Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF IOT-BASED AUTOMATIC RAIN GAUGE USING NODEMCU FOR RAINFALL MEASUREMENT

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Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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DEVELOPMENT OF IOT-BASED AUTOMATIC RAIN GAUGE USING NODEMCU FOR RAINFALL MEASUREMENT

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I declare that this project report entitled "Development of Iot-based Automatic Rain Gauge using Nodemcu for Rainfall Measurement" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

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DEDICATION

This study is wholeheartedly dedicated to our beloved parents for our source inspiration and our strength when we thought to giving up, who always provide their moral, emotional and financial support.

To our brother, sisters, friends, classmates and my supervisor for shared their opinion, guidance and idea to encouragement to finish this study.

Lastly, to our Almighty God for giving us healty life and strength. All of these will not finish without permission.

ABSTRACT

Meteorologists and hydrologists use a type of instrument to collect and measure the amount of liquid within period of time which is called as rain gauge. Before technology evolved, measurement was carried out through manual method of conventional rain gauge or standard rain gauge. Basically, when measurement is obtained, the water in container is measured in height using stick measure. After measurement are collected, the water needs to be discarded manually. Sometimes the accuracy of measurement may be incorrect and erroneous. Furthermore, it is also convenient if the data from rain gauge can be automatically collected. Therefore, an Internet of Things (IoT) based rain gauge system is developed to solve such issues. Nodemcu ESP8266 microcontroller is used to interface between input and outputs. It also has built in Wi-Fi capability, so the result can be transferred from the microcontroller to the phone app. The accumulated water is measured using water flow sensor where it allows the water to flow and directly discarded. Therefore, this ensure a more advanced and smooth measurement process. Solar panel and batteries are used as power source for the rain gauge system. The measurement result will be displayed on the LCD that is connected to the rain gauge system. In addition, the data will also be shown and stored on the Blynk application.

ABSTRAK

Ahli meteorologi dan ahli hidrologi menggunakan sejenis alat untuk mengumpulkan dan mengukur jumlah cecair dalam jangka masa yang dikenali sebagai tolok hujan. Sebelum teknologi berkembang, pengukuran telah dilakukan melalui kaedah manual alat tolok hujan konvensional atau alat tolok hujan standard. Pada asasnya, apabila ukuran tersebut diperoleh, air di dalam bekas disukat ketinggiannya menggunakan kayu ukur. Setelah ukuran air telah dikumpulkan, ianya perlu dibuang secara manual. Selalunya, ketepatan pengukuran mungkin tidak betul dan salah. Tambahan pula, ia juga mudah jika data tersebut dapat dikumpul secara automatik oleh tolok hujan. Oleh itu, sistem tolok hujan berasaskan "Internet of Things (IoT)" dilakukan untuk menyelesaikan isu tersebut. Mikropengawal Nodemcu ESP8266 digunakan untuk menghubungkan antara input dan output. Ia juga mempunyai keupayaan Wi-Fi yang terbina didalamnya, maka output tersebut boleh dipindahkan daripada mikropengawal ke aplikasi telefon. Air yang terkumpul diukur menggunakan sensor aliran air dimana ia membolehkan air mengalir dan terus dibuang. Oleh itu, ia dapat memastikan proses pengukuran lebih maju dan lancar. Panel solar dan bateri digunakan sebagai sumber tenaga kepada sistem tolok hujan. Hasil pengukuran akan dipaparkan pada LCD yang disambungkan kepada sistem tolok hujan. Sebagai tambahan, data itu juga akan dipaparkan dan disimpan pada aplikasi Blynk.

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LIST OF SYMBOLS

mm	-	Milimeter
ml	-	Mililitre
cm^2	-	Surface area in centimetre
l	-	Litre
mm/min	-	Milimeter per minute
mm/h	-	Milimeter per hour
%	-	Percentage
cm	-	Centimeter
π	-	3.14159

LIST OF ABBREVIATIONS

IoT	-	Internet of Thing
LCD	-	Liqiud Crystal Display
WSN	-	Wireless Sensor Network
GPRS	-	General Pocket Radio Services

CHAPTER 1

INTRODUCTION

1.1 Background

Rain gauge is an instrument to measure rainfall rate in a certain period of time by meteorologists and hydrologists. For the conventional method it is usually carried out manually to record the data. It works by catching the rainfall through the funnel-shaped collector that attached with measuring tube at the wide and open area where it can receive the rain. Automatic rain gauge is rain gauge electronically work to record the data by measuring the rainfall which will be displayed on mobile phone. The measurement of rainfall uses technology to enable physical world to be linked to computer-based system. In our daily life, the technology is important that can be sensed everywhere surrounding us. The innovation of project makes improvements in terms efficiency, accuracy and benefits in economy.

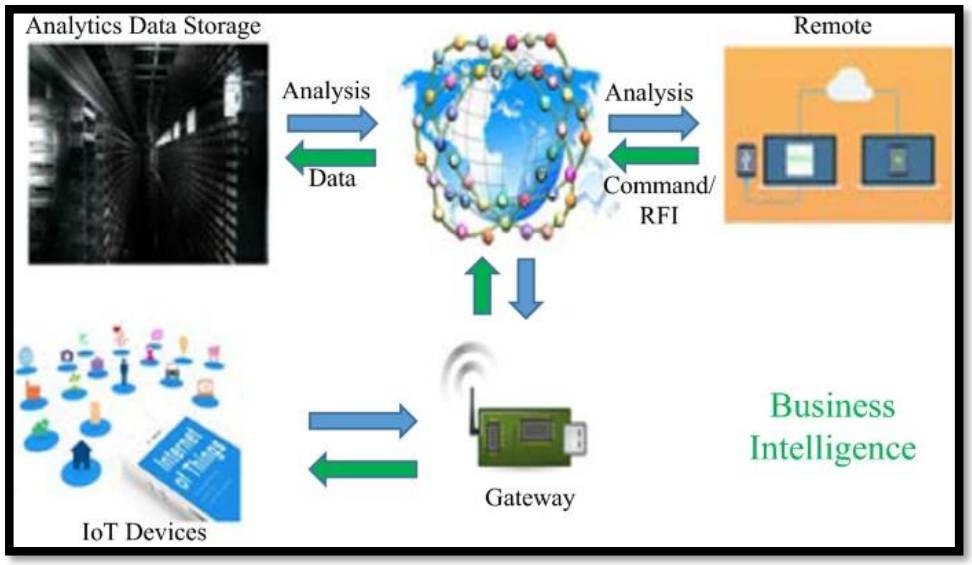

Figure 1.1 Internet of Things (IoT)

This project aims to develop IoT-based Automatic Rain Gauge using Nodemcu for Rainfall Measurement. Figure 1.1 shows the IoT (Internet of Thing) can be accessed worldwide, anytime it is required. All the physical devices can be connected and obtain the data for analyzing of some applications. The Internet of Things (IoT) provides a wide variety of connectivity with different application qualities. In development of IoT, the technology of Wi-Fi provides a platform for remarkable amount of IoT solutions.

The Wi-Fi in this project is used in microcontroller nodemcu ESP8266. ESP8266 contains crucial element of a computer including networking Wi-Fi, so it is suitable for doing Internet of Things (IoT) projects. To measure the rainfall, water flow sensor will be used and installed through tubes, which allows the sensor to detect the rain that flow and feed the signal to the microcontroller. The water will not be collected as usual because this project will be easier than the conventional method. Solar panel and batteries are used as power sources for the rain gauge system.

From this project, the measurement results will be displayed on LCD rain gauge system while in Blynk app the data will also shown and can be stored. The system will run automatically and it is very helpful for meteorologists and hydrologists to obtain the data measurement of rainfall. This project is also convenient and advantageous because the water will flow through the tubes without being collected conventionally.

1.2 Problem Statement

Rain gauge is one of the meteorological equipment that has been widely used for measuring point rainfall due to its accuracy and cost efficiency. However, the conventional method for recording the data of rainfall from typical rain gauge needs to be carried out manually, which can be tedious and also leads to inaccuracy. To overcome such a limitation, it needs to be incorporated with an automatic data reading and operational to improve the

efficiency, using Internet of Things (IoT) capabilities. The reading of accumulated rainfall will be carried out automatically and the data will be sent to mobile phone or cloud. Then, the water will flow ongoing through the tube and it will not to be discarded as conventionally. So it is advanced for this project.

1.3 Project Objective

The main aim of this project is to develop automatic rain gauge by using nodemcu microcontroller for rainfall measurement. Specifically, the objectives are as follows:

a) To develop an automatic rain gauge that is able to read accumulated rainfall data automatically using nodemcu microcontroller.

b) To measure and record the data of the rainfall into cloud.

c) To display the data from the application Blynk.

1.4 Scope of Project

The scope of this project are as follows:

a) The accumulated rainfall will be measured using water flow sensor.

b) The data will be collected from the cloud.

c) The system will be assisted by solar panel and batteries.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Nowadays, there are many types of rain gauge worldwide which have the same function of measuring the rainfall. Every type of rain gauge differs in how rainfall is measured based on the component used. This chapter will review the past articles to know every different process.

2.2 Type of Rain Gauge

There are three major types of rain gauges which are standard rain gauge, weighing rain gauge and tipping bucket rain gauge. Each type differs in its use and in its involving component. From the conventional type to automatic type, the accuracy in measurement also improves.

2.2.1 Standard of Rain Gauge/Conventional Rain Gauge

Standard rain gauge or conventional rain gauge are being used in this article[1] to measured amount of the rainfall collected in tube. For manual rain gauge there are usually errors in calculating and measuring of the rainfall amount.

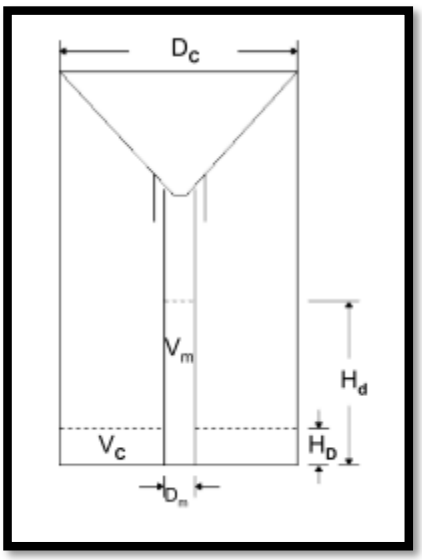

Figure 2.1 Rain gauge with measuring tube[1]

Figure 2.1 above shows conventional rain gauge that are still used to supply the data to weather stations. Since rainfall is measured manually, formulas are used to get the exact value. The conventional rain gauge is simple and easy to constructed. In certain period, this system may easily overflow and the data measurement will be incorrectly as mentioned in this journal [2].

2.2.2 Weighing Rain Gauge

Weighing rain gauge is operated to record the amount of water collected and measure the weight of that rain water. The authors in this article [3] stated that to measure the rain fall magnitude and all weather conditions, weighing rain gauge are used. This system is selected because bad weather condition causes difficulty of forecasting when flood happens. Weighing rain gauge, measures when water is collected in bucket. Journal [4] mentioned that weighing rain gauge is operated to weigh rainwater collected by the device.

2.2.3 Tipping Bucket Rain Gauge

Tipping bucket rain gauge is most common type that is always used in this field. In this journal [2] , it was mentioned that tipping bucket rain gauge which measures in snowfall is inefficient as the solid ice have to melt first, thus delaying the process and the time taken for the measurement may be incorrect. In this article [5], tipping bucket was used to analyze the stability of water flow rate that was measured. The weakness of this system is the water that flows between pair of tipping buckets is not measured thus the inaccuracy may increase. Figure 2.2 below shows the design of tipping bucket of rain gauge.

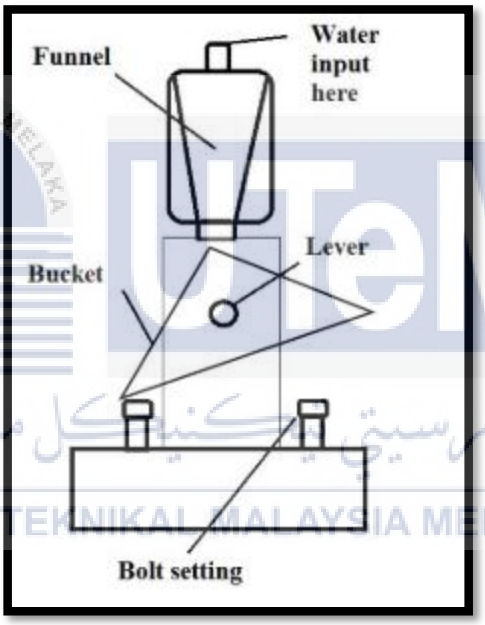

Figure 2.2 Tipping bucket of rain gauge[5]

2.3 Methods for Rain Measurement

Every research will have different method to measured the rainfall and also the component that is used. In conventional rain gauge, mostly the method will collected rainfall through funnel-shaped collector attached together with measuring tube. The record data will take only once in a day means 24 hours because it is manually recorded. The measurement of rainfall be obtained from the cylinder using stick or ruler to read the value. After the data

is recorded, the water will be discarded by flip the tube and make sure there is no water in cylinder tube.

2.3.1 Rain Gauge Development Employing Bluetooth and RF Modem

In this article [6] was discussed that the method which uses Bluetooth and RF-FSK enables data to be read easily and promptly. The amount of rain was captured by the sensor and sent to the microcontroller. The data was accepted and sent by Bluetooth and RF Modem. Figure 2.3 below shows the block diagram of the rain gauge system.

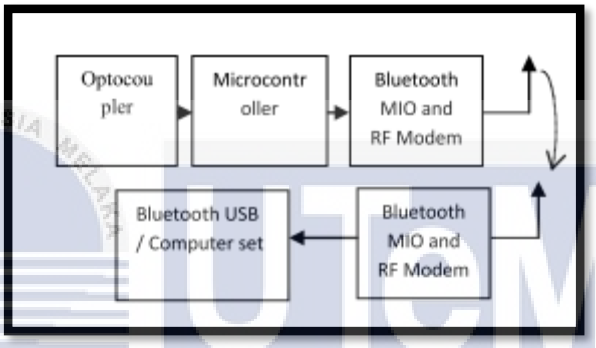

Figure 2.3 Block diagram of the system[6]

For Bluetooth and RF Modem, there are different distance between rain system set and computer set. Table 2.1 shows the measurement results. Optocoupler is an electronic device which function is to transfer electrical signals between two isolated circuits by using lights.

Table 2.1 The results of measurement[6]

MEASUREMENT RESULT			
No	Water volume	I_{manual} (mm)	$I_{automatic}$ (mm)
1	50ml	2,5	2,269108
2	100ml	5	4,538217
3	500ml	25	24,392914
4	1000ml	50	49,76114

2.3.2 Development of Rain Gauge using Measurement for Microwave Network

In this paper[7], which discussed the use of load cell to sense the weight of water in a container. The weight of the accumulated water in the container will be detected by load sensor. Since load cell has analog signal data, the data should be converted to the digital form by ADC module. Then, the Arduino will read the data and display it on the screen. In order to empty the container from water, this paper used DC motor to discard the water. The data accumulated of rainfall in mm/h. Figure 2.4 shows the system of rain gauge.

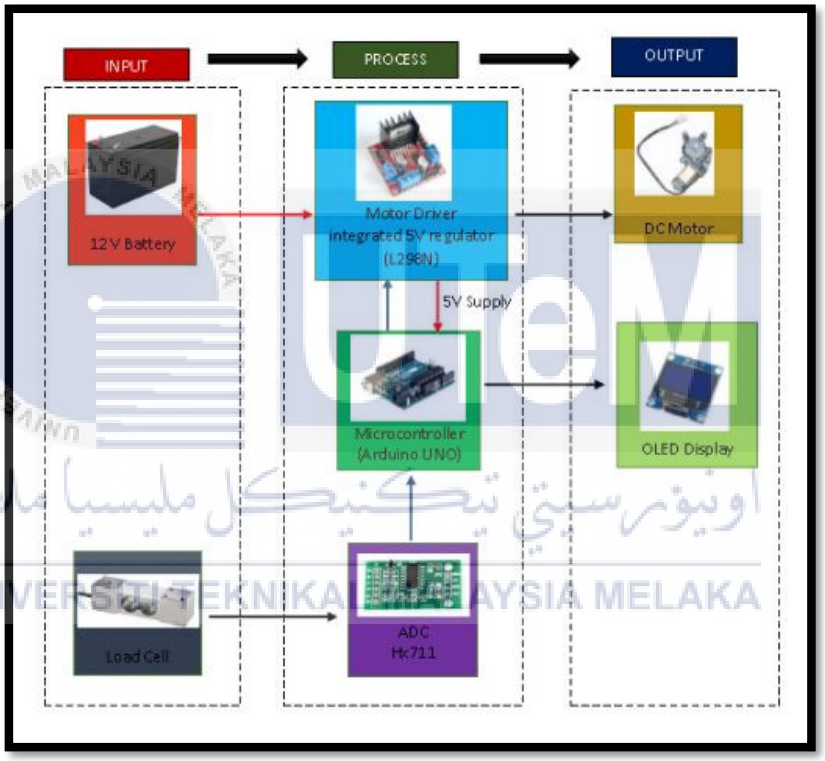

Figure 2.4 Rain gauge process[7]

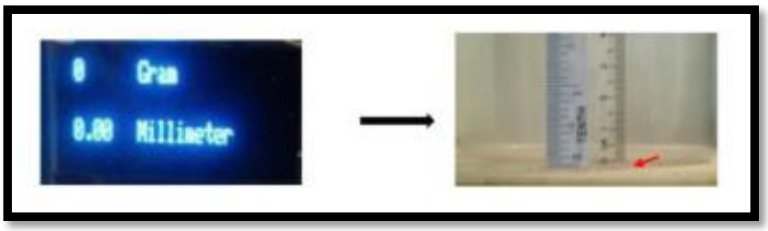

Figure 2.5 When container water empty[7]