**Problem Identification**

Although there are many fish hobbyists around the country that enjoy the serene look of a fish tank, maintenance of a fish tank is by no means trivial. Poor maintenance of fish tanks can degrade the appearance of them over time and at worst, could be fatal to the fish themselves. “Maintenance” here refers to keeping fish tank parameters such as nitrate concentration or temperature at a suitable level and keeping fish healthy. But fish tank maintenance is time consuming and requires commitment and constant attention. One important aspect of maintenance is the process of feeding. Besides the obvious consequences of underfeeding, overfeeding can also bring diseases and even death to the fish. Not only will the fish consume more than necessary, but the remaining food content could pollute the water. Fish feeding is also very frequent. Also, according to diet changes and the size of fish, the amount of fish food to dispense would also vary. Given the precision and attention required for fish feeding we propose to build an automatic fish feeder.

To collect information regarding the opinions about our proposed product we conducted a survey. Admittedly, the sample size became limited due to time constraints, but we deemed it large enough to develop an initial understanding. According to this, more people do not own a fish tank than people that do and most do not even consider a fish tank desirable. As for the reason, many people agree that the time-consuming task of maintenance is to blame, at least partly. To further predict the success of our product, we asked, “would you add a fish tank to your house if the maintenance was automated?”. Only a miniscule minority responded no, and half the responses were yes.

We also chose feeding since it is often erroneously done as made clear by our survey. According to the survey, out of the respondents that do own a fish tank, only a very small percentage knew the right amount to feed while many underfed. Also, many people find maintenance to be impractical due to their daily schedule and most are agreeable to having a fish tank if this wasn’t a factor. More than half the respondents said they leave home sometimes or even very often, leaving them without a method to feed their fish. Also, Half the respondents said they add or remove fish or change the diet of their fish every few months. So, we believe that if the maintenance was automated by a machine with an adjustable timer, the procedure could be made less tedious and more precise.

The timer would allow flexibility in the frequency of feeding to overcome the difficulties mentioned above. Users could simply enter the number of hours between feeding times without the hassle of having to change their habitual routines of feeding. This will also improve the quality of the fish tank and the health of the fish residing in it. It will also incline more people who like fish keeping but hate consistently feeding, to buy fish tanks to their house. As buying fish tanks become more common, the demand for automatic fish feeders will grow proportionally. Even though some fish tank feeders are available in the market, we discovered design flaws or deficiencies that could be rectified. Hence, we decided to create an automatic fish feeder that could distinguish itself by being improved in these aspects.

**Technical feasibility**

Hardware requirements:

AT mega 328p IC, 555 timer IC, Capacitors and Resistors, 0.91-inch 128X32 OLED Display Module I2C IIC Serial Blue 3.3-5V, Push buttons x5, SMD LEDs, Buzzer, AA Li-Ion batteries x2, Charging module

All these components are very frequently used in electronic applications and are generally available in electronic equipment shops. Hence, these components can be easily procured. Each component costs no more than Rs. 1150 and all these components will collectively cost around Rs. 3250.

Technical skills needed to make the circuit are,

-Solidworks for Enclosure design

-Altium Designer for PCB design

-Atmel Studio for IC programming

The first of these two skills are taught within the Engineering Design Project module taught in the University of Moratuwa during our time as undergraduates. The necessary knowledge required to implement the required program using Atmel Studio can be obtained by self-study.

The enclosure and platform alone were estimated to cost Rs.10 800 as an upper bound. It will be 3d printed using PLA material which is material that is not just commonly used but also has good dimensional accuracy which will facilitate our design. It is also one of the more affordable options, so we believe this enclosure is feasible both financially and physically.

The PCB is available in will cost Rs. 1440 as an upper bound. So, the total cost of the prototype was estimated to be around Rs. 15 490. We deem this cost affordable and feasible.

**Technical Specifications**

Dimensions = (Length = 11.5062cm, Width = 7.7978cm, Height = 9.2964cm)

Color = Black

Capacity of Container= 150 ml

Material = PLA Plastic

Weight = 300g

Power consumption = 2 rechargeable AA batteries

Batteries are rechargeable within the device through a micro-USB cable

Up to 3 rotations per cycle and 3 cycles per day (9 rotations per day)

A platform whose inclination can be changed

Programmable using five buttons and includes a display screen

**Block Diagram of our product**

Diagram

Description automatically generated

The direction of the electrical connection arrows in the above block diagram indicates the direction of signals being transmitted.

