



UNIVERSITI PUTRA MALAYSIA

**DEVELOPMENT OF A WATER TEMPERATURE AND PH
MEASUREMENT SYSTEM FOR FISH PONDS**

JASMAN BIN JAFFAR

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AND PH MEASUREMENT SYSTEM FOR FISH
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MASTER OF SCIENCE
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By

JASMAN BIN JAFFAR

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science

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Dedicated to my parent,

Haji Jaffar bin Haji Mohamed and Hajjah Nik Zainab binti Yusof

My beloved wife,

Nik Roshayati binti Nik Abdul Rahman

My beloved daughters and sons,

Syazana binti Jasman

Zulhilmi bin Jasman

Faiz bin Jasman

Syamimi binti Jasman

for their endless support



Abstract of thesis presented to the Senate of University Putra Malaysia in fulfilment
of the requirement for the degree of Master of Science

**DEVELOPMENT OF A WATER TEMPERATURE AND PH
MEASUREMENT SYSTEM FOR FISH PONDS**

By

JASMAN BIN JAFFAR

JANUARY 2009

Chairman : Dr. Mohd. Nizar bin Hamidon, PhD

Faculty : Engineering

Breeding fish in the pond is one of the main sources of food to Malaysian. Water is an important medium for fish and other organisms which live in it. The aquaculture activities such as fish breeding in the pond depend on the suitable water quality. The water quality is one of the major factors in determining a good quality of fish and optimum earning.

Fish Breeder needs some knowledge about water quality because the aquaculture activities will face high risk if the quality of water is out of the standard level.

Water Temperature and pH Measurement System is vital in controlling the water quality so that the problem regarding the water quality can be detected early, if weather changes suddenly such as heavy rain or increased in whether temperature. This instrument also will help to ensure the produce of fish and the quality which are not affected due to the water quality factor.



This research is aiming in developing a digital measurement device which can determine the water quality parameter in the pond. It also gives an early warning in avoiding the process to the fish growth in the pond. By using this instrument, fish breeder can detect the changes in water quality that influence the growth and the health of the fish.

The digital measurement system is for monitoring the parameter of water quality for pH and temperature. This digital measurement can be applied at a location of the pond. It is portable equipment, cheap and reliable for water quality monitoring. This instrument was built using microcontroller AT89S52 with pH and temperature sensor together by Liquid Crystal Display (LCD) and keypad to be used easily.

The programming language is used to write the program to determine the water quality parameter value which detected by the sensors and show the each parameter value at LCD then remind the fish breeder the situation of water quality in the pond.

This measurement device is tested at Pusat Ternakan Ikan, Lembaga Kemajuan Pertanian Kemubu (KADA), KM 24 Keteroh, Kelantan and this testing was done at various ponds. This measurement device is very useful and easy to use without needs more technical knowlegde. The fish breeder can take immediate action if water quality parameter which been measured higher than the standard measurement.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**MEMBINA SISTEM PENGUKURAN PH DAN SUHU AIR UNTUK
TERNAKAN IKAN DALAM KOLAM**

Oleh

JASMAN BIN JAFFAR

JANUARI 2009

Pengerusi : Dr. Mohd. Nizar bin Hamidon, PhD

Fakulti : Kejuruteraan

Ternakan ikan dalam kolam adalah merupakan satu sumber makanan bagi rakyat Malaysia. Air adalah medium yang penting bagi ikan dan organisma-organisma lain yang hidup dalam air. Aktiviti akuakultur seperti ternakan ikan dalam kolam bergantung pada kualiti air yang sesuai bagi ternakan tersebut. Penjagaan kualiti air bagi ternakan ikan dalam kolam merupakan faktor yang penting untuk menentukan hasil pengeluaran ikan yang optimum dan kualiti ikan yang baik.

Penternak ikan memerlukan pengetahuan berkenaan kualiti air kerana aktiviti akuakultur menghadapi risiko yang tinggi jika berlaku perubahan paras kualiti air yang tidak sesuai bagi ternakan ikan dalam kolam.

Sistem pengukuran pH dan suhu air diperlukan untuk memantau paras parameter kualiti air supaya masalah berkaitan kualiti air dapat dikesan lebih awal jika perubahan cuaca secara mendadak seperti hujan lebat atau panas terik. Dengan adanya instrumen ini, hasil dan kualiti ternakan tidak akan terjejas disebabkan faktor kualiti air.

