

# Faculty of Electrical and Electronic Engineering Technology



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# Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours

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# DEVELOPMENT OF FLOOD MONITORING SYSTEM WITH ALERTING SYSTEM BASED ON DATA COLLECTION VIA IOT APPLICATION

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A project report submitted in partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours UDDECEMENT Faculty of Electrical and Electronic Engineering Technology

# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

# DECLARATION

I declare that this project report entitled "Development of Flood Monitoring System with Alerting System based on data collection via IoT Application " 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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# APPROVAL

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 Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

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# DEDICATION

Thank you, God Almighty, for being my firm foundation, my source of motivation, wisdom, knowledge, and insight, and for inspiring me to complete this work. All the way through this programme, He has been my rock, and it is only by His grace that I have been able to soar. This project is also a tribute to my mom and dad. Thanks for not charging me exorbitant interest on the money I owe you. My mom and dad will enjoy this.



### ABSTRACT

Development Of Flood Monitoring System With Alerting System Based On Data Collection Via Iot Application was a project used a wireless sensor network to collected flood data in the vicinity of Melaka Sentral River. The project has been created a system that can monitor and predict the flood used a wireless sensor network comprised of a sensor, a transceiver to transmit data, and a computational device. Water level, temperature, and velocity data were all important in predicting flood disasters. On top of that, this project was focusing on water level, temperature, humidity, and water raindrops. The working principle of this mechanism was as follows: sensors collected flood parameters at a specific location, then these parameters were transmitted from nodes to the base station. The system would compare the measured parameter to the probability of a flood disaster that we had set. If the measured values exceed the threshold values, the IoT application sends an alert message and activates an alarm, alerting the targeted area. As a result, the data gathered had been saved in this database system and used in the future whenever the sensor reads the water level.

### ABSTRAK

Pembangunan Sistem Pemantauan Banjir Dengan Sistem Makluman Berdasarkan Pengumpulan Data Melalui Aplikasi Iot merupakan projek menggunakan rangkaian penderia tanpa wayar untuk mengumpul data banjir di sekitar Sungai Melaka Sentral. Projek ini telah mencipta sistem yang boleh memantau dan meramalkan banjir menggunakan rangkaian sensor wayarles yang terdiri daripada sensor, transceiver untuk menghantar data, dan peranti pengiraan. Data paras air, suhu dan halaju semuanya penting dalam meramalkan bencana banjir. Selain itu, projek ini memberi tumpuan kepada paras air, suhu, kelembapan dan titisan air hujan. Prinsip kerja mekanisme ini adalah seperti berikut: sensor mengumpul parameter banjir di lokasi tertentu, kemudian parameter ini dihantar dari nod ke stesen pangkalan. Sistem akan membandingkan parameter yang diukur melebihi nilai ambang, aplikasi IoT menghantar mesej amaran dan mengaktifkan penggera, memberi amaran kepada kawasan yang disasarkan. Akibatnya, data yang dikumpul telah disimpan dalam sistem pangkalan data ini dan digunakan pada masa hadapan apabila sensor membaca paras air.

