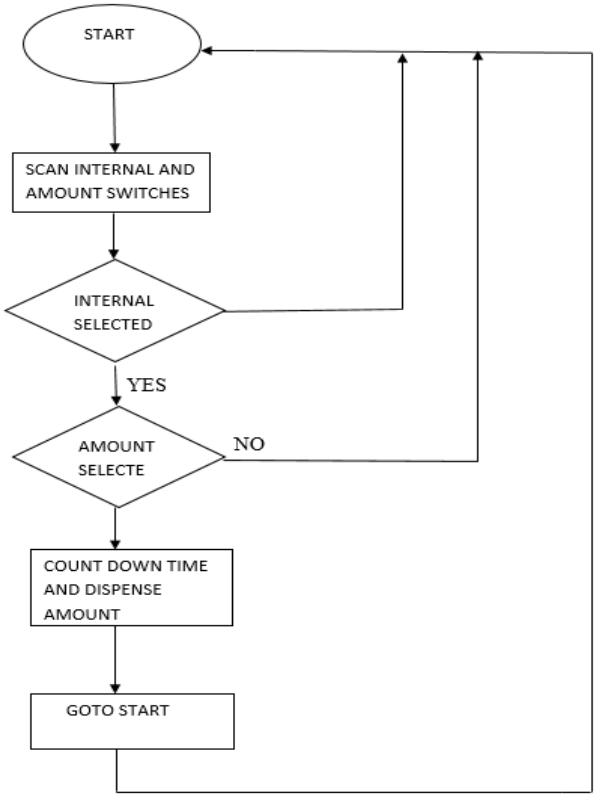

Figure 3: Flowchart of the C Language Code.

The code scans the interval and amount select switches (PORT B) for any input. If there is an interval input it scans for the amount input, if there is no amount input is keeps on looping until there is one. When there are inputs for both interval and amount the microcontroller counts down the time and sends the right train of pulses to the motor via PORT A to go the selected number of through and fro movements. The software does not cater for multiple inputs for example two feeding intervals selected at once, as this is handled in hardware as multiple tap switches are used and only one option can be

selected at a time. The software and hardware were integrated to give the functional system.

Design Assumption

The assumption made in the design and implementation of this study is that pellet flow will be constant no matter the amount left in the storage container leading to uniform amount dropping per dispense.

TESTING, RESULTS AND DISCUSSION

Test and Results

The testing was done in three different stages.

Stage One

The study is powered to the power supply, with the feed all set for dispense

Figure 4: The Fish Feeder being Connected to the Power Supply.

Stage Two

This stage shows the LCD displaying the countdown of the time. The study is programmed to dispense at an interval of two (2) minutes. This time can be adjusted through the push buttons on the study.

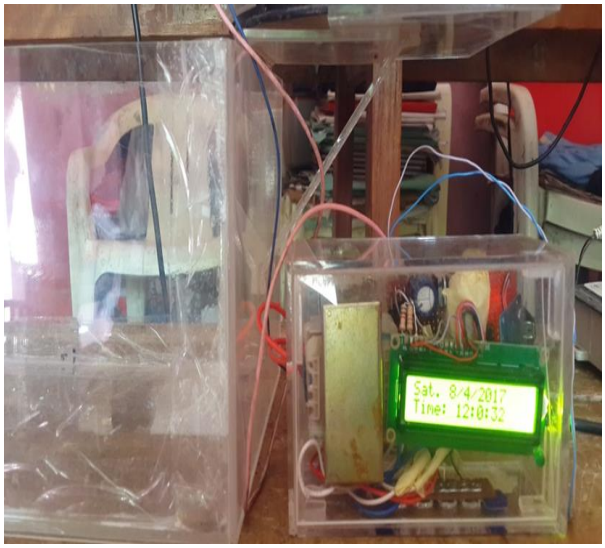

Figure 5: Displaying the Time on the LCD.

Stage Three

This stage shows the feeder dispenses the feed. As the time programmed reaches, the feed dispenses the feed on to the water. Based on reality of this work, it is expected that the feeding system should be an interval of 12 hours. The lever opens at the specified time then closes after some seconds. It is expected to continue its timing till the next feeding time. Figures 6 and 7 show the feeder dispensing.

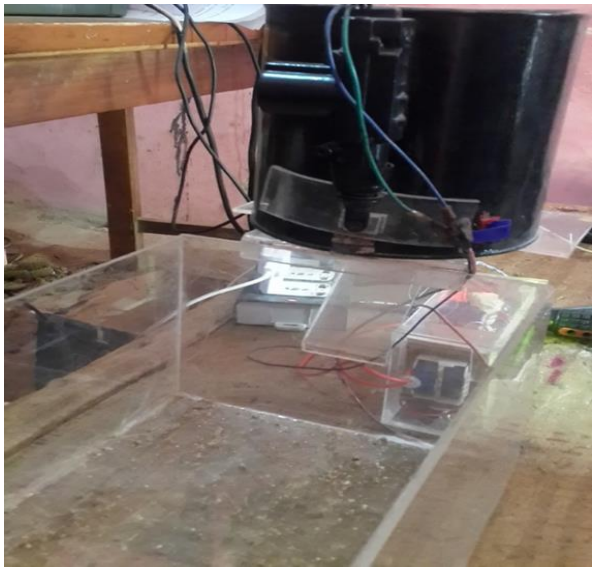

Figure 6: Opening of the Feeder for Food to be Dispensed.

Figure 7: Food Being Dispensed by the Feeder.

The container of the microcontroller-based fish feeder has the ability to accommodate different types of feeds. The implication is that the release of feeds can differ. Also, the rate at which the container will be exhausted is subject to the set time and set quantity of the fish owner. At the end of the testing, the workings of the automatic fish feeder turned out to be satisfactory.

CONCLUSION

This study provides a convenient way of feeding fish. The fish owner can rest knowing fully well that the fish will be fed at the correct time intervals. This comes in handy when the owner is travelling or too busy to attend to the regular feeding schedule. The construction of an automatic Arduino-based fish feeder was successfully achieved. We also have to consider balancing the optimum cost with it practical usage.

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