Kajian ini bertujuan membina satu alat pengukuran digital yang dapat menentukan parameter kualiti air dalam kolam dan memberi amaran awal bagi mengelakkan gangguan kepada tumbesaran ikan. Dengan menggunakan alat pengukuran ini, penternak ikan akan dapat mengesan perubahan kualiti air yang boleh mempengaruhi tumbesaran dan kesihatan ikan.

Sistem alat pengukuran digital bagi mengawasi parameter kualiti air ini terdiri daripada pH dan suhu. Alat pengukuran digital ini boleh diaplikasikan di lokasi kolam ternakan sebagai peralatan mudah alih, murah dan boleh dipercayai untuk memantau parameter kualiti air.

Alat ini dibina dengan menggunakan sistem pengawal mikro ATMEL AT89S52, penderia pH dan suhu bersama-sama paparan cecair kristal (LCD) serta papan kekunci bagi memudahkan penggunaan.

Bahasa pengatur digunakan untuk menulis atur cara bagi menentukan nilai parameter-parameter kualiti air yang dikesan oleh penderia. Setiap bacaan parameter kualiti air akan dipaparkan melalui paparan cecair kristal (LCD) dan mengingatkan penternak ikan keadaan semasa kualiti air dalam kolam tersebut tersebut.

Alat Pengukuran Digital ini telah diuji di Pusat Ternakan Ikan, Lembaga Kemajuan Pertanian Kemubu (KADA), KM 24 Ketereh, Kelantan dan pengujian ini telah dijalankan di dalam beberapa jenis kolam. Alat pengukuran ini sangat berguna dan senang digunakan tanpa memerlukan pengetahuan teknikal. Penternak ikan boleh bertindak dengan segera jika paras kualiti air yang diukur melebihi paras yang dibenarkan.

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I certify that a Thesis Examination Committee has met on 16 January 2009 to conduct the final examination of Jasman bin Jaffar on his thesis entitled “Development of a Water Temperature and pH Measurement System for Fish Ponds” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1988. The Committee recommends that the student be awarded the Master of Science.

Members of the Thesis Examination Committee were as follows:

Sudhanshu Shekhar Jamuar, PhD

Professor,
Faculty of Engineering
University Putra Malaysia
(Chairman)

Adznan Jantan, PhD

Associate Professor,
Faculty of Engineering
University Putra Malaysia
(Internal Examiner)

Samsul Bahari Mohd. Noor, PhD

Lecturer
Faculty of Engineering
University Putra Malaysia
(Internal Examiner)

Ibrahim Ahmad, PhD

Professor
Faculty of Engineering
Universiti Tenaga Nasional
(External Examiner)

BUJANG KIM HUAT, PhD

Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 19 March 2009



This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Mohd. Nizar bin Hamidon, PhD

Faculty of Engineering
University Putra Malaysia
(Chairman)

Norhisham bin Misron, PhD

Faculty of Engineering
University Putra Malaysia
(Members)

Rahman bin Wagiran, Msc

Senior Lecturer
Faculty of Engineering
University Putra Malaysia
(Members)

HASANAH MOHD. GHAZALI, PhD

Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 9 April 2009



DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institutions.

JASMAN BIN JAFFAR

Date: 2 March 2009

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LIST OF ABBREVIATIONS

ALU	Arithmetic Logic Unit
ADC	Analog Digital Converter
ALE	Address Latch Enable (ALE)
ASCII	American Standard Code for Information Interchange
C	Celsius
CMOS	Complementary Metal-Oxide Semiconductor
CPU	Central Processing Unit
DAS	Data Acquisition System
DC	Direct Current
EOC	End of Conversion
E	Enable
H ⁺	Hydrogen Ion
HEX	Hexadecimal
IO	Input Output
ISP	In System Programming
KHz	Kilo Hertz
LCD	Liquid Crystal Display
LED	Light Emitting Diode
mV	Mili-volt
NH ₃	Ammonia
NH ₄ Cl	Ammonia Chloride
OE	Output Enable
PCB	Printed Circuit Board
PIC	Programmable Interface Controller



pH	Potential of Hydrogen
pF	pico Farad
pKa	Log Ka
RAM	Random Access Memory
ROM	Read Only Memory
RS	Register Select
RST	Reset
RW	Read Write
SC	Start Conversion
SFR	Special Function Register
V	Volts
V _{in}	Voltage Input
V _{out}	Voltage Output
μA	Micro ampere

CHAPTER 1

INTRODUCTION

1.1 Introduction

The water quality from one activity to another is difference. For example, water quality for agriculture is not same with water quality for fish breeding in the pond. Water quality in the pond is very important because the effect from quality of water can slow the growth of the fish in the pond and also may cause the death of the fish.