The functionality of each module in the block diagram is as follows:

* Battery – Powers the PCB and the various components in the device
* Charging module – Charges the battery and receives power from an external supply through a micro-USB cable
* Container – Contains the fish food to be dispensed and undergoes rotation during feeding
* Servo motor – Rotates the container based on the signal from the PCB to allow dispensing of food
* PCB – Controls the operation of servo motor based on the configuration set by the user through the control interface and controls the display interface, buzzer and LED indicator.
* Display – Displays the current configuration and any changes made according to the inputs received by the control interface
* Control interface – Receives inputs from the user (sets the configuration for feeding
* LED indicator – Indicates the current battery level by checking the battery (green for moderate or high battery and red for low battery)
* Buzzer – To notify the user when the fish food is being dispensed through an alarm
* Platform – Provides a space for the device to stand at a certain level and is physically connected to the fish tank

**Sketches**

UI Design

**Display**

Setting up the configuration first involves a sequence of selecting the no of rotations for each cycle (morning, day, night) where M, D and N letters will display in that order. After the rotations are set, the full configuration is displayed afterwards. The user can use the reset button to change the configuration. Using the power button doesn’t delete the configuration. The user can press the enter button for a long time to test the device’s operation.

**Control interface**

Sketch of Control interface

Buttons and the functionality of each button

Power – Turns on and turns off device (without deleting the configuration)

Up – Increases number

Down – Decreases number

Enter – Selects number for a transient push and tests the operation of the device for a single roatation when kept pressed for a longer duration

Reset - Resets configuration

**Marketing**

The enclosure of our product will mainly be composed of PLA material not just due to the affordability, dimensional accuracy, and the ease of reprinting, but also, since it is derived from plant starches and is hence a more environmentally friendly approach than other selections such as ABS.

This material also has the convenient feature of being recyclable and compostable. Hence, in the case of any damage to the enclosure not subject to the conditions specified in the warranty, we will provide the customer the option to return his device in exchange for a small price. We can then recycle the material to create new units without having to procure new material. This will be beneficial both environmentally and in terms of profit.

A unit that faces a malfunction in its programming without being subjected to the terms specified in the warranty will require its circuitry to be replaced. To facilitate this, we will ensure the components of the final product are easily removable and that the schematics and parts are available for replacement. We predict that the revenue achieved from these replaceable parts will overcome the loss of profit experienced by not employing planned obsolescence. We also predict that the electronic waste dilemma could be resolved to a large extent by making repairability available. As the products grows to be more successful in the market, a manufacturing unit will be established to repair units with reparable defects.

**Budget**

The needed components are,

|  |  |
| --- | --- |
| Component | Price |
| AT mega 328p IC | Rs. 1150 |
| 555 timer IC | Rs. 15 |
| Capacitors and Resistors | Rs. 100 |
| 0.91-inch 128X32 OLED Display Module I2C IIC Serial Blue 3.3-5V | Rs. 900 |
| Push buttons x5 | Rs. 50 |
| Smd LEDs | Rs. 4 |
| Buzzer | Rs. 40 |
| AA Li-Ion batteries x2 | Rs. 800 |
| Charging module | Rs. 170 |
|  |  |
|  |  |

Each component costs no more than Rs. 1150. All these components will collectively cost around Rs. 3250.

For the enclosure we plan to utilize 3D printing which costs 1 dollar per cubic inch of PLA material internationally. Considering the complexity of our enclosure, the enclosure for our product was estimated to use 20-30 cubic inches. So, the enclosure alone was estimated to cost Rs.10 800 as an upper bound. Here one dollar was assumed to be equivalent to 360 Sri Lankan Rupees.

The PCB will cost around 2$ to 4$ according to the international market, so in Sri Lankan rupees it will cost Rs. 1440 as an upper bound.

So, the total cost of the prototype was estimated to be around Rs. 15 490.

**Manufacturing**

Number of Units

100 units are to be manufactured per month in the initial stage, With the gaining of the market quantity will be increased up to 500 per month at the maturity stage

Approximated cost

There are imported quality automatic fish feeding products in the Sri Lankan market, but they have less sales of high cost. Because of the dollar crisis in Sri Lanka, consumers have to pay around Rs. 10 000 for buy one but they are willing to buy such kind of a product around Rs 6000 (nearly price of an imported feeder before the dollar crisis)

Expected Price of the Product= Rs 6000

Price excluding 20 % VAT= = Rs 5000

20 % Profit margin= Rs 1000

Allowable cost per unit= Rs. 4000