

DEVELOPMENT OF AN UNDERWATER DEPTH  
AND TEMPERATURE MEASURING DEVICE

LIM YU YAO

FACULTY OF SCIENCE AND TECHNOLOGY  
UNIVERSITY COLLEGE OF SCIENCE AND TECHNOLOGY MALAYSIA  
2004



**1100028952**

LP 13 FST 2 2004



1100028952

Development of an underwater depth and temperature measuring  
device / Lim Yu Yao.



**PERPUSTAKAAN**  
KOLEJ UNIVERSITI SAINS & TEKNOLOGI MALAYSIA  
21030 KUALA TERENGGANU

**1100028952**

1100028952	

Lihat sebelah

**HAK MILIK  
PERPUSTAKAAN KUSTEM**

# DEVELOPMENT OF AN UNDERWATER DEPTH AND TEMPERATURE MEASURING DEVICE

By

LIM YU YAO

Research Report submitted in partial fulfillment of  
the requirement for the degree of  
Bachelor of Science (Marine Science)

Department of Marine Science  
Faculty of Science and Technology

This project should be cited as:

Lim, Y.Y. 2004. Development Of An Underwater Depth and Temperature Measuring Device. Undergraduate Thesis, Bachelor of Science in Marine Science, Faculty of Science and Technology, Kolej Universiti Sains dan Teknologi Malaysia, 76p.

**1100028952**



**JABATAN SAINS SAMUDERA  
FAKULTI SAINS DAN TEKNOLOGI  
KOLEJ UNIVERSITI SAINS DAN TEKNOLOGI MALAYSIA**

**PENGAKUAN DAN PENGESAHAN LAPORAN  
PROJEK PENYELIDIKAN I DAN II**

Adalah ini diakui dan disahkan bahawa laporan penyelidikan bertajuk:

Development of an underwater depth and temperature sensor oleh Lim Yu Yao, No. Matrik: UK 5884 telah diperiksa dan semua pembedaan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Samudera sebagai memenuhi sebahagian daripada keperluan memperolehi Ijazah Sarjana Muda (Sains Samudera), Fakulti Sains dan Teknologi, Kolej Universiti Sains dan Teknologi Malaysia.

Disahkan oleh:

Penyelia Utama

Nama: Prof. Madya. Dr. Khalid bin Samo

Cop rasmi: **PROF. MADYA DR. KHALID SAMO**  
Timbalan Dekan  
Pusat Pengajian Siswazah  
Kolej Universiti Sains dan Teknologi Malaysia  
Mengabang Telipot  
21030 Kuala Terengganu.

Tarikh: .....

Ketua Jabatan Sains Samudera

Nama: Prof. Madya. Dr. Kamaruzzaman bin Yunus

Cop rasmi: **PROF. MADYA DR. KAMARUZZAMAN B. YUNUS**  
Ketua  
Jabatan Sains Samudera  
Fakulti Sains dan Teknologi  
Kolej Universiti Sains dan Teknologi Malaysia  
21030 Kuala Terengganu.

Tarikh: .....

## ACKNOWLEDGEMENTS

First of all, I would like to express my gratitude to Associate Prof. Dr. Khalid bin Samo of his precious guidance, advice, and monitoring throughout this project.

Also thanks to Electronic and Instrumentation Lab Science Officer, Mr. Azizi for his help in the lab. Thanks to my marine science coursemates (Meng Ho, Poh Oo, Wel Kean, Jimmy, Boon Poh, John, Johnson, Siew Peng, Dor, Ching Hui, Hou, Kuan Thai and Yee Ching), and my marine biology counterpart (Winnie, Lo, We Ling, Chong Ling and Mun Heang) that always provided me with advice and support. Thank you all for sharing and caring.

To my family, they will always in my heart wherever I may be, whatever I may do.

Lim Yu Yao

Bachelor of Marine Science

2004

## TABLE OF CONTENTS

ACKNOWLEDGEMENT	ii
TABLE OF CONTENTS	iii
LISTS OF TABLES	vii
LISTS OF FIGURES	viii
LIST OF ABBREVIATIONS	ix
LIST OF APPENDIX	x
ABSTRAK	xi
ABSTRACT	xii
1.0 INTRODUCTION	1
1.1 Objectives	3
2.0 LITERATURE REVIEW	
2.1 Measurement	4
2.1.1 Definition	4
2.1.2 Advancement	4
2.1.3 Depth	5
2.1.4 Temperature	5
2.2 Electronic Instrumentation	6
2.2.1 Definition in Marine Environment	6
2.2.2 Subsystem	7



2.2.3	Terminology	9
3.0	METHODOLOGY	
3.1	Theoretical Approach	12
3.2	Materials	12
3.2.1	Depth Sensor, FPBS-04A	12
3.2.2	Temperature Sensor, LM 35	13
3.2.3	Object Oriented Programmable Intergrated Circuit (OOPic)	14
3.2.4	Electronic Component	15
3.2.5	Measurement Devices	16
3.2.6	RS-232C Serial Cable	16
3.2.7	Hyper Terminal Software	16
3.2.8	9 Volt Battery	16
3.3	Circuits	
3.3.1	Circuit Used for Depth Sensor	17
3.3.2	Circuit Used for Temperature Sensor	17
3.4	Assembling Procedures	
3.4.1	First Phase (Depth)	18
3.4.2	Second Phase (Temperature)	18
3.4.3	Final Phase (Depth and Temperature)	19
3.5	OOPic Programming	
3.5.1	First Phase (One Sensor)	21

3.5.2	Second Phase ( Both Sensor)	21
3.5.3	Final Phase (Both Sensor with Linear Equation)	21
3.6	Calibration Experiments	
3.6.1	Depth Calibration	22
3.6.2	Temperature Calibration	22
3.7	Repeatability Test	23
4.0	RESULT	
4.1	Measuring Device	24
4.2	OOPic Programming	
4.2.1	First Phase (One Sensor)	25
4.2.2	Second Phase (Both Sensor)	31
4.2.3	Final Phase (Both Sensor with Linear Equation)	36
4.3	Calibration Experiments	
4.3.1	Depth	37
4.3.2	Temperature	40
4.4	Repeatability Test	
4.4.1	Depth	43
4.4.2	Temperature	46
5.0	DISCUSSION	
5.1	Depth Measurement	49
5.2	Temperature Measurement	50

5.3	Power Supply	50
6.0	CONCLUSION	51
7.0	SUGGESTION	52
	REFERENCES	53
	APPENDIX	55
	CURRICULUM VITAE	76

## LISTS OF TABLES

Table		Page
4.1	Output voltage from multimeter and Hyper Terminal at depths from 5 cm to 90 cm	37
4.2	Output voltage measured by multimeter and Hyper Terminal from temperature 10°C to 35°C	40
4.3	Output voltage measured with Hyper Terminal from 1 to 100 seconds	43
4.4	Comparison of measured temperature with standard thermometer and Hyper Terminal	46

## LIST OF FIGURES

Figure		Page
3.1	Theoretical approach of measuring device	12
3.2	Depth amplifier circuit	17
3.3	Depth circuit (actual scale)	18
3.4	Temperature circuit (actual scale)	19
3.5	Block diagram for final phase	19
3.6	Housing of the sensors	20
4.1	Top view of measuring device	24
4.2	Depth sensor's output voltage measured by multimeter	38
4.3	Depth sensor's output voltage measured by Hyper Terminal	38
4.4	Deviation of depth sensor's output voltage measured by multimeter and Hyper Terminal	39
4.5	Temperature sensor's output voltage measured by multimeter	41
4.6	Temperature sensor's output voltage measured by Hyper Terminal	41
4.7	Deviation of temperature sensor's output voltage measured by multimeter and Hyper Terminal.	42
4.8	Change in measured output voltage with time	44
4.9	Temperature measured by Hyper Terminal compared to the temperature measured by standard thermometer	47
4.10	Deviation of temperature measured with Hyper Terminal	48

## LIST OF ABBREVIATIONS

$^{\circ}\text{C}$	Degree Celsius
v	Voltage
$v_i$	Input voltage
$v_o$	Output voltage
$v_r$	Reference voltage
$v_s$	Source voltage
I	Current
$\Omega$	Ohm
Pa	Pascal
m	Meter
DC	Direct Current
AC	Alternating Current

## LIST OF APPENDIX

Appendix		Page
1	OOPic R	55
2	OOPic R Schematic	59
3	Fujikura FPBS Depth Sensor Data Sheet	60
4	LM 35 Precision Centigrade Temperature Sensor	63

## ABSTRAK

Alat pengukuran elektronik digunakan untuk mengukur, memproses dan menyimpan data data kuantitatif. Pengukuran data yang tepat boleh digunakan untuk membuat model-model alam persekitaran seperti tasik dan laut. Alat pengukur yang tepat bergantung kepada data yang dimasukkan dan hipotesis/teori model. Dimana kedua-dua faktor itu bergantung kepada penyampelan data. Terdapat pelbagai jenis alat pengukuran kedalaman dan suhu bawah air di pasaran. Alat-alat sedemikian mahal dan susah dikendalikan semasa penyelenggaraan. Satu alat pengukuran dibina untuk menguji teknik-teknik pengukuran kedalaman dan suhu air. Alat pengukuran itu gagal mengukur kedalaman air dalam konsol Hyper Terminal kerana perubahan voltan output yang cepat, manakala suhu dapat diukur pada julat 10 °C to 35 °C pada ketepatan  $\pm 3$  °C pada suhu bilik.



## ABSTRACT

Electronic measurement instruments are used to measure, process and record the massive quantitative data. Precise quantitative data obtained through sampling could generate useful environment models of water bodies such as lake and sea. The technological ability of system control is largely based on the quality of the adopted models and the data fed into them: both the models and the data depend on measurements. A wide range of commercial instrument is available to measure underwater temperature and depth. The instruments are expensive to maintain and purchase. A simple measuring device was developed locally to test the feasibility of measuring underwater depth and temperature. Underwater depth is not measurable in the measuring device developed because of a fast varying output signal, while temperature is measurable at a range from 10 °C to 35 °C with an accuracy of  $\pm 3$  °C at room temperature.