

**SMART POOL SYSTEM BASED ON  
WIRELESS SENSOR NETWORK**

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**Bachelor Of Mechatronics Engineering**

**2009**

I declare that this report entitle “Smart Pool System Base on Wireless Sensor Network” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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**SMART POOL SYSTEM BASE ON WIRELESS SENSOR NETWORK**

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**This report is submitted in partial fulfillment of requirements for the degree of Bachelor Of  
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To my beloved mother and family

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## ABSTRACT

Wireless Sensor Network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure or motion at different locations. ZigBee is a wireless mesh networking standard being developed by an international consortium to provide open, reliable, low-power wireless communication. The purpose of the WSN is to form the network and communicate with computer to enable the data logging from the pool that positioning at the WSN. This project is to develop the monitoring system of water in the pool base on WSN by apply Zigbee as a main wireless network device to communicate the sensor and computer. This project consists of two component, software and hardware component. For software component a Graphical User Interface (GUI) is designed using Borland C++ builder and the design of the sensor circuit for monitoring the water parameter such as temperature, water level, pH level, water quality, water in and water out indicator in the hardware component. The completely integrated WSN device is then evaluated through some experiment to confirm the performance and reliability of the monitoring system.

## ABSTRAK

Rangkaian Penderia Tanpa Wayar adalah peranti rangkaian tanpa wayar yang terdiri daripada bahagian penyebaran automatik yang menggunakan peranti pengesan untuk bekerjasama memantau keadaan fizikal atau keadaan persekitaran, seperti suhu, bunyi, getaran, tekanan dan pergerakan di lokasi-lokasi yang berlainan. Kegunaan WSN adalah untuk membentuk rangkaian dan berkomunikasi dengan komputer untuk membolehkan data diambil daripada kolam yang diletakkan peranti WSN. Projek ini adalah membangunkan satu sistem pemantauan tanpa wayar berasaskan WSN dengan mengaplikasikan ZigBee sebagai peranti rangkaian tanpa wayar yang berkomunikasi di antara penderia dan komputer. Projek ini mengandungi dua komponen, perisian dan perkakasan. Untuk komponen perisian Antaramuka Pengguna Grafik direkabentuk menggunakan perisian Borland C++, dan bagi komponen perkakasan pula litar penderia untuk mengesan parameter air seperti suhu, paras air, tahap pH, kualiti air, penunjuk masukan dan penunjuk keluaran air direkabentuk. Peranti WSN yang telah diintegrasikan sepenuhnya diuji dalam satu eksperimen, tahap prestasinya bagi memastikan kebolehpercayaan alat ini untuk digunakan dalam sistem pemantau.



## TABLE OF CONTENTS

CHAPTER	CONTENTS	PAGE
	DECLARATION	iii
	DEDICATION	iv
	ACKNOWLEDGEMENT	v
	ABSTRACT	vi
	ABSTRAK	vii
	TABLE OF CONTENTS	viii
	LIST OF TABLES	xii
	LIST OF FIGURES	xiii
	LIST OF ABBREVIATIONS	xvi
	LIST OF APPENDICES	xix
1	INTRODUCTION	1

1.2	General Introduction	1
1.2	Problem statement	1
1.3	Objective of This Project	2
1.4	Scope of Project	2
1.5	Outline of Project Report	3
<b>2</b>	<b>BACKGROUND AND RELATED WORK</b>	<b>4</b>
2.1	Literature Review of Past Works	4
2.1.1	Study Case 1 on WSN Application: Habitat Monitoring.	5
2.1.2	Study Case 2 on WSN Application: Gait Analysis and Real-Time Feedback Shoe-Integrated Sensor System.	7
2.1.3	Study Case 3 on WSN Application: Precision Agriculture.	9
2.1.4	Study Case 4 on WSN Application: Water Quality Monitoring.	10
2.2	Theories Behind The Work	12
2.2.1	WSN Overview.	12
2.2.2	IEEE 802.15.4 Standard Overview	12
2.2.3	ZigBee Overview	14
2.2.3.1	Z-Stack Overview	14