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

# TABLE OF CONTENTS

DECLARATION APPROVAL DEDICATIONS ABSTRACT i ABSTRAK ii ACKNOWLEDGEMENTS iii TABLE OF CONTENTS 4 LIST OF TABLES 6 LIST OF TABLES 6 LIST OF TABLES 7 LIST OF SYMBOLS 9 LIST OF ABBREVIATIONS 9 LIST OF ABBREVIATIONS 10 LIST OF APPENDICES 11 CHAPTER 1 INTRODUCTION 12 1.1 Background 12 1.2 Problem Statement 12 1.3 Project Objective 14 1.3 Project Objective 14 1.3 Project Objective 15 1.4 Scope of Project RSITI TEKNIKAL MALAYSIA MELAKA 16 1.5 Project Outline 19 2.1 Introduction 19 2.2.2 Flood monitoring system 19 2.2.2 Flood Monitoring System 20 2.3 Types of flooding 21 2.3.1 Flash Flooding 21 2.3.2 River Flooding 21 2.3.2 Nater level using paraonic sensor 29 2.5.1 Water level using utrasonic sensor 30 2.6 Component used in Flood Monitoring and Alerting System 31 2.61 Ultrasonic sensor 50 2.6 Component used in Flood Monitoring and Alerting System 31 2.61 Ultrasonic sensor for water level detection 31 2.61 Ultrasonic sensor for water level detection 31 2.61 DHT11 for temperature and humidity detection 31 2.61 DHT11 for temperature and humidity detection 31 3.5 DHT11 for temperature and humidity detection 32 3.5 DHT11 for temperature and humi		IAG
APPROVAL     DEDICATIONS     ABSTRACT   i     ABSTRAK   ii     ACKNOWLEDGEMENTS   iii     TABLE OF CONTENTS   4     LIST OF TABLES   6     LIST OF FIGURES   7     LIST OF ABBREVIATIONS   9     LIST OF ABBREVIATIONS   10     LIST OF APPENDICES   9     CHAPTER 1   INTRODUCTION     1.1   Background     1.2   Problem Statement     1.3   Project Objective     1.4   Scope of Project     1.5   Project Outline     17   CHAPTER 2     LITERATURE REVIEW   19     2.1   Introduction     1.2   Flood monitoring and warning technologies     2.1   Flood Monitoring System     2.2.1   Flood Monitoring System     2.3.1   Flash Flooding     2.3.2   River Flooding     2.3.1   Flash Flooding     2.3.1   Flash Flooding     2.4.1   Remote Sensing Data     2.5.1   Water level using uresource sensor     2.5.1<	DECLARATION	
DEDICATIONS     ABSTRACT   i     ABSTRAK   ii     ACKNOWLEDGEMENTS   iii     TABLE OF CONTENTS   4     LIST OF TABLES   6     LIST OF TABLES   7     LIST OF ABBREVIATIONS   9     LIST OF ABBREVIATIONS   10     LIST OF APPENDICES   9     CHAPTER 1   INTRODUCTION     1.2   Problem Statement     1.3   Project Objective     1.4   Scope of Project     1.5   Project Outline     CHAPTER 2   LITERATURE REVIEW     1.1   Introduction     1.2   Flood monitoring and warning technologies     2.1   Flood Monitoring and warning system     2.2   Flood monitoring and warning system     2.3   Types of flooding     2.3.1   Flash Flooding     2.3.2   River Flooding     2.4.1   Remote Sensing Data     2.5.1   Water level using utrasonic sensor     2.5.1   Water level using pressure sensor     2.5.1   Water level using utrasonic sensor     2.5.1   Water level usin	APPROVAL	
ABSTRACT   i     ABSTRAK   ii     ACKNOWLEDGEMENTS   iii     TABLE OF CONTENTS   4     LIST OF TABLES   6     LIST OF FIGURES   7     LIST OF ABBREVIATIONS   9     LIST OF ABBREVIATIONS   10     LIST OF APPENDICES   11     CHAPTER 1   INTRODUCTION     1.1   Background     1.2   Problem Statement     1.3   Project Objective     1.4   Scope of Project     1.5   Project Outline     17   CHAPTER 2     LITERATURE REVIEW   19     2.1   Introduction     2.2   Flood monitoring and warning system     2.3   Types of floods in Malaysia     2.3.1   Flash Flooding     2.3.2   River Flooding     2.3.1   Flash Flooding     2.3.2   River Flooding     2.4.1   Remote Sensing Data     2.4.2   Local Sensing Data or Telemetry     2.5.1   Water level using ultrasonic sensor     2.5.1   Vater level using pressure sensor <t< th=""><th>DEDICATIONS</th><th></th></t<>	DEDICATIONS	
ABSTRAK   ii     ACKNOWLEDGEMENTS   iii     TABLE OF CONTENTS   4     LIST OF TABLES   6     LIST OF FIGURES   7     LIST OF ABBREVIATIONS   9     LIST OF ABBREVIATIONS   10     LIST OF APPENDICES   11     CHAPTER 1   INTRODUCTION     1.1   Background     1.2   Problem Statement     1.3   Project Objective     1.4   Scope of Project     1.5   Project Outline     CHAPTER 2   LITERATURE REVIEW     2.1   Introduction     19   2.2.1     2.3   Types of floods in Malaysia     2.3.1   Flood Monitoring system     2.3.1   Flood Monitoring and warning system     2.3.2   River Flooding     2.4.1   Remote Sensing Data     2.4.2   Local Sensing Data   24     2.4.3   Nater level using ultrasonic sensor   29     2.5.4   Water level using ultrasonic sensor   29     2.5.1   Water level using ultrasonic sensor   29     2.5.2   Water level	ABSTRACT	i
