

# WIRELESS WEATHER STATION BY USING ZIGBEE

AHMAD NAQUIDDIN BIN AHMAD SAAHIRY

This Report Is Submitted In Partial Fulfillment Requirements For The  
Bachelor Degree Of Electronic Engineering (Telecommunication)

Faculty Of Electronic And Computer Engineering  
Universiti Teknikal Malaysia Melaka

JUNE 2014

**WIRELESS WEATHER STATION BY USING ZIGBEE**

**AHMAD NAQUIDDIN BIN AHMAD SAAHIRY**

**JUNE 2014**



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

**BORANG PENGESAHAN STATUS LAPORAN**

**PROJEK SARJANA MUDA II**

**Tajuk Projek** : WIRELESS WEATHER STAION BY USING ZIG BEE

**Sesi Pengajian** :

Saya AHMAD NAQUIDDIN BIN AHMAD SAAHIRY

(HURUF BESAR)

mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (  ) :

**SULIT\***

\*(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

**TERHAD\*\***

\*\* (Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

**TIDAK TERHAD**

Disahkan oleh:

\_\_\_\_\_  
(TANDATANGAN PENULIS)

\_\_\_\_\_  
(COP DAN TANDATANGAN PENYELIA)

“I hereby declare that this thesis entitle WIERLESS WEATHER STATION BY USING ZIG BEE is the result of my own effort with exception of excerpts cited from other work of which the source were duly noted”

SIGNATURE : .....

NAME : AHMAD NAQUIDDIN BIN AHMAD SAAHIRY

DATE : .....

“I declare that I have read this work and in my opinion this work is adequate in term of scope and quality for the purpose of awarding a Bachelor’s Degree Of Electronic Engineering (Telecommunication)”

SIGNATURE : .....

NAME : MR. ROSMAN BIN ABD RAHIM

DATE : .....

**To my beloved parents**

Ahmad Saahiry bin Abd Rahman and Saleha Binti Othman

**My siblings**

Nurul Atiqah, Ahmad Afiq, Ahmad Al hadi, Ahmad Hakimi

**My supervisor**

Mr. Rosman Bin Abd Rahim

**All of my friend**

For their support, motivation and inspiration

## ACKNOWLEDGEMENT

First and foremost, I would like to express my heartily gratitude to my Supervisor, Mr Rosman Bin Abd Rahim for the guidance and enthusiasm given throughout the progress of this final year project.

My appreciation also goes to my family who has been so tolerant and supports me all these years. Thanks for their encouragement, love and emotional supports that they had given to me.

I would also like to thank our Final Year Project and Fabrication Lab Technician, En. Imran bin Mohammed Ali for their co-operations, guidance and helps in fabricate the PCB of this project.

There is no such meaningful word than.....Thank You So Much

## ABSTRACT

This project is about designing and development of the wireless weather by using XBee S2, microcontroller Arduino Uno R3, sensors temperature and humidity and other several devices. The main problem is to monitoring the weather in long distance, in the market have the product but is too expensive to own it. The objective of this project is to made monitoring system that can measurement weather that can monitoring anywhere and anytime, the output of this project can be display on LCD of PC monitoring, the LCD will display the temperature, humidity and other result, on the PC monitor it will display the result measurement continuous. Microcontroller used is Arduino Uno R3 is the better than PIC it because is microcontroller is easy to used just need to upload coding and ready to used, the microcontroller function is to collect the data from the sensors and will send to XBee S2 transmit to send to XBee S2 receive, the distance of the XBee S2 is 10m to 90m. The advantage of this project is low cost, easy to carry, lighter and provide distance measurement of weather.



## ABSTRAK

Projek ini adalah mereka dan membangun kaji cuaca tanpa wayar dengan menggunakan XBee S2, pengawal mikro Arduino Uno R3, sensor suhu dan kelembapan dan lain-lain beberapa peranti . Masalah utama adalah untuk memantau cuaca di jarak jauh, di pasaran mempunyai produk tetapi terlalu mahal untuk dimiliki. Objektif projek ini adalah untuk sistem pemantauan dibuat yang boleh pengukuran cuaca yang boleh memantau dimana-mana dan bila-bila masa , keluaran dari projek ini boleh menjadi paparan pada “LCD” pemantauan “PC”, “LCD” akan memaparkan suhu, kelembapan dan selain itu pada “PC” memantaunya akan memaparkan ukuran hasil yang berterusan . pengawal mikro digunakan adalah “Arduino Uno R3” adalah lebih baik daripada PIC kerana adalah pengawal mikro adalah mudah untuk digunakan hanya perlu memuat naik pengekodan dan bersedia untuk digunakan , fungsi pengawal mikro adalah untuk mengumpul data dari sensors dan akan hantar ke XBee S2 menghantar untuk hantar ke XBee S2 menerima, jarak yang XBee S2 adalah 10m untuk 90m . kelebihan projek ini adalah kos rendah , mudah untuk dilaksanakan, lebih ringan dan memberikan ukuran jarak mengukur cuaca.

## TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	<b>REPORT STATUS VERIFICATION FORM</b>	<b>ii</b>
	<b>DECLARATION</b>	<b>iii</b>
	<b>SUPERVISOR CONFIRMATION</b>	<b>iv</b>
	<b>DEDICATION</b>	<b>v</b>
	<b>ACKNOWLEDGEMENT</b>	<b>vi</b>
	<b>ABSTRACT</b>	<b>vii</b>
	<b>ABSTRAK</b>	<b>viii</b>
	<b>TABLE OF CONTENTS</b>	<b>ix</b>
	<b>LIST OF TABLES</b>	<b>xiii</b>
	<b>LIST OF FIGURES</b>	<b>xiv</b>
	<b>LIST T OF ABBREVIATION</b>	<b>xvi</b>
<b>1</b>	<b>INTRODUCTION</b>	
	1.1 Project Introduction	1
	1.2 Objective	2
	1.3 Problem Statement	2
	1.4 Scope of project	3
	1.5 Chapter organization	5

<b>2</b>	<b>LITERATURE REVIEW</b>	<b>6</b>
2.1	Literature review overview	6
2.2	Preview Work	7
2.2.1	Oregon Scientific WMR 968 Wireless Weather Station	9
2.2.2	LA Cross Technology Ws-2308 Complete Wired/Wireless	11
2.2.3	DG 950 Digital Wireless Home Wind & Weather Station	13
2.3	Present Work	16
2.4	Summary	16
<b>3</b>	<b>METHODOLOGY</b>	<b>20</b>
3.1	Introduction	17
3.2	Design flow	18
3.3	Hardware and Development	19

3.3.1	Arduino Uno R3	20
3.3.2	XBee Sheild	26
3.3.3	DHT11 Temperature and Humidity Sensors	29
3.3.4	Hitachi HD44780 LCD Keypad Sheild	32
3.3.5	USD Cable	32
3.3.6	Plastic Cases	34
3.4	Development of Wireless Weather station	34
3.5	Software Development	38
3.6	Hardware Development	42
<b>4</b>	<b>RESULT AND DISCUSSION</b>	<b>44</b>
4.1	Introduction	44
4.2	Result	44
4.5	Discussion	46
<b>5</b>	<b>CONCLUSIONS AND RECOMENDATIONS</b>	<b>47</b>
5.1	Conclusion	47
5.2	Recommendation	48

<b>REFERENCES</b>	49
<b>APPENDIX A</b>	50
<b>APPENDIX B</b>	54
<b>APPENDIX C</b>	57
<b>APPENDIX D</b>	59

**LIST OF TABLES**

<b>TABLE</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	Specification Of Model WMR 968	10
2.2	Specification Of Model Ws 2308	12
2.3	Specification Of Model DG 950	15
3.1	Summary of Arduino Uno R3	21
3.2	Pin Signal For XBee Shield	28
3.3	Specification of DHT11	29
3.4	Detail Of DHT11	30

## LIST OF FIGURES

<b>FIGURE</b>	<b>TITLE</b>	<b>PAGE</b>
1.1	DHT 11 Temperature and humidity Sensors	4
2.1	RF Transceiver	7
2.2	Sensor HS 1101	9
2.3	Sensors LM 335	9
2.4	Oregon Scientific WMR 968 Wireless Weather Station	9
2.5	LA Cross Technology Ws-2308 Complete Wired/Wireless	11
2.6	DG 950 Digital Wireless Home Wind & Weather Station	13
3.1	Flowchart Of The Project	18
3.2	Hardware Block Diagram	19
3.3	Hardware Arduino Uno	20
3.4	Input And Output Of Arduino Uno	20
3.5	XBee Without Shield	26
3.6	XBee With Shield	27
3.7	DHT11	29
3.8	Hitachi HD44780	32
3.9	USD Cable	32
3.10	Plastic Cases	34

