UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PORTABLE WEATHER MONITORING SYSTEM

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Computer Engineering Technology (Computer Systems) with Honours

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Computer Engineering Technology (Computer Systems) with Honours. The member of the supervisory is as follow:

……

Mohd Saad bin Hamid

(Supervisor)

ABSTRAK

Kebelakangan ini, Arduino menyediakan sumber platform prototaip yang terbuka, yang memudahkan pelaksanaan dari segi penderia dan elemen interaktif. Kemudian, teknologi penderia telah dibangunkan dan telah digunakan secara meluas dalam bidang industri, pertanian, perubatan dan banyak lagi. Untuk menyelesaikan penghantaran data pada jarak pendek dan campur tangan manusia yang kadang-kadang menyebabkan isu ralat paralaks dan ketahanan dalam mengukur parameter cuaca. Masyarakat memerlukan sesuatu untuk memantau perubahan cuaca yang tidak dijangka di sekeliling kita. Projek ini bertujuan untuk mewujudkan Sistem Pemantauan Cuaca Mudah alih yang mengukur keadaan cuaca menggunakan penderia seperti suhu, kelembapan, tekanan atmosfera dan ketinggian. Kepentingan maklumat tersebut adalah ia dapat membantu komuniti dalam bidang pertanian dan juga perindustrian. Bacaan ditunjukkan menerusi Paparan Hablur Ceacir (LCD). Projek ini dibangunkan dengan menggunakan NodeMcu ESP8266, penderia DHT11 dan BMP180 sensor barometer. Peranti ini cukup berguna untuk individu yang melakukan aktiviti luar seperti mendaki atau merentas hutan. Dengan bantuan sensor DHT11 dan sensor BMP180 yang membolehkan pengguna untuk memantau keadaan cuaca yang berubah-ubah. Selain itu, data dari LCD juga direkod dan juga boleh diakses dengan telefon pintar berdasarkan dari sambungan yang telah disediakan oleh modul Wi-Fi.

ABSTRACT

In recent years, Arduino provides an open source hardware prototyping platform, which allows an easy implementation of sensors and interactive elements. Then, the development of sensor technology has been used broadly in the fields of industry, agriculture, medicine and many more. In case of low communication rate and short-distance data communication and human intervention that sometimes resulted in issue of parallax error and durability in measuring the weather parameters. In the need of something to monitor the unexpected weather changes around us. This project is about to create a Portable Weather Monitoring System based on Arduino that measures the condition of the weather using sensors such as temperature, humidity, atmospheric pressure and altitude. The important of the information is it can help the in the agricultural and industry fields. The reading is shows on the Liquid Crystal Display (LCD). This project is developed by using NodeMcu ESP8266, DHT11 sensors, and BMP180 barometric sensor. This devices is useful for outdoor activities such as hiking or jungle trekking. With the help of DHT11 sensor and BMP180 sensor that providing user to monitor the changing condition of the weather. Besides, it also record the data from the LCD and also can be accessed with the smartphone based from the connectivity that been provided by the Wi-Fi module.

DEDICATION

Every challenges need efforts as well as guidance of elders, especially those who are very close to our heart.

This thesis is dedicated to:

My beloved family,

My Parents,

My Supervisor,

My Lectures

And all my friends

Thanks for their encouragement and support.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

LCD	-	Liquid Crystal Display
IDE	-	Integrated Development Environment
PCB	-	Printed Circuit Board
I2C	-	Inter-integrated Circuit
USB	-	Universal Serial Bus
UART	-	Universal Asynchronous Receiver/Transmitter
ICSP	-	In-Circuit Serial Programming
AC	-	Alternating Current
DC	-	Direct Current
B4A	-	Basic 4 Android
RAD	-	Rapid App Development
UI	-	User Interface
BASIC	-	Beginner's All-purpose Symbolic Instruction Code
API	-	Application Programming Interface
GIS	-	Graphic Information System
SQL	-	Structured Query Language
PHP	-	Hypertext Preprocessor
SIR	-	SQLite Index Recovery
WiMAX	-	Worldwide Interoperability for Microwave Access
TCP/IP	-	Transmission Control Protocol/Internet Protocol
IR	-	Infrared Radiation
GSM	-	Global System for Mobile
CDMA	-	Code Division Multiple Access
PC	-	Personal Computer
IEEE	-	Institute of Electrical and Electronics Engineers
MIMO	-	Multiple Input Multiple Output
M2M	-	Machine-to-Machine