A digital instrument has been built to help fish breeders to determine the water quality parameter. This parameter can measured the pH level and temperature of water then show the desirable range that needed for fish production, slow growth and will cause the death of the fish (Claude, 1979). The digital measurement that used in determining the water quality is ATMEL AT89S52 microcontroller to analysis the data from the sensors. This digital measurement can be applied at the location of the pond and also as portable equipment for water quality monitoring.

This research is divided into two main component, hardware design and software development as shown in Figure 1.1. The hardware consists of the sensor circuit, data conversion, microcontroller based system and Input/Output unit. The software development consists of writing the program via assembly language, compiling, assembling and loading the machine code into microcontroller.

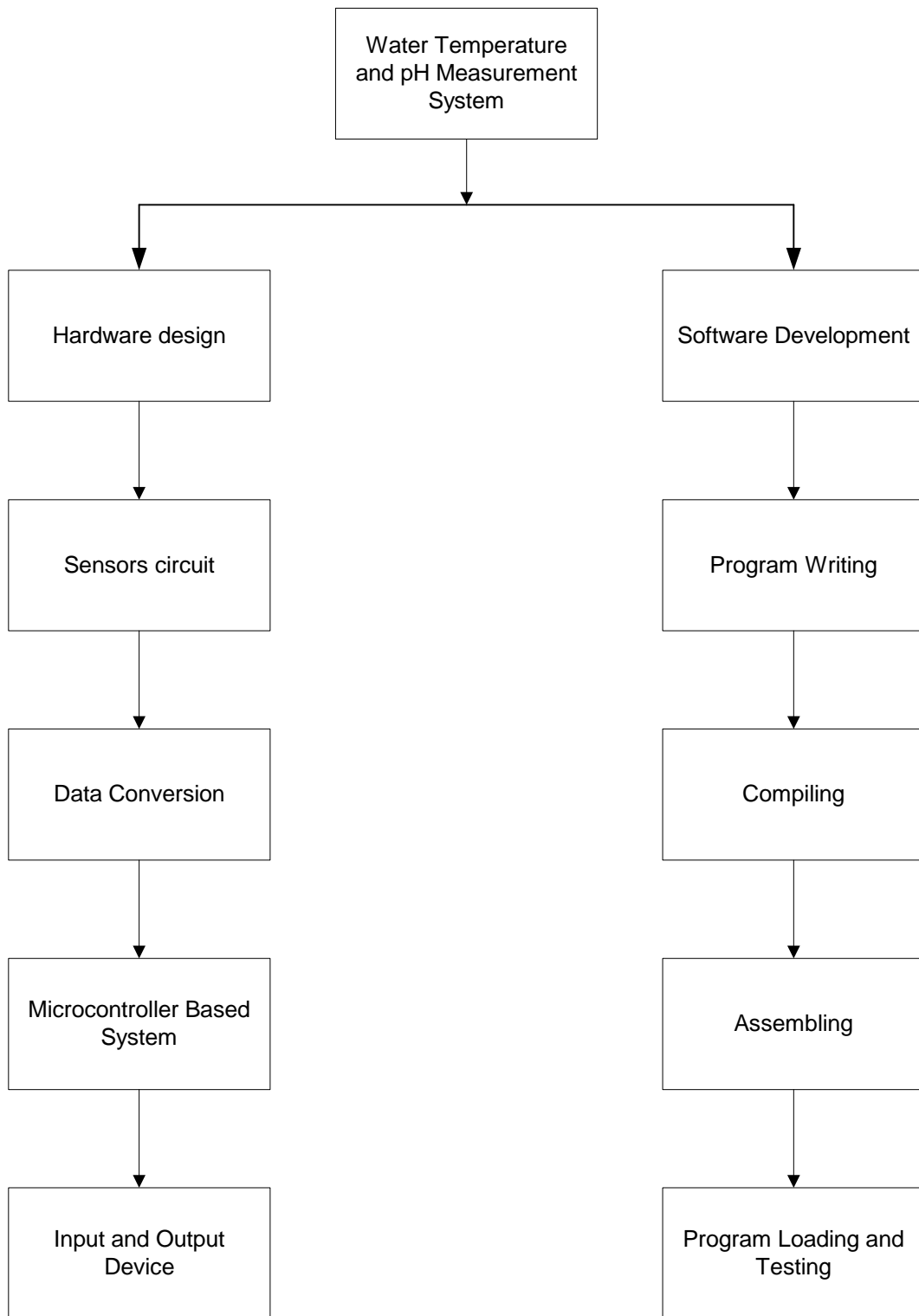


Figure 1.1. The Digital Measurement Structure

1.2 Problem Statement

Seventy percent of the earth area is consist of water where the water is one of the most important valuable natural resource of life for the humans, animals and plants. Water quality in the fish pond is very essential for fish breeders. Fish breeding is one of the contributor factors for sources of food and an economy source in Malaysia.

Our country will face a short of fish if the fish breeder in pond facing the water quality problem which causes a production of fish was decrease. The important water quality parameter for fish in pond are pH, Temperature, Conductivity, Salinity, Chlorine, Ammonia and Dissolved Oxygen (Claude, 1979). Therefore, a research which executed will help in determine water quality observation to avoid problem to fish breeding in pond.

An importance pH and temperature parameter is chosen for this research because these parameters can influence fish growth in pond. These parameters also can be measured at in-situ test by using an electronic sensor without needs the laboratory analyses. The others parameter needs the laboratory analyses to determine Dissolved Oxygen (DO), Ammonia and Saltness. Beside that, the changes of pH and temperature level can influence fish health in pond. There are some impact will be happen on fish if pH level changes in water as fish become stress and causes death (Wurt and Durborrow, 1992). Fish production will be optimum level if pH water among 6.5 to 9.0 (Claude, 1979).

Impacts which happen on fish if temperature changes acutely, Padilah, et al. (2003) explain that fish movement will become fast. Masser (1997) also claimed that

temperature changes can causes death on fish. The effect of pH and temperature will be discusses on detail in Chapter 2.

The problems to determine a water quality in pond can reduce if have one digital measurement device which can determine water quality parameters. Although the temperature and pH measurement had exist, a digital measurement device was built will be help the fish breeder in pond early detect a situation of water in the pond. So that, the production rate will be at optima level and avoid death to fish. Hence, fish production in pond will increase the growth of Malaysia economic income.

1.3 Research Objective

The main objective of this research is to design, construct and test a Water Temperature and pH measurement system for determining fish pond water quality parameter that can be used to avoid problem to fish breeding in pond regarding with quality of water. In order to achieve the objectives in this research, the following activities were carried out.

- i. Design and develop the hardware of the planned system
- ii. Characterize the pH and temperature sensor to determine the water quality.
- iii. Develop the software for microcontroller to find out the water quality parameters.
- iv. Apply the digital measurement system in fish pond to measure the water quality parameters effectively.

1.4 Applications

The digital measurement system for determining fish pond water quality parameter that can be used for;

- i. Monitoring the water quality in the fish pond
- ii. Water treatment in purifier plants
- iii. Water quality control in lakes or rivers
- iv. Measurement device at laboratory

1.5 Scope of Research

Scope of this research is to characterize the sensors for water pH and temperature. The major component of designs digital measurement for determining fish pond water quality parameter is by microcontroller based system and sensor conditioning circuit. Therefore, a scope of this research also to design the microcontroller based system with interfacing circuit and joint with the sensor and then develops the software to measure the water quality parameter. The signals were produce by sensor usually in the analog form as voltage, frequency and capacitance and so on, where this signals varying in time. Normally sensor will change a measured value such as temperature, speed or velocity to electrical signal either voltage or current. Electrical signal such as voltage must be change in the digital form because a microcontroller can only interpret and analyse data in the digital form. Data Acquisition System (DAS) accepts analog input signals and provide digital output. An Analog Digital Converter (ADC) is actually just one part of what is called a data acquisition system.