2.2.3.2	Technology	15
2.2.3.3	Protocol Stack System	16
2.2.3.3.1	Physical Layer	17
2.2.3.3.2	MAC Layer	19
2.2.3.3.3	Network Layer	20
2.2.3.3.4	Application Layer	21
2.2.3.4	Network Topology	21
2.2.3.4.1	Coordinator (PAN- Personal Area Network)	22
2.2.3.4.2	Full Function Device	23
2.2.3.4.3	Reduced Function Device	23
2.2.3.5	Data Transmission	23
2.2.4	Sensor	25
2.2.4.1	Temperature	26
2.2.4.2	Water level	28
2.2.4.3	Float-Level Sensor	28
2.2.4.4	PH sensor	29
2.2.4.5	Water quality sensor	31
2.2.5	Software for the Graphical User Interface (GUI).	31
2.2.5.1	Borland C++ Builder	31
2.2.5.2	LabVIEW	32
2.2.5.3	Visual Basic	32

<b>3</b>	<b>DESIGN AND CONFIGURATION</b>	<b>33</b>
3.1	Methodology	33
3.2	Literature Review and Technical Research	34
3.3	Design GUI and ZigBee Developer kit (ZigBee Dev.) Configuration	35
3.3.1	Design Graphical User Interface (GUI)	35
3.3.2	ZigBee Developer Kit (ZigBee Dev.) Configuration	35
3.4	Integration GUI with ZigBee	36
3.5	Construct Electronics Sensor Circuit and Connect the Sensor Circuit to ZigBee	37
3.5.1	Temperature Sensor	37
3.5.2	Water Level Sensor.	39
3.5.3	PH sensor	40
3.5.4	Water quality sensor	43
3.6	Calibrate Sensor on GUI Programming	44
3.6.1	Temperature sensor	45
3.6.2	Water Level Sensor.	46
3.6.3	PH Sensor	48
3.7	Performance analysis.	49
3.7.1	Title of Experiment	50
3.7.2	Objectives of Experiment	50
3.7.3	Background of Experiment	50

3.7.3.1	Receiver Energy Detection (ED)	50
3.7.3.2	Link Quality Indicator (LQI)	51
3.7.4	Procedure of Experiment	51
3.7.4.1	Procedure of Experiment 1	51
3.7.4.2	Procedure of Experiment 2	53
<b>4</b>	<b>RESULT AND ANALYSIS</b>	<b>55</b>
4.1	Hardware Design	55
4.2	Hardware Configuration	57
4.3	Running The System	58
4.3.1	Discussion of Result	61
4.4	Measurement Result	61
4.4.1	Temperature	62
4.4.2	Water Level	63
4.4.3	pH Level.	64
4.4.4	Discussion of Result.	65
4.4.5	Water Quality and Water In/Water Out Indicator.	65
4.4.6	Discussion of Result	66
4.5	Coverage Performance Analysis	66
4.5.1	Measurement Outdoor Environment	67
4.5.1.1	Measurement Result.	67
4.5.1.2	Discussion of Result.	68

4.5.2	Measurement Indoor Environment	68
4.5.2.1	Measurement Result	68
4.5.2.2	Discussion of Result	69
<b>5</b>	<b>CONCLUSION AND FUTURE WORK</b>	<b>70</b>
	<b>REFERENCES</b>	<b>71</b>
	<b>APPENDICES</b>	<b>73</b>

## LIST OF TABLES

<b>TABLE</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	LR-WPAN devices Architecture.	13
2.2	ZigBee Technology	15
2.3	Frequency Band and Data rate.	17
2.4	General MAC Frame Format	20
2.5	A pH glass electrode description	30
3.1	ZigBee Pin Configurations	36
3.2	Component for water quality sensor	44
3.3	ADC parameter	45
3.4	Temperature vs. voltage	45
3.5	Temperature Configuration Value.	46
3.6	Level vs. voltage	46
3.7	Level configuration value.	47
3.8	Voltage corresponding pH level	48
3.9	pH configuration value.	49
4.1	Voltage and resistance value for thermistor output.	62
4.2	Voltage and resistance value for water level sensor output	63
4.3	pH sensor testing result.	65
4.4	Average value of LQI between Coordinator and End Device for different distance and direction	67