IoT	-	Internet of Things
SD	-	Secure Digital
KMD	-	Kenya Meteorological Department
WSNs	-	Wireless Sensor Networks
VIN	-	Voltage Input
GND	-	Ground
SCL	-	Serial Clock
SDA	-	Serial Data
PWM	-	Pulse Width Modulation
TX	-	Transmit
RX	-	Receive
CH_PD	-	Chip Power-Down
RST	-	Reset

CHAPTER 1

INTRODUCTION

In this chapter, it will discussed about the project background, problem statement, objectives of the project and project scope.

1.1 Background

The weather monitoring system is an instruments that measures the environment parameters without human interventions. Lately, the weather monitoring system shows its values and importance to community to keep on track with weather conditions until industrial. By different climatic behaviours, the weather monitoring will help getting the information of weather parameters such as temperature, humidity, altitude and pressure. This portable monitoring weather system using a wireless communication for record and send it to the phone. By using wireless communication, the connectivity is more handful to the user thus do not require a physical presence and can get the information anywhere required.

Wireless communication can be defined as transmitting the information with a distance either it far or not without using a wire. Wi-Fi technology is the convenient technology that acts as the wireless communication for the portable weather monitoring system and phone. Example of the application of the device is for outdoor activities such as hiking or jungle trekking. The sensors assist the user that provide user to monitor the changing condition of the weather. Besides, it also record the data from the LCD with the help of Wi-Fi that transfer the data to the web.

1.2 Problem Statement

Monitoring environmental parameters are important in various applications. In earlier period, the system of weather monitoring are generally need a human intervention that sometimes resulted in parallax error and durability. Therefore, this demand a development of a microcontroller based embed system for weather monitoring that monitor and provide data to be examined. For example in agriculture section, it is believe that the change of climate can cause extreme weather events. For example, the events include heat waves, droughts, strong winds, and heavy rains. Droughts are very damaging to the plants because for the long-term, plants will do not have enough water to survive. Besides, it also effects the poverty in the world. Heat waves can give to crops an impact of extreme heat, which can limit the production of the plants. The winds that extremely strong that also can be called as "sandblasting" can cause a severe damages to the plant. Heavy rains that cause flooding can also be damaging to crops and soil structure because most of plants cannot survive in soaked conditions that occurs for a long time because the roots need to breathe. In addition, rain combo with the strong winds can knock down large trees, and ruin the houses.

Besides, for the current situation right now that temperature and humidity that is so high like in Malaysia can cause discomfort to the community. Besides, the weather also can changes unexpectedly that becomes a threat for the people safety and comfort. For a person that always face this challenges need to know the changes of environment conditions around instantly so that they can prepare for the worst.

1.3 Objectives

The objectives of this project are:

- To develop weather monitoring device
- Able to measure the weather parameters by using sensor
- To perform analysis on device accuracy

1.4 Scopes

The scope for this project will cover the development of the portable weather monitoring system. This project have two part which is the software and hardware.

This project will be used an Arduino Software (IDE) that have features that help in developing the program. By attach it to the board to upload programs and interact with them. In this part, it will consist the NodeMcu and the sensors, the input is from the environment is loaded and the microcontroller will process and display it on LCD. After that, using a Wi-Fi to make connection from the device to the internet or smartphone.

The Figure 1.1 show the block diagram of this project:

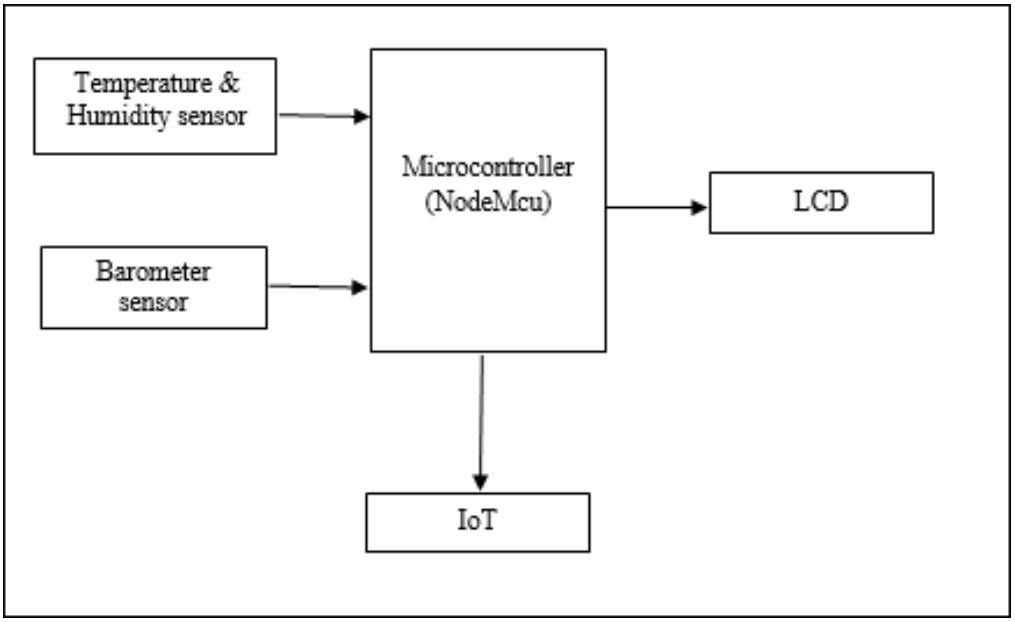

Figure 1.1: Block diagram

1.5 Project Outline

This thesis is divides into five chapters that is to collect and obtain the overall result of this project. Where it gathered all the steps, idea and method involved to gaining the successful of this project. In chapter 1, it is about introducing the whole idea of this

project development. Providing the overview, problems statement, the project objective, and the scope to make this project achieve its objectives.

In chapter 2, there will be about the literature review, where all the information of previous work that related in these project is described in details. All of the information like the part of hardware and software will classify from the journal, articles, book and some related sources.

In chapter 3, is briefly about all the methodology and the implementation process to achieve the goal of this project. A concept of the system architecture will be construct to get a better understanding how the overall operations of this implement system will be done. Like the required pin ports of Arduino board also need to be concerned. Both of the hardware and software operations details will be explained through of the flowchart that has included.

In chapter 4, is the main part in this project. This chapter will contain the findings and analysis of the projects that is described in more detail on how it functions. It is also includes the completion of the project, development, implementation, and problem analysis projects.

In chapter 5 it will be more focused on the whole findings of this project and thesis. A discussions, conclusions, appendix, references and some attachment will be includes together.

CHAPTER 2
LITERATURE REVIEW

To make this project work, therefore some studies and research need to be carried out. Book, articles, journal and internet are the sources of information and studies that is reliable and trusted. Based from that information, it been used as a guide to help this project can be carried out smoothly and successfully within time given. All the studies and info collected is occupying on the topic and component that is related to this project.

2.1 Effects of temperature and humidity on weather

Generally, in air, humidity is the quantity producing an amount of water vapour in the atmosphere of a gas while temperature is the intensity or degree that currently contain in object or substance. Besides, humidity also used to measure the amount of water that air can hold. Then, how much water that the air can hold can be find out by using the temperature. Windows2universe.org (2015) in their article found that when the temperature is higher, then there will be more water. A high humidity in the air will cause in the air to have an enough water that can make rain or snow. Changing in temperature also cause a variation in humidity. For example, the humidity of the environment right now is 100% and the effect if the temperature is it will decreased. For clouds, humidity is important because they are made from water and ice.

2.1.1 DHT11 and LM35 sensor

The LM35 sensor is an integrated-circuit temperature components that give output voltage corresponding to the temperature in Centigrade. This device has an advantage over temperature sensors that are calibrated in Kelvin, as its not required user to draw a large constant voltage from the power source to obtain proper Centigrade scaling. This LM35 also does not need any trimming or external calibration to provide typical efficiency reading at room temperature.

