

EEL 4914 Senior Design

Preliminary Design Report

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Fresh Water Aquarium Monitor

Team Name: “Finding Nemo”



Submitted by:

**Mike Arms
marms@ufl.edu
727.560.1663**

**Beth Spalding
beth02@ufl.edu
352.870.7232**

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I. Introduction

This project has very practical applications to almost every individual who has a small or large scale fresh water fish aquarium. For example, if a family leaves their home for a week long vacation, instead of trying to find someone to feed the fish while they are away, the fish monitor will feed the fish, monitor the temperature and PH levels, and adjust accordingly. This device will have great value for those individuals who value the health of their fresh water friends.

Existing commercial products are very costly and provide many features that the average aquarium owner may not use. Commercial available features include password protection, water conductivity, weather simulation, sunrise and sunset simulation, and ORP (oxidation reduction potential). All of these features are excess for the average owner. Costs range anywhere from \$150 upwards to \$400, more than an owner would want to pay if their aquarium only cost around \$50. Our product will minimize cost and provide only the basic features needed to successfully monitor and maintain a fresh water aquarium.

II. Abstract

This project was realized over the summer when a close friend received a fresh water aquarium as a gift. One afternoon, the fish were found with small white spots all over them. It turned out to be a bacterial infection and something that could have easily been prevented if the water temperature was kept between a certain level.

Project "Finding Nemo" aims to monitor and control the temperature, PH levels, and feed the fish in a fresh water fish aquarium. The temperature will be monitored using a basic temperature sensor and the temperature adjustment will be performed by turning on or off a light. The PH levels will be monitored using a PH sensor and the levels will be adjusted according to the user's discretion. The technical challenges this team will face is programming the monitor for temperature and PH, and working with the PH sensor. Sensors of this type typically are difficult to work with and on average, last only a year.

At the end of the term, this outcome we expect is to build a working aquarium monitor to monitor the temperature and PH levels within the tank. The device will be able to store user input as to when and how often the fish will be fed, at what temperature the water should be kept, and the required PH levels. It will provide feedback of the current levels and adjust the temperature accordingly if the levels are out of the specified user input.

III. Technical Objectives

This project will use basic DC wall power. There will be a temperature probe to monitor the water and another sensor to measure the pH. The pH levels can be adjusted at the user's discretion while the temperature will be corrected automatically. A step motor will be used to dispense food. A microprocessor will take in the data from the sensors and output the current level readings to an LCD screen. The user will input the range of acceptable conditions of the aquarium as well as the desired number of feedings per day on a keypad.

IV. Project Features

In order to minimize cost and facilitate ease of use, this product will have the necessary, but minimal features.

Main Objective

Our goal is to market this product to the average aquarium owner, so a basic, user-friendly product is a must.

Features

- *LCD Display* – this part of the device will be used to enter user-defined inputs for temperature, pH and fish feeding time, through basic push buttons and display the current temperature and pH levels.
- *Push-Button Input* – minimal push-buttons will be used as the means for entering the desired data.
- *Temperature monitoring and control* – the device will monitor and display the temperature of the aquarium, and if the temperature is out of the user-specified range, the device will turn on/off a lamp to adjust the temperature.
- *PH monitoring* – the device will monitor and display the current pH readings and notify the user if the pH is out of the user-defined range.
- *Fish feeder* – the device will contain a step motor with rotating cavity to feed the fish. At the user-defined time, the motor will dispense the food to the aquarium.

V. Concept/Technology

PIC Microcontroller

This type of microcontroller is also referred to as a *single-chip computer*. PIC stands for Programmable Interface Controller and it has many advantages. It is widely available, has a very low cost, wide range of available development tools, and serial programming capability. It has a variety of features including a CPU, RAM, ROM, I/O lines, can store and run a program, and many have serial and parallel ports along with A/D converters.

LCD Display

A basic LCD display will interface with the PIC Microcontroller in order to display the information pertaining to the temperature and pH sensors.

Temperature Sensor

This sensor will take analog temperature data, which will then be converted to digital format for use in the controller. There are many temperature sensors available that easily interface with the PIC Microcontroller.