## LIST OF FIGURES

NO	TITLE	PAGE
2.1	System architecture for habitat monitoring	6
2.2	Schematic of the Shoe-Integrated Gait Sensors (SIGS)	8
2.3	Photos of the first prototype of the SIGS	8
2.4	Lofar Agro setup	9
2.5	Sensor node location	11
2.6	Sensor node configuration	11
2.7	IEEE 802.15.4 Standard Layer	13
2.8	Different part of ISO model shared by customer ZigBee Stack and IEEE.	17
2.9	Star Topologies	21
2.10	Mesh Topologies	21
2.11	Cluster Tree	22
2.12	Coordinator to Device	24
2.13	Device to Coordinator	25
2.14	Thermistor wiring diagram.	27
2.15	A float-level sensor that uses a float and arm to activate a limit switch when the liquid level is high enough.	28/29
2.16	pH glass electrode construction	30
3.1	Methodology Flow Chart.	34
3.2	ZMN2430HP Block Diagram	35
3.3	Block Diagram Representation of the Host	36
3.4	(a) Shrinking tube and (b) glue use to cover the wire connected to the thermistor.	37
3.5	Thermistor covers by stringing tube and glue.	37
3.6	Thermistor circuit	38
3.7	The connection of the thermistor on the board.	38



3.8	Voltage divider circuit	39
3.9	Variable resistor circuit.	39
3.10	Fix the variable resistor to the holder	40
3.11	Connect the variable with determinant blade.	40
3.12	Negative 3 volt Circuit	41
3.13	3 volt power supply circuit	41
3.14	PHE-1304-NB pH sensor electrode.	42
3.15	pH sensor connector.	42
3.16	Power supply circuit.	43
3.17	Water quality sensor use phototransistor	43
3.18	Graph Temperature vs. voltage	45
3.19	Graph Level vs. voltage	47
3.20	Graph pH vs. voltage	48
3.21	Coordinator and End Device positioning	52
3.22	Coordinator and End Device positioning	54
3.23	Project Planning Chart	54
4.1	The Cirronet ZMN2405HP ZigBee module	55
4.2	The Cirronet ZMN2405HP ZigBee module (Coordinator) Integrate with the computer.	56
4.3	Temperature sensor and the circuit connection.	56
4.4	Water level sensor and the circuit connection.	56
4.5	pH sensor and the circuit connection.	57
4.6	Water Quality sensor and the circuit connection.	57
4.7	The hardware Connection.	57
4.8	The hardware that has been attached at the	58
4.9	Comport Setting	58
4.10	Main Spool GUI	59
4.11	Main Spool GUI after connected to the ZigBee module	59
4.12	Spool GUI	60
4.13	Pool monitoring windows	60
4.14	Spool system monitoring windows.	61

4.15	Temperature Windows in Spool Screen	62
4.16	Graph of Temperature Comparison.	63
4.17	Water level windows	64
4.18	Graph of Water Level Comparison.	64
4.19	pH level windows	65
4.20	Water Quality Windows	66
4.21	Water in Indicator Windows	66
4.22	Water out Indicator Windows	66
4.23	Graph of Link Quality Indicator based on data in Table 4.4	67
4.24	Graph of Link Quality Indicator for a distance at 0 degree direction	68
4.25	Average value of LQI between Coordinator and End Device for different	69

## LIST OF ABBREVIATIONS

A/D	- Analog To Digital
ADC	- Analog To Digital Converter
ADCX,	- Analog To Digital Converter X
ADCY	- Analog To Digital Converter Y
ADCZ	- Analog To Digital Converter Z
ADO	- ActiveX Data Object
API	- Application Programming Interface
BPSK	- Binary Phase Shift Keying
CSMA/CA	- Carrier Sense Multiple Access/Collision Avoidance
CCA	- Clear Channel Assessment
COM	- Component Object Model
DACs	- Digital To Analog Converter
DAO	- Data Access Object
DAQ	- Data Acquisitions
DSSS	- Direct Sequence Spread Spectrum
DC	- Direct Current
DO	- Dissolved Oxygen
ED	- Receiver Energy Detection
FFD	- Full Function Device
FSRs	- Force Sensitive Resistors
GUI	- Graphical User Interface
GDI	- The Great Duck Island
GTS	- Guaranteed Time Slot
IDE	- Integrated Development Environment
I/O	- Input/Output
ISM	- Industrial Scientific And Medical