Meanwhile, DHT11 is a low-cost and basic digital temperature and humidity sensor. To measure the surrounding air, it uses a capacitive humidity sensor and a thermistor to produce a digital signal on the data pin. Careful timing skill is required to grab data. Apart from that, the disadvantages of this sensor is when using it, it can only get the data once for every 2 seconds.

2.2 Atmospheric pressure and altitude

Atmospheric pressure describes the pressure exerted by the atmosphere and when the atmospheric pressure measured by a barometer it can be called as barometric pressure since the device that is used is barometer. Altitude can be related to the sea level or ground level that is from the perspective of height of an object or point. The air gets 'thinner' with increasing altitude means the atmospheric pressure drops as go higher up in the atmosphere, then it can be conclude that density of air and atmospheric pressure decrease as the altitude goes up. A research has been made about to use the altitude as a training for athlete. The process is an athlete trains and lives at bearable altitude for some times that gives the athletes physiological adaptations during that enhanced athletic performance. These physiological adaptations will improve competitive performance of the athletes (Robertson, 2009) . Besides, Keller et al. (2005) explored that weather give an effect to the mood and psychology process that can result either good or bad.

2.2.1 Determining Altitude

Since pressure varies with altitude, use a pressure sensor to measure altitude.

The average pressure of the atmosphere at sea level is 1013.25 hPa (or mbar). As climbing towards, the altitude difference can be computed between those two pressure measurements (p and p_0) as shown in equation below:

$$\text{altitude} = 44330 * \left(1 - \left(\frac{p}{p_0}\right)^{\frac{1}{5.255}}\right)$$

Figure 2.1: Finding p and p_0 (Grusin, 2016)

There are two ways:

1. The output of the equation will be the current altitude above sea level if using sea level pressure (1013.25 hPa) that is the mean sea level pressure that always been used, as the baseline pressure (p0).
2. Other method is if using the current location to take single pressure reading, the first pressure reading will be took as a baseline (p0), then it will result in the changes of relative altitude from the baseline.

2.2.2 MPL3115A2 and BMP180 sensor

This sensor have precision measurement of barometric pressure and altitude beside a great low-cost sensing solution. Apart from that, the MPL3115A2 can resolve altitude at 0.3 meters with 1.5 Pascal resolution if want to be compared to BMP180 that can do only 0.17 meters. This components have some advantages if compared to the BMP180 for example used ultra-low power for interrupt outputs plus given an attempt to the user an easy to read altitude with built in altimeter calculation means there is no need for any calculation and calibration.

For BMP180, it also offers to measure temperature, altitude and barometric pressure. This sensor can be soldered on Printed Circuit Board (PCB) or strip board with 3.3 V as the power source. Supplying more than 3.3 V power supply will damaged or burned this component. This BMP180 sensor is the sensor that replaced the BMP085 in this component lineage, but even the BMP180 is the new one and have its own library, it still can use the BMP085 library without any problem. Therefore, the two sensors that been discussed offers a simplicity in using it and the price also same.

2.3 Arduino

The use of Arduino is very popular when making projects based on software and hardware. For many years, from ordinary objects to scientific equipment, Arduino has been the core for many projects that's been created nowadays. Arduino board able to read the input and turn it into the output. For example, when the senses the heat of it surrounding then it shows a reading on the LCD display. The Arduino board can be control by the set of instruction that have been implemented by the user that using its own programming language structured on Wiring, besides the Arduino Software (IDE), structured on Processing.

Choosing Arduino as the core of the projects is because it is inexpensive, cross-platform, clear program environment, extensible software, and extensible hardware. As been mentioned by Badamasi (2014) different from any programmable equipment, Arduino is ready to load the new code onto the board and does not need any separate piece of hardware, just using Universal Serial Bus (USB) cable to transfer the program that using a simplified version of C++, easy to learn for the beginners to learn the program. In addition, its offers more accessible package with an easier environment to learn