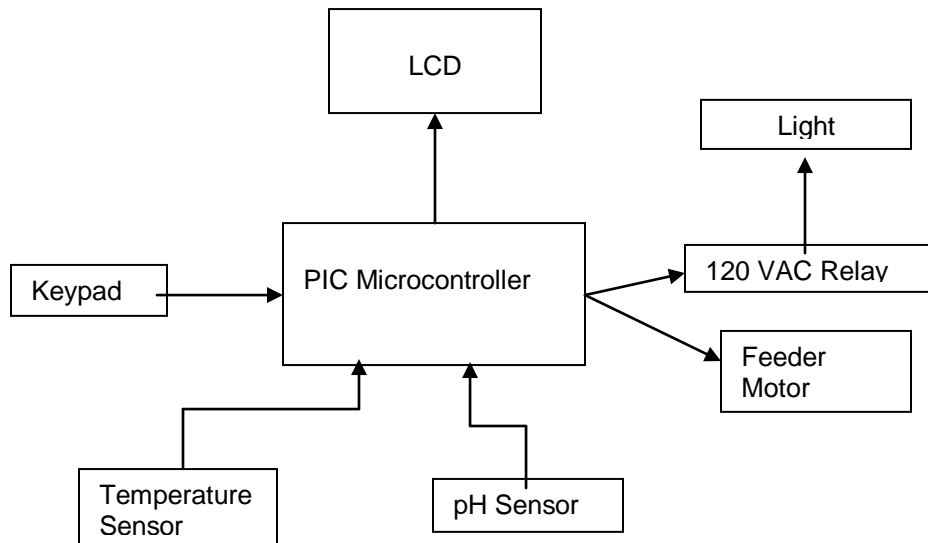
pH sensor

Testing the pH of the water will require more than what is required to test temperature. pH sensors test how basic or acidic the liquid is and can be translated into a concentration of hydrogen ions. The measurement ranges between 0 and 14. A very acidic solution has a low pH value from 0 to 2, corresponding to a large concentration of hydrogen ions. A basic solution has a high pH value from 12 to 14, corresponding to a small number of hydrogen ions. It is important to note that over time, the electrical properties in the pH measuring electrodes change, so the electrode will eventually have to be replaced.

Stepper Motor

The stepper motor is ideal for feeding the fish. It is different than a regular DC Motor. For a DC Motor, speed is measured in revolutions per minute and runs continuously. A stepper motor will run after a pulse of electricity. This pulse will rotate the motor by a predefined increment in a step fashion, hence the name stepper motor, and has a high degree of precision.

VI. Flowcharts & Diagrams



VII. Product Comparison

After deciding on this design product, we researched to see if there were any comparable existing products and what we found will be discussed here. We can see from the monitors introduced below that they are not only expensive, but have many more features than the average aquarium owner would need.

Digital Aquatics ReefKeeper 2

([AquaDirect Link](#))

Features – fully enclosed stand-alone device. PH monitor, interface with PC, several channels, different modes, timers, wavemaker, digital thermometer and temperature control,

fan/chiller control, high power



AquaController Jr, 3 and 3 Pro ([Neptune Systems Link](#))

Features – fully enclosed, stand-alone device. This device includes pH, Temperature, ORP, Cond and DO monitoring and control, Ethernet port, e-mail alarms, telnet server, lighting control, wavemaker, seasonal variations, digital calibration (a picture of each device is shown below).

Cost – \$149.95 to \$649.95



VIII. Gantt Chart

Number	Task	Start	End	Duration	Q3 - 2007			Q4 - 2007		
					July	August	September	October	November	December
1	Project Research	8/25/2007	9/15/2007	15			█			
2	Preliminary Design Report	9/10/2007	9/29/2007	15			█			
3	Order Parts	9/15/2007	10/1/2007	10			█			
4	Circuit Design	9/15/2007	10/10/2007	17			█			
5	Breadboard (Preliminary Assembly)	10/1/2007	10/30/2007	21				█		
6	Programming	10/1/2007	10/30/2007	21				█		
7	Preliminary Debug	10/15/2007	11/7/2007	17				█		
8	Mil PCB	11/1/2007	11/14/2007	9					█	
9	Debug/Testing	11/7/2007	11/30/2007	17					█	
10	Packaging	11/25/2007	12/1/2007	5						█
11	Fine Tune Project	11/25/2007	12/4/2007	6						█
12	Report	11/25/2007	12/4/2007	6						█
13	Final Presentation	12/4/2007	12/5/2007	1						█

RESPONSIBILITIES

Mike will be responsible for odd numbered tasks; Beth will be responsible for the even numbered tasks. The reports will be written by both team members, regardless if they fall on an even or odd numbered task.