ACKNOWLEDGEMENTS   iii     TABLE OF CONTENTS   4     LIST OF TABLES   6     LIST OF FIGURES   7     LIST OF SYMBOLS   9     LIST OF ABBREVIATIONS   10     LIST OF APPENDICES   11     CHAPTER 1   INTRODUCTION     1.2   Problem Statement     1.3   Project Objective     1.4   Scope of Project     1.5   Project Outline     7   CHAPTER 2     LITERATURE REVIEW   19     2.1   Introduction     1.2   Flood Monitoring System     2.3   Types of floods in Malaysia     2.3.1   Flood Monitoring System     2.3.1   Flood Monitoring and warning system     2.3.1   Flood Monitoring 2012     2.4.1   Remote Sensing Data     2.4.1   Remote Sensing Data     2.4.2   Local Sensing Data or Telemetry     2.5.1   Water level using pressure sensor     2.5.1   Water level using pressure sensor     2.6   Component used in Flood Monitoring and Alerting System     2.6.1   Ultrasonic sensor for water leve	ABSTRAK	ii
TABLE OF CONTENTS   4     LIST OF TABLES   6     LIST OF FIGURES   7     LIST OF SYMBOLS   9     LIST OF ABBREVIATIONS   10     LIST OF APPENDICES   10     CHAPTER 1   INTRODUCTION     1.1   Background     1.2   Problem Statement     1.3   Project Objective     1.4   Scope of Project     1.5   Project Outline     CHAPTER 2   LITERATURE REVIEW     2.1   Introduction     2.2   Flood monitoring and warning technologies     2.1.   Flood Monitoring System     2.2.1   Flood Monitoring System     2.3.1   Flash Flooding     2.3.2   River Flooding     2.3.1   Flash Flooding     2.3.2   River Flooding     2.4   Types of data sensing in previous technology     2.5.1   Water level using ultrasonic sensor     2.5.2   Water level using pressure sensor     2.6   Component used in Flood Monitoring and Alerting System     3.6.1   Ultrasonic sensor for water level detection     2.5.2   Wat	ACKNOWLEDGEMENTS	iii
LIST OF TABLES   6     LIST OF FIGURES   7     LIST OF SYMBOLS   10     LIST OF ABBREVIATIONS   11     LIST OF APPENDICES   10     CHAPTER 1   INTRODUCTION     1.1   Background     1.2   Problem Statement     1.3   Project Objective     1.4   Scope of Project     1.5   Project Outline     CHAPTER 2   LITERATURE REVIEW     1.1   Introduction     2.2   Flood monitoring and warning technologies     2.2.1   Flood monitoring system     2.3   Types of floods in Malaysia     2.3.1   Flash Flooding     2.3.2   River Flooding     2.4.1   Remote Sensing Data     2.4.2   Local Sensing Data or Telemetry     2.5.3   Water level using pressure sensor     2.5.4   Water level using pressure sensor     2.5.2   Water level using pressure sensor     2.6   Component used in Flood Monitoring and Alerting System     2.5.2   Water level using pressure sensor     2.6   Component used in Flood Monitoring and Alerting System	TABLE OF CONTENTS	4
LIST OF TIGURES   7     LIST OF SYMBOLS   9     LIST OF ABBREVIATIONS   10     LIST OF ABBREVIATIONS   10     LIST OF APPENDICES   11     CHAPTER 1   INTRODUCTION     1.1   Background     1.2   Problem Statement     1.3   Project Objective     1.4   Scope of Project     1.5   Project Outline     CHAPTER 2   LITERATURE REVIEW     2.1   Introduction     2.2   Flood monitoring and warning technologies     2.2.1   Flood Monitoring System     2.3.1   Flash Flooding     2.3.2   River Flooding     2.3.3   River Flooding     2.4.1   Remote Sensing Data     2.4.2   Local Sensing Data or Telemetry     2.5.4   Water level using ultrasonic sensor     2.5.1   Water level using pressure sensor     2.6   Component used in Flood Monitoring and Alerting System     2.5.2   Water level using pressure sensor     2.6   Component used in Flood Monitoring and Alerting System     2.5.1   Water level using pressure sensor	LIST OF TABLES	6