ISO	- International Organization For Standardization
JTAG	- Joint Test Action Group
LabVIEW	- Laboratory Virtual Instrumentation Engineering Workbench
LCD	- Liquid Crystal Display
LDR	- Light Dependent Resistors
LED	- Light Emitting Diode
LQI	- Link Quality Indication
MAC	- Media Access Control
MHz	- Mega Hertz
NVRAM	- Non-Volatile Random Access Memory
OAD	- Over The Air Download
OS	- Operating System
OSI	- Open Systems Interconnection
PAN	- Personal Area Network
PC	- Personal Computer
PHY	- Physical
PPDU	- Protocol Data Unit
PIC	- Peripheral Interface Controller
PSM1	- Projek Sarjana Muda 1
PSM2	- Projek Sarjana Muda 2
PVDFs	- Polyvinylidene Fluoride, A Piezoelectric Material
RAD	- Rapid Application Development
RAM	- Random Access Memory
RDO	- Remote Data Object
RF	- Radio Frequency
RFD	- Reduced Function Device
ROM	- Read Only Memory
RTD	- Resistance Temperature Detectors
SiO <sub>2</sub>	- Silicon Dioxide
SIGS	- The Shoe-Integrated Gait Sensors
SPI	- Serial Peripheral Interface

- SSCS - Service Specific Convergence Sub-Layer
- USB - Universal Serial Bus
- VB - Visual Basic
- WPAN - Wireless Personal Area Network
- WSN - Wireless Sensor Networks
- WYSIWYG - What You See Is What You Get
- XML - Extensible Markup Language
- ZC - Zigbee Coordinator
- ZCP - Zigbee Compliant Platform
- ZED - Zigbee End Device
- ZR - Zigbee Router
- ZDO - Zigbee Device Object

## LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	Spool GUI Programming Code.	73
B	Zigbee Module Developer's Kits	95

# CHAPTER 1

## INTRODUCTION

### 1.1 General Introduction

A wireless sensor network is a collection of nodes organized into a cooperative network [1]. Each node consists of processing capability may contain multiple types of memory, have a RF transceiver, have a power source, and accommodate various sensors and actuators. The nodes communicate wirelessly and often self-organize after being deployed in an ad hoc fashion.

Smart pool system used WSN as an intercession tool between electronic sensor and computer. The electronic sensors measuring the pool water condition and the information transmit to the computer through WSN network which is connected to the computer. The electronic were are used to measured the water conditions consist of temperature, water level, pH level, water quality, inlet and outlet water indicator.

All of the data collected at the WSN then connected to the computer which shows graphically using the graphical user interface (GUI). The GUI communicates with WSN node assigned as coordinator through USB, and the WSN coordinator forms the network with other WSN device assigned as a router or end-device which is connected to the electronic sensor.

### 1.2 Problem Statement

Nowadays many house and hotel constructed the pool to enhance the comfortability at their place. The pools must have a system to monitor and to control the parameters that determine the quality of the water in the pools. Below are some of the characteristic of the old pool system that is possible to be upgraded.

1. High cost maintenance and high power consumption in the conventional transmission system using cable or wire.
2. Manual data collection is inaccurate and not properly stored.
3. The available pool system cannot be monitored from far away.
4. Manual pool system requires lot of time to manage the operation.

### **1.3 Objective of This Project**

Objective of this project are:

1. To apply Wireless Sensor Network system based on ZigBee standard for monitoring the pool.
2. To build Graphical User Interface (GUI) in purpose to displays the value of parameter on the pool graphically at the PC.
3. To develop hardware Wireless Sensor Network and integrate with software (GUI)
4. To make performance analysis of the monitoring system.

### **1.4 Scope of Project**

The scope of the project is to:

- Study on the wireless sensor network (WSN) and apply it to the monitoring system.
- Study about Borland C++ Builder Software to develop the graphical User Interface (GUI).
- Study and implementation of the ZigBee based wireless module integration with PC (GUI).
- Construct the electronic circuit of temperature sensor, pH sensor, level sensor and quality sensor for water monitoring purpose.

### **1.5 Outline of Project Report**

This report composed of 5 chapters. The content for each chapter as a following: