



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DEVELOPMENT OF REMOTE TERMINAL UNIT (RTU)  
FOR POWER QUALITY MONITORING SYSTEM**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical and Electronic Engineering Technology (Industrial Power) with Honours.

by

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## **APPROVAL**

This report is submitted to the Faculty of Electrical and Electronic Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

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## ABSTRAK

Projek ini memperkenalkan reka bentuk dan pembangunan Unit Pemantauan Jarak Jauh (RTU) kos rendah untuk sistem pemantauan kualiti kuasa bagi meningkatkan kebolehpercayaan kuasa antara pengguna. RTU memainkan peranan penting dalam mengesan kesalahan dan ditugaskan untuk menghantar mesej dengan segera ke bilik kawalan. RTU menyediakan pemantauan operasi kesalahan dan pengumpulan data untuk analisis. Reka bentuk projek ini akan memberi tumpuan kepada membangunkan satu set model asas yang komprehensif untuk mensimulasikan voltan lendut menggunakan MATHLAB/Simulink. Microchip akan diprogramkan kepada beberapa jenis kesalahan khusus untuk keadaan voltan lendut apabila ia menerima data dari MATHLAB/Simulink. Selepas itu, status kesalahan tersebut akan dipaparkan dalam paparan LCD dan Wi-Fi akan menghantar maklumat tersebut ke bilik kawalan untuk memberi amaran kepada pekerja akan keadaan semasa melalui Paparan Grafik (GUI). Akhirnya, sistem ini dapat mengesan sama ada voltan lendut atau voltan biasa dan masa ketika voltan lendut itu bermula dan tamat, malah ia akan bersedia untuk dihubungkan dengan Unit Pemantauan Jarak Jauh yang lengkap.

## **ABSTRACT**

This project introduces the design and development of a low-cost Remote Terminal Unit (RTU) for power quality monitoring system to increase the reliability of power among the consumers. The RTU plays an important role in detecting faults and assigned it by sending message to control room instead. The RTU provides monitoring fault operation and data collection for analysis. The design of this project will be aimed on developing a set of basic models to simulate a voltage sag using MATHLAB/Simulink. The microchip will be programmed to a specific type of fault for voltage sag condition when it receives data from the MATHLAB/Simulink. After that, the status will be appeared on the LCD display and Wi-Fi Module will send the information directly to control room as warning the operators on the current situation via Graphical User Interface (GUI). Finally, the system is able to detect the voltage sag or normal voltage and the starting and ending time of the voltage sag occurred, thus ready to be interfaced with the complete Remote Terminal Unit (RTU).

## **DEDICATION**

To my beloved parents

Abd Rashid Bin Bambok

Rahayu Binti Osman

Sibling

Nurul Syahidah Binti Abd Rashid

Muhammad Zafran Aqil Bin Abd Rashid

Nurul Syafinaz Hawa Binti Abd Rashid

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Mr. Johar Akbar bin Mohamat Gani

Thank you very much for the support, support, love, encouragement, help and blessing



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## TABLE OF CONTENTS

	<b>PAGE</b>
<b>TABLE OF CONTENTS</b>	<b>x</b>
<b>LIST OF TABLES</b>	<b>xv</b>
<b>LIST OF FIGURES</b>	<b>xvi</b>
<b>LIST OF APPENDICES</b>	<b>xix</b>
<b>LIST OF SYMBOLS</b>	<b>xx</b>
<b>LIST OF ABBREVIATIONS</b>	<b>xxi</b>
<b>CHAPTER 1      INTRODUCTION</b>	<b>1</b>
1.0    Introduction	1
1.1    Project Background	1
1.2    Problem Statement	6
1.3    Objectives	8
1.4    Scope	9
1.5    Report Outline	10
<b>CHAPTER 2      LITERATURE REVIEW</b>	<b>11</b>
2.0    Introduction	11
2.1    Power Quality	12
2.1.1    Power Quality Issues	12

2.1.2	Voltage Sag	16
2.1.2.1	Voltage Sag Types	18
2.1.2.2	Factors That Affect the Type of Voltage Sag	21
2.1.3	Wavelet	23
2.1.3.1	Families of Wavelets	23
2.1.3.2	Wavelets Properties	24
2.1.3.3	Equation for DWT and CWT	25
2.1.3.4	Mother wavelet choice	26
2.2	Past and Current Trends in RTU Development	27
2.3	Power Quality Monitoring in Distribution Automation System	30
2.4	Proteus 8 Professional	32
2.5	MATLAB/Simulink	33
2.6	Wi-Fi Module	34
2.7	Summary	37
<b>CHAPTER 3</b>	<b>METHODOLOGY</b>	<b>38</b>
3.0	Introduction	38
3.1	Hardware Development	41
3.1.1	Power Supply Unit	43
3.1.2	Arduino UNO Main Board	44
3.1.3	Analog Inputs of Arduino UNO	45

3.1.4	Digital Inputs of Arduino UNO	45
3.1.5	Digital Outputs Arduino UNO	46
3.1.6	Wi-Fi Module	46
3.2	Software Development	48
3.2.1	Proteus 8 Design Suite Software	49
3.2.2	MATLAB/Simulink	51
3.2.2.1	MATLAB/Simulink Design Procedure	53
3.2.2.2	MATLAB coding Construction	62
3.2.3	Arduino IDE Software	70
3.2.3.1	Blynk app coding	71
3.3	Summary	73
<b>CHAPTER 4 RESULT AND DISCUSSION</b>		<b>74</b>
4.0	Introduction	74
4.1	Project's Input Result	74
4.2	Specifications of RTU System	76
4.3	Software Development	77
4.4	The overall of RTU System	77
4.5	Fault Detection	78
4.6	Analysis of the Optimum Method	81
4.7	Summary	87

<b>CHAPTER 5</b>	<b>CONCLUSION</b>	<b>88</b>
5.0	Summary	88
5.1	Attainment of the Project Outcomes	90
5.2	Application of the Project Outcomes	91
5.3	Difficulties Encountered during Project Execution	92
5.4	Recommendations for Project Future Improvement	93
<b>REFERENCES</b>	<b>94</b>	
<b>APPENDIX</b>	<b>98</b>	
<b>Overview</b>	<b>100</b>	
<b>Summary</b>	<b>101</b>	
<b>Power</b>	<b>102</b>	
<b>Memory</b>	<b>103</b>	
<b>Input and Output</b>	<b>104</b>	
<b>Communication</b>	<b>105</b>	
<b>Programming</b>	<b>106</b>	

<b>Automatic (Software) Reset</b>	<b>107</b>
Wemos D1 Release 1 (R1) and Release 2 (R2)	109
<b>R1 vs. R2 - The Difference</b>	<b>109</b>
<b>Settings in Arduino IDE (v1.8.7):</b>	<b>109</b>
<b>Table 1.0 – Gantt chart PSM 1</b>	<b>113</b>
<b>Table 2.0 – Gantt chart PSM 2</b>	<b>114</b>

## LIST OF TABLES

<b>TABLE</b>	<b>TITLE</b>	<b>PAGE</b>
Table 2.1:	Classification and typical event characteristic	13
Table 2.2:	Voltage Sag Types	20
Table 2.3:	Transformer Winding Connection	22
Table 3.1:	ABC Arrangement for Sag Vectors	52
Table 3.2:	Classification of Output in Voltage Phases with corresponding type at Substation A	65
Table 4.1:	Specification detail Of the RTU system for the project	76
Table 4.2:	Comparison of the Window Length Testing	86

## LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 1 .1(a):	Voltage Sag Waveform (Rufus, 2012)	4
Figure 1.1(b):	Wavelet Waveform (Wee & Liang, 2008).	5
Figure 2.1:	Normal Voltage Waveform	14
Figure 2.2:	Voltage Sag Waveform	14
Figure 2.3:	ABC Classifications for Voltage Sag (Namrata, 2014)	19
Figure 2.4:	Families of wavelet that used for analysis (Shariatinasab et al.)	24
Figure 2.5:	Analysis of DWT signal (Patil & Sheelavant, 2015)	26
Figure 2.6:	The Block Diagram of R.T.U (Matti & Aziz, 2012)	29
Figure 2.7:	ISIS8 Professional	32
Figure 2.8:	MATLAB/Simulink	33
Figure 2.9:	Wi-Fi Module – ESP8266	34
Figure 2.10:	Mode of operation Wi-Fi Module	36
Figure 3.1:	Project Development Flowchart	39
Figure 3.2:	The RTU System framework via the Wi-Fi Module	42
Figure 3.3:	Arduino UNO board with configuration pins labelling	44
Figure 3.4:	Wi-Fi Module Configuration Pins	46



Figure 3.5: Wi-Fi Module Interfacing with the Arduino Uno Board	47
Figure 3.6: Software Development Block Diagram	48
Figure 3.7: Proteus 8 Software interface	49
Figure 3.8: Schematic Circuit of Arduino UNO board and Wi-Fi module using the Proteus Software	50
Figure 3.10: Command window interface of MATLAB software	54
Figure 3.11: Simulink Icon to Open Simulink in MATLAB	55
Figure 3.12: Simulink Library Browser interface	55
Figure 3.13: Design of Simulink Model for the project	56
Figure 3.14: Desired output from the MATLAB/Simulink after running the Simulink model	57
Figure 3.15: Simulink model for setting of 2-phase fault	58
Figure 3.16: Output of 2- phase setting	59
Figure 3.17: Simulink model for setting of 1-phase fault	59
Figure 3.18: Output of 1-phase setting	60
Figure 3.19: Simulink model for setting of 3-phase fault	60
Figure 3.20: Output of 3-phase setting	60
Figure 3.21: Value of workspace for sag time values when produced	61
Figure 3.22: The pop-up window when the MATLAB is launched and opened	62
Figure 3.23: Sample on how the folder is created in MATLAB	63
Figure 3.24: Editor Space for Writing the MATLAB programming codes	63

Figure 3.25: MATHLAB coding for the RTU Signal	64
Figure 3.26: Output waveform produced for 3-phase fault setting at substation A	66
Figure 3.27: Output waveform produced for 2-phase fault setting at substation A	67
Figure 3.28: Output waveform produced for 1-phase fault setting at substation A	68
Figure 3.29: Input of RTU system	69
Figure 3.30: Arduino Software (IDE) interface window when opened and launched	70
Figure 3.31: The windows display after the Arduino icon is launched	71
Figure 3.32: Coding of the projects that implements each type of faults	72
Figure 3.33: Coding for text message and notification of the faults occurred	73
Figure 4.1: Sketch for Output Normal Waveform	74
Figure 4.2: The Fault Box and RCL Box setting in MATLAB	75
Figure 4.3: The Normal Voltage output for line-line-line-ground selection type	75
Figure 4.4: MATLAB GUI for selected fault testing	79
Figure 4.5: Simulink connection diagram for 1-phase fault condition testing	79
Figure 4.6: LCD display on Blynk app for 2-phase fault type	80
Figure 4.7: Sag waveform of the analyzed signal	82
Figure 4.8: Produced wavelet waveform when using the first derivative method	83
Figure 4.9: Sag waveform of the analyzed signal	84
Figure 4.10: Produced wavelet waveform when using the second derivative method	85

## LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix 1	Arduino UNO	98
Appendix 2	Gantt Chart	84

## LIST OF SYMBOLS

<b>I/O</b>	-	Input/output
<b>Kv</b>	-	kilovolt
<b>Pu</b>	-	Per Unit
$\psi(t)$	-	Continuous Function in Both Time Domain
<b>W</b>	-	Angular velocity
<b>X</b>	-	Displacement
<b>Z</b>	-	Height
<b>Q</b>	-	Angle
<b>ms</b>	-	milisecond
<b>s</b>	-	Second
<b>%</b>	-	percent
<b>mV</b>	-	miliVolt
<b>V</b>	-	Volt

## LIST OF ABBREVIATIONS

<b>GUI</b>	Graphical User Interface
<b>DAS</b>	Distribution Automaton System
<b>IEEE</b>	Institute of Electrical and Electronics Engineers
<b>PIC</b>	Peripheral Interface Controller
<b>PQM</b>	Power Quality Monitoring
<b>RMS</b>	Root Mean Square
<b>RTU</b>	Remote Terminal Unit
<b>SCADA</b>	Supervisory Control and Data Acquisition
<b>GSM</b>	Global System for Mobile Communication
<b>LG</b>	Line-to-Ground
<b>LLG</b>	Line-Line-to-Ground
<b>LLLG</b>	Line-Line-Line-to-Ground
<b>VRMS</b>	Voltage Root Mean Square
<b>CWT</b>	Continuous Wavelet Transform
<b>TNB</b>	Tenaga Nasional Berhad

## CHAPTER 1

### INTRODUCTION

#### 1.0 Introduction

This part will describe further about the project background, problem statement, objectives, scope of project and expected results for this RTU project, in brief.

#### 1.1 Project Background

Nowadays, the electrical power systems are very vital among the users due to high request of power usage. Electrical power system has many important parts which are the generation, transmission, distribution and load (consumers). This electrical power system has a standardized network that supply power to the area. As a pioneer of the National Grid in Peninsular Malaysia, Tenaga Nasional Berhad (TNB) designated two sort of voltage level networks in electrical power system. Retrieved from (<https://www.tnb.com.my/assets/files/ESAHv3.pdf>), for transmission grid voltage, the rates are 500kV, 275kV and 132kV while the distribution voltage are rated at 33kV, 11kV and 400/230V respectively.

In the electrical distribution system, too much failure had occurred until the Distribution Automation System (DAS) was introduced. According to (Parikh, 2009), The Distribution Automation System (DAS) is a system that enables an electrical utility to monitor, coordinate, and operate distribution components in a real-time mode from remote locations. (Razak, 2014) studied that DAS is also known as an electrical part on the distribution stage that can run automatically within the system that contain of electrical components or mechanisms on that distribution stage which function consequently at lower voltage level. Among many functions of DAS is to track down the faults position, dissociate faults and recover back the supply services area to the consumer. The DAS can upgrade effectiveness, reliability and grade of electric service with respect to the application of the utilities. The improved technology in DAS and the automation application enables to naturally observing, maintaining and controlling the switches of the framework where it very well can be practiced through the intelligent electronic devices (IED).

Remote Terminal Unit (RTU) is the one of the vital tools for execution for DAS where it essentially acts as a remote that enables checking and controlling of the substations. Besides that, the RTU plays an imperative act in authorizing the operators at the control center area to deal with and run the distribution system. The measured electrical variables will be determined by the RTU at the distribution system.

(Jusoh, 2013) discussed that at remote locations, the collected information from the process equipment will shift back to the focal unit in order to identify the data status. This remote terminal unit can interpret the information in three states which are in analog input, digital (status input) and digital (control outputs). The RTU's information that converge in electrical parameters are the Root Mean Square (RMS) value of voltage and current, frequency, temperature and power.

In this RTU project, generally the tested fault happens at the Three Phases to Ground Fault (L-L-L-G), Single Line to Ground (L-G) and Double Line to Ground (L-L-G) fault. All this type of faults is caused by the voltage sag disturbances. In order to ensure good quality of electrical facilities, the RTU is utilized to control and track the power quality disruption when faults happened. The power quality is an electrical system that forms a stable and clear energy. Furthermore, power quality always accessible in a pure noise-free sinusoidal waveform and it always operated at standard frequency position and voltage level. However, many loads will appoint to these disturbances with the expand of energy request from industrial operation, retrieved from (<http://www.comsys.se/solutions/powerquality.html>).