3.11	XBee and XBee without Shield	35
3.12	Com Test/ Query Modem	35
3.13	Setting Modem Configuration	36
3.14	Terminal	37
3.15	IDE	38
3.16	IDE Software Launch	39
3.17	Communication Serial Call Response	40
3.18	Project Coding	40
3.19	Upload Arduino Uno Program	40
3.20	Uploading Sketch Tx and Rx	41
3.21	Done Uploading	41
3.22	Board For Circuit	42
3.23	The Circuit	42
3.24	Connection Two Circuit	43
3.25	XBee S2	43
4.1	Arduino Sketch	44
4.2	The Result LCD Hitachi HD 44780	45
4.3	The Result PC	45



**LIST T OF ABBREVIATION**

cm	–	centimeter
Hz	–	Hertz
V	–	Volt
LCD	–	liquid crystal display
IO	–	Input/output
E	–	Enable
R/W	–	Read/Write
RS	–	Register select
CRT	–	Cathode ray tube
IDE	–	Integrated development environment
A/D	–	Analog to digital
DC	–	Direct current
GND	–	Ground
CTS	–	Clear To Send
Vcc	–	IC Power Supply

## CHAPTER 1

### INTRODUCTION

#### 1.1 Introduction

Wireless Weather Station is used worldwide for climatology monitoring is facility with instruments and equipment observing atmospheric condition to provide information for weather forecasts. It is a device that can monitor temperature and humidity of the surrounding.

The wireless weather station, develop in this project is more economical but it is still on high cost and need more improvement to complete this project. For safety, the remote station must be cover to avoid any unexpected situation.

The wireless weather station developed in this PSM consists of a base station and remote station that include a temperature and humidity sensor to take measurement of the weather conditions. The remote station collects and transfers data through the Arduino Uno and Hitachi HD 44780. The base station XBee receives will receive the incoming data XBee transmit from C-TU software and transfer it to laptop or computer and Hitachi HD 44780.

Furthermore, wireless weather station using the Arduino Uno as a microcontroller, XBee shield, DHT11 Humidity and Temperature Sensor to collect a data and Hitachi HD 44780 and

computer as the output display. The program that has been upload are XBee Shield, Hitachi HD 44780 and DHT11 Humidity and Temperature Sensor into Arduino Uno.

This project also make our life easier and can get the result as soon as possible. By using DHT11 the reading for more accurate in temperature and humidity is more accurate compare other sensor. In this we use zig bee basics the can transmit the signal 10 to 90 m other than we use zig bee pro than can transmit the signal 10 to 750 m because this project use in small area only, for the controller, use Arduino uno R3 the controller allows for faster transfer rates and more memory. No drivers needed for Linux or Mac and the ability to have the Uno show up as a keyboard, mouse, joystick, others. This project is fully developed wireless station by using XBee that can be used anytime n anywhere.

## **1.2 Objectives of project**

The objectives of this project are:

- i. Implement a general purpose mini weather system based on wireless sensors station using some basic components like microcontroller Arduino Uno R3, DHT11, Zig Bee and other components.
- ii. To create an attractive and friendly user wireless weather station.
- iii. To build a wireless weather station that has transmitter and receiver digital data system.

## **1.3 Problems Statement**

The main concern of this project will be about its temperature and humidity. It is because this project is more compact and smaller compared to existing wireless weather station. As for that, it will gain more people interest in our product.

In addition to that, this project is simpler in its design thus making it more innovative. Due to our wireless weather station for being small and compact, it will make it easier to carry anywhere and lighter compared to normal wireless weather station. For example, travelling or to any expeditions.

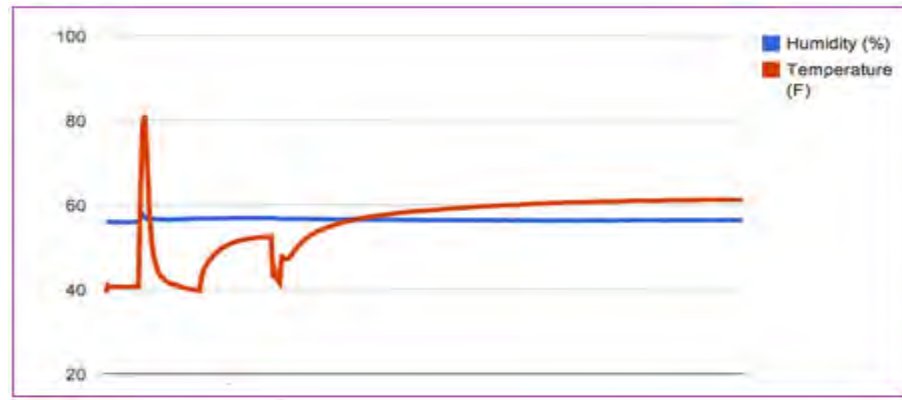
But the most unique thing about this wireless weather station is using Arduino Uno as microcontroller. Existing wireless weather station only used PIC 16F873 and this microcontroller is more complex and such an old fashion of microcontroller. This project also used other ARDUINO tools as our hardware. Namely Hitachi HD 44780 and DHT11 Temperature and Humidity Sensor. The program for Arduino is friendly user because it is less complex.

As for that, this project can also be used commercially for agriculture industry, research home owners and government agencies. This will be advantages for this project.

#### **1.4 Scope of project**

This project focused on the how to make this weather station to be wireless that anyone or anywhere can check about temperature and humidity around us easily.

Firstly, find the step for built this project. Before start anything, firstly must decide which one item that want to used. For example, many items can detect temperature and sensor such as LM 335but for this project is suitable withDHT11 Temperature and Humidity Sensor because it can detect and read it perfectly. This is proved by this graph.



**Figure 1.1:** Function of this graph is to check DHT11 Temperature and Humidity Sensor is function or not.

The first spike for the temperature is breathing onto the sensor. The gradual rise means it can detect hot or high temperature because breathe is  $C_2O$ . The sharp drop is when took it out to reprogram it. Then the next rise is it being back in again. For the humidity, actually the straight line is function or still reading. When the temperature is higher, the humidity is lower. When the temperature is lower, the humidity becomes higher.

Secondly is learning and find components function in project and find any connection in all hardware. In this session, are getting a very long time to find the items. For this project, it very concerned about the quality, price and convenience to make program. Besides that, also need to make a purchase by mail because the item is not in the market at Kuala Lumpur.

## 1.5 Chapter organization

This report consists of five chapters. Chapter 1 is about the problems statement, objectives of project, scopes of project, significant of project and chapter organization.

Chapter 2 will discuss more on theory and literature review about the component that used in this project. This section also contains the previous researches that have been collected from different sources for the development of the project.

Chapter 3 is about the design and methodology of the project. It will explain the methods in details such as the connection of the circuit and the device in order to complete the circuit.

Chapter 4 is about the result and discussion of this project. It will show the student observation in this project.

Chapter 5 will discuss the conclusions and recommendations for the further research when the others students want to upgrading the system in the future.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 History

Throughout the years, it was discovered that this project is not the first to build a Wireless Weather Station. There are several other Wireless Weather Stations that have been built and most of them use different hardware and software. So, in this section, I decided to take other projects to make a brief comparison with this project, wireless weather station. We will point out the types of hardware and software used in previous projects with the ones that had been used to build this wireless weather station.

Previous projects may have used old hardware devices or software that is complex and hard to find anymore. These are some of the disadvantages that the previous projects have and this leads to findings to use newer technology to make some improvement in our project.

## 2.2 Previous Work

### i. RF Transceiver

The different between previous wireless weather station projects is the connection part. The previous work used RF Transceiver while this project is using XBee Shield as the access point. RF Transceiver is a device comprising both a transmitter and a receiver which are combined and share common circuitry or a single housing. When no circuitry is common between transmit and receive functions, the device is a transmitter-receiver. The size is also big. Besides that, the RF Transceiver uses RF modules for high speed data transmission. The microelectronic circuits in the digital-RF architecture work at speeds up to 100 GHz. So, it had been replacement by XBee Shield. Using XBee Shield is as the access point is much easier to set up rather than using RF transceivers. Although both use radio frequency, RF transceiver in previous project used TX5002 for the transmitter and RX5002 for the receiver. Besides that, for setting up the XBee Shield, we only need to use program instead of designing a circuit.



**FIGURE 2.1:**RF Transceiver