FRIENDLY AQUARIUM CONTROL SYSTEM USING PIC

Mohd Akmal Hisyam B. Norruddin

Bachelor of Mechatronics Engineering

APRIL 2010

"I hereby declare that I have read through this report entitle "Friendly Aquarium Control System Using PIC" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Mechatronic Engineering"

Signature : .....

Supervisor's Name : Mrs. Irma Wani Binti Jamaludin

Date : 26 April 2010

FRIENDLY AQUARIUM CONTROL SYSTEM USING PIC

MOHD AKMAL HISYAM BIN NORRUDDIN

A report submitted in partial fulfillment of requirements for degree of Bachelor in Mechatronic Engineering

FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APRIL 2010

I declare that this report entitle "Friendly Aquarium Control System Using PIC" is the result of my own research except as cited in references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : Mohd Akmal Hisyam Bin Norruddin

Date : 26 April 2010

ACKNOWLEDGEMENT

Alhamdulillah, finally the Final Year Project (FYP) is complete. I take a great pleasure in this opportunity to thank many persons who generously advise and assist me while I was doing this Final Year Project (FYP) which it is a compulsory to all Universiti Teknikal Malaysia Melaka (UTeM) students to pass it before awarded with a degree.

First of all, I want to express my deepest thanks and gratitude to my project supervisor, Mrs. Irma Wani Bt. Jamaludin for her full support morally and physically, assistances, guidance, and tolerances, which is invaluable for me to complete my Final Year Project (FYP).

I also want to thank the panels, Mr. Mohd Shahrieel B. Mohd Aras and Mr. Ruzaini B. Hashim who were given me a good comment during my presentation and proof reading the final report. I also would like to take this opportunity to express my appreciation to my family and friends for their patients, understanding and also for the undivided support that they had given throughout the completion of my project.

Last, but not least I would like to thank all those who had helped and supported me all this long during my Final Year Project (FYP).

ABSTRACT

Many fish keepers cannot make any provision for feeding the fish because of their long vacation. Well-established aquariums tend to run on "auto-pilot" for longer periods of time when fish keepers are not around. The first stage in the project is to create the automatic lighting system that controlled by the user time setting. The fish keeper will set up the specified time of lights which need to be turn on and off using the relay. The second stage in the project is to display the water temperature in Celsius on Liquid Crystal Display (LCD) after measuring the temperature by using temperature sensor. It features an alarm setting for the programmed aquarium high or low temperature range. The alarm will make the alert flash if the water temperature falls outside the chosen range. The third stage in the project is to design and develop the automatic feeder fish that controlled by the user time setting. The automated fish feeder can feed the fishes on the certain amount as needed, unlike available commercial fish feeders. It is better to approximate the right amount of the food and the regularity of the feeding first before fish keepers left home. The timer mechanism will slowly turns the plate or drum, sequentially dropping the food into the aquarium as each compartment passes over an opening under the plate or drum. Overall, this project will design and develop a friendly aquarium control system by using PIC.

ABSTRAK

Ramai pemelihara ikan perhiasan tidak dapat menyelenggarakan waktu yang tepat untuk memberi makan ikan peliharaan mereka apabila tidak berada di rumah. Akuarium yang lengkap seharusnya mempunyai fungsi pilot automatik untuk tempoh masa yang lama bergantung kepada tempoh masa pemelihara tiada. Fasa awal projek ini adalah untuk mencipta satu sistem pencahayaan automatik yang dapat dikawal oleh pengguna melalui penetapan masa. Pemelihara ikan akan menentukan waktu yang dikehendaki untuk menghidup dan mematikan lampu menggunakan suis. Fasa kedua projek ini adalah untuk memaparkan suhu air di dalam sesebuah akuarium. Bacaan boleh ditentukan sama ada dalam bacaan Celsius dan dipaparkan pada paparan hablur cecair atau kristal cecair (LCD) selepas suatu bacaan diperolehi melalui sensor suhu. Mekanisma ini merangkumi satu aturan penggera untuk mengesan perubahan suhu yang telah ditetapkan. Penggera akan menghasilkan kerdipan diod pemancar cahaya (LED) jika suhu air di dalam akuarium tidak sama dengan suhu yang telah ditetapkan. Fasa ketiga projek adalah untuk merekabentuk serta membina satu alat pemberi makan makanan ikan automatik yang dapat dikawal dengan aturan waktu tertentu. Alat pemberi makan ikan automatik ini dapat memberi ikan makan pada jumlah yang dikehendaki, tidak sama seperti alat pemberi makan ikan komersial yang berada di pasaran sekarang. Oleh itu, apa yang harus dilakukan hanyalah untuk memastikan jumlah makanan ikan yang betul serta tahap kekerapan yang diperlukan sebelum pemelihara meninggalkan rumah. Mekanisma pengaturan secara perlahan akan memusingkan kepingan penghalang atau penutup dan seterusnya makanan ikan akan jatuh ke dalam akuarium mengikut jumlah yang telah ditetapkan. Keadaan ini akan berlaku setiap kali kepingan penutup itu melalui bukaan yang terdapat di bawahnya. Kepingan penutup akan berhenti berpusing apabila jumlah makanan ikan yang jatuh ke dalam akuarium telah mencukupi mengikut jumlah yang telah ditetapkan.

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LCD – Liquid Crystal Display

PLC – Programmable Logic Circuit

EEPROM – Electrically Erasable Programmable Read-Only Memory

DC – Direct Current

RTDs – Resistant Temperature Detectors

IC – Integrated Circuit

W – Watts

AC – Alternating Current

DVDT – Deferential Voltage Deferential Time

RC – Remote Control

RTC – Real Time Clock

MCU – Microcontroller Unit

SQW/OUT – Square Wave / Out

MSB – Most Significant Bit

I2C – Inter – Integrated Circuit

MHz – Mega Hertz

S1 – Switch 1

S2 – Switch 2

LED – Light Emitting Diode

.ASM – Assemble

.1ST - Information

.MCL – Macro Command Language

.HEX – Hexadecimal

PIC – Peripheral Interface Controller

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CHAPTER 1

INTRODUCTION

1.1 Background of the Project

This project will ensure the lighting and the temperature aspect of the aquarium as well as its fish feeder are be well maintained. Besides this, it will reduce the time spending of maintaining an aquarium. With this design, one can freely go for holiday for days without worrying to trouble friends or neighbors to help feeding the fish, or to on and off the aquarium light and monitor its water.

1.2 Problem Statement

Plants and fishes will respond better to consistent lighting periods. Fish fed during the day should be allowed 30 minutes of light during feeding. When deciding on how much light to provide, a range of 1 to 3 watts per gallon will provide most fresh water aquariums with optimal plant growth and visual presentation.

Fish is "cold-blooded" and maintain the same body temperature as its environment. It is extremely important to maintain a constant temperature as the sudden changes will cause stress problem to the fishes and become one of the reasons for the fish to easily get deceases. It is recommended that the water temperature is verified on a daily basis.

Many fish keepers cannot make provision for their fish feeding time when they went for a long vacation. Most tropical fish are surprising in their ability to fast. The automated fish feeder can feed fish as much or as little as user wants, unlike available commercial fish feeders. It is better to estimate the amount of food and the frequency of feeding they need.

1.3 Objective

The objectives of this project are:

i. To design a lighting system for the aquarium using timer.
ii. To display water temperature in the aquarium on LCD.
iii. To detect when the water temperature is falls outside the chosen range.
iv. To design an automatic practical fish feeder.

1.4 Scope

There are four main scopes to achieve through this project. Firstly, use the PIC 16F877A as the main controller in the system. Secondly, the real time clock is an integrated circuit that keeps track of the current time. This is to make sure the project functioned base on the time set. Thirdly, a 240 V relay is used to control the current to the circuit board before the feeding time. Lastly, the RC servo motor is used to control the rotation of the feeder container enclosure.

1.5 Summary

In this chapter, the background, problem statement, objective and scope of the project have been discussed. These elements are very important to describe the whole of the project and to assess the ability of students to solve problems based on engineering field. The reference for this project will continue in the next chapter.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, reviews from previous projects researches that are related with this project are being well discussed. The information from the reviews are become the additional sources for this project as to complete it more successfully. It is also will help to enhance the original idea of this project with the reviews pros and cons.

2.2 Aqua Kleen Aquarium Water Changer and Cleaner

This project was designed by Ramesh Rajandran to make the feeding process of an aquarium become easier. Feeding the fishes is almost ignored by the fish keeper on the certain time when they are busy with their daily work.

Ramesh Rajandran used a Programmable Logic Controller (PLC) as the main controller. Each and every move of this project is controlled by an EEPROM. All the connections are made to the Programmable Logic Controller (PLC) from each and every part of the project including the food feeding device, which is giving an output signal for automation. [1]

propagate. However, temperature variation can be detrimental to some species and in the most cases; a relatively constant temperature is the goal.

The larger the volume of the water, the easier it becomes to control the temperature, because of the high specific heat of the water creates a high thermal mass that resists rapid changes in the temperature.

In the past, only the most sophisticated and expensive instruments were adequate for monitoring and controlling aquaculture systems. However, today there are many new developments in the solid state electronic which are bringing down the cost and increasing the reliability of sensors and instruments. The following are several review of the sensors and instruments system usage to monitor some of the parameters of an aquaculture system.

2.3.1 Liquid – Filled Thermometer

The liquid – filled thermometer is the simplest and the most economical way to measure the temperature. The thermometer will indicates the temperature by the expansion and contraction of mercury or alcohol in a scaled glass column. A common type used in aquaculture is a sealed unit that floats in the water.

These thermometers are accurate, simple and reliable, but also prone to breakage and cannot be interfaced with a control system. They are most appropriately used as a back-up to the other temperature indicators and for calibration of the other temperature sensors.

2.3.2 Bimetallic and Gas Bulb Thermometer

Both of these thermometer are mechanical and can be used to indicate temperature on a dial or used to either open or close an electrical switch such as those used on the most common thermostats. These types of thermometer are very simple, reliable and can be interfaced with electronic systems.

2.3.3 Thermocouple

Two wires of dissimilar metals are connected at each end to generate a voltage that related to the temperature difference between the two junctions. There are six common types of thermocouples depending on the kinds of the metal used to make them. They have wide operating ranges but have very low DC voltage outputs.

Due to this low voltage, in the past thermocouples could only be used with very expensive instrumentation; however, advances in solid state electronics have greatly reduced the price of the instrumentation to the point where it is a practical method of measuring temperature today. These sensors are very inexpensive if you make your own. Simply cut the wires to the length desired and soldered the ends together. Thermocouples are very practical when you want to measure the temperature at numbers of location.

2.3.4 Resistant Temperature Detectors (RTDs) and Thermistors

Resistant temperature detectors and thermistors work on the principle of resistance changing with the changing in the temperature. This resistance can be measured and calibrated to a temperature scale which can be electronically displayed. Although the principle of the operation is completely different, RTDs and thermocouples are very similar from a user's point of view. Thermocouples usually

are more flexible in application and have a better long-term stability than the RTDs. However, the RTDs and the thermistors have much higher temperature sensitivity than the thermocouples, thus this requiring a less sophisticated electronics.

2.3.5 Integrated Circuit (IC) Transducer

An integrated circuit transducer is a solid-state microelectronic circuit that is contained in a transistor – like housing and has an output voltage or current proportional to its temperature when supplied with a constant current or voltage. IC transducers are very reliable and simple to use and interface with control circuits.

They have the advantage of being a completely packaged temperature indicator in comparison to the thermocouples and RTDs which must be connected to any electronic circuit. IC transducers, sometimes called IC sensors, are very linear, are pre-calibrated and cost about the same as RTDs and thermocouples. Still they do have a limited temperature range (minus 85° to 125° Celsius). However, this should not be a problem with aquaculture operations.

2.3.6 Microcontroller

Microcontroller is an enhanced microprocessor. In addition to the microprocessor, a microcontroller typically contains several parallels and serial ports, system clock generators, data and program memory, timers, counters, interrupt logic, analog-to-digital converters, digital-to-analog converters and even digital signal processing subsystems on the same chip. Thus, a single-chip microcontroller may be placed in an application to perform as an embedded controller with no other support chips.

Microcontroller that can be programmed by means of an interview with the aqua culturist may be available soon. In the meantime, microcontroller can still be

developed to monitor and control most of the parameters in an aquaculture production facility, but may require a considerable cooperative effort among the aqua culturist, engineer and hardware and software suppliers.

Microcontroller allows large amounts of the real-time data to be collected, providing a basic for improving the efficiency of the production system as it operates. A precisely – controlled environment that minimizes stress on the aquatic organism and reduces grow out period.

For example, if the system is completely automated with the microcontroller, including the monitoring of feed, growth rate of fish and energy utilization, simple experiments can be run to determine whether it is economically feasible to increase the water temperature in order to increase the growth rate. In the other words, the aqua culturist can continually improve the efficiency of the operation by observing its performance under different operating conditions.

2.4 Mecha Tank

The fluorescent light is attached to a sensor mounted in view of daylight so that the "night" and "day" times of the tank follow those of the environment. An ideal fish tank would have its environment follow closely the natural environment. This means that if the tank was indoors, its light must follow the natural cycle of night and day because some fish would require such for breeding purposes. [3]

The simple idea of using a photocell resistor is to detect the environment outdoors light and use it as a condition to either switch on the 16W fluorescent lamp or turn it off. Since the lamp needs 120VAC to operate, we used a relay to switch between the different power supplies. The lists of parts used are one unit of 5VDVDT Relay and one unit of 16w fluorescent lamp.

Another great improvement would be to design the fluorescent lamp to dim according to the natural light, so that it has dusk till dawn effect rather than just either