LIST OF FIGURES   9     LIST OF ABBREVIATIONS   10     LIST OF ABBREVIATIONS   11     LIST OF APPENDICES   11     CHAPTER 1   INTRODUCTION     1.1   Background     1.2   Problem Statement     1.3   Project Objective     1.4   Scope of Project     1.5   Project Outline     CHAPTER 2   LITERATURE REVIEW     2.1   Introduction     2.2   Flood monitoring and warning technologies     2.1.1   Flood Monitoring System     2.2.2   Flood monitoring and warning system     2.3.1   Flash Flooding     2.3.2   River Flooding     2.4.1   Remote Sensing Data     2.4.2   Local Sensing Data or Telemetry     2.5.3   Measurement using calculation for system     2.5.4   Water level using ultrasonic sensor     2.5.5   Water level using pressure sensor     30   Component used in Flood Monitoring and Alerting System     2.6.1   Ultrasonic sensor for water level detection     31   2.6.1   Ultrasonic sensor for water level detection     31<	LIST OF FICUPES SALAYS	7
LIST OF SYMBOLS   9     LIST OF ABBREVIATIONS   10     LIST OF APPENDICES   11     CHAPTER 1   INTRODUCTION     1.1   Background   12     1.2   Problem Statement   14     1.3   Project Objective   15     1.4   Scope of Project   16     1.5   Project Outline   17     CHAPTER 2   LITERATURE REVIEW   19     2.1   Introduction   19     2.2   Flood monitoring and warning technologies   19     2.2.1   Flood Monitoring System   20     2.3   Types of floods in Malaysia   21     2.3.1   Flooding   22     2.4   Types of data sensing in previous technology   23     2.4.1   Remote Sensing Data   24     2.4.2   Local Sensing Data or Telemetry   25     2.5   Measurement using calculation for system   29     2.5.1   Water level using ultrasonic sensor   29     2.5.2   Water level using ultrasonic sensor   29     2.5.1   Water level using pressure sensor   30		
LIST OF ABBREVIATIONS   10     LIST OF APPENDICES   11     CHAPTER 1   INTRODUCTION   12     1.1   Background   12     1.2   Problem Statement   14     1.3   Project Objective   15     1.4   Scope of Project   16     1.5   Project Outline   17     CHAPTER 2   LITERATURE REVIEW   19     2.1   Introduction   19     2.2   Flood monitoring and warning technologies   19     2.2.1   Flood monitoring and warning system   20     2.3   Types of floods in Malaysia   21     2.3.1   Flash Flooding   21     2.3.2   River Flooding   22     2.4   Types of data sensing in previous technology   23     2.4.1   Remote Sensing Data   24     2.4.2   Local Sensing Data or Telemetry   25     2.5   Measurement using calculation for system   29     2.5.1   Water level using pressure sensor   30     2.6   Component used in Flood Monitoring and Alerting System   31     2.6.1	LIST OF SYMBOLS	9
LIST OF APPENDICES11CHAPTER 1INTRODUCTION121.1Background121.2Problem Statement141.3Project Objective151.4Scope of ProjectSTIT TEKNIKAL MALAYSIA MELAKA1.5Project Outline17CHAPTER 2LITERATURE REVIEW2.1Introduction192.2Flood monitoring and warning technologies192.2.1Flood Monitoring System202.3Types of floods in Malaysia212.3.1Flash Flooding222.4Types of data sensing in previous technology232.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	LIST OF ABBREVIATIONS	10
CHAPTER 1INTRODUCTION121.1Background121.2Problem Statement141.3Project Objective151.4Scope of Project151.5Project Outline161.5Project Outline192.1Introduction192.2Flood monitoring and warning technologies192.2.1Flood Monitoring System202.3Types of floods in Malaysia212.3.1Flash Flooding212.3.2River Flooding222.4Types of data sensing in previous technology232.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	LIST OF APPENDICES	11
1.1Background121.2Problem Statement141.3Project Objective151.4Scope of Project RSITI TEKNIKAL MALAYSIA MELAKA161.5Project Outline17CHAPTER 2LITERATURE REVIEW2.1Introduction192.2Flood monitoring and warning technologies192.2.1Flood Monitoring System202.3.1Flash Flooding212.3.1Flash Flooding212.3.2River Flooding222.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5.1Water level using ultrasonic sensor292.5.2Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT111 for temperature and humidity detection32	CHAPTER 1 INTRODUCTION	12
1.2   Problem Statement   14     1.3   Project Objective   15     1.4   Scope of Project RSITI TEKNIKAL MALAYSIA MELAKA   16     1.5   Project Outline   17     CHAPTER 2   LITERATURE REVIEW     2.1   Introduction   19     2.2   Flood monitoring and warning technologies   19     2.2.1   Flood Monitoring System   19     2.2.2   Flood monitoring and warning system   20     2.3   Types of floods in Malaysia   21     2.3.1   Flash Flooding   21     2.3.2   River Flooding   22     2.4   Types of data sensing in previous technology   23     2.4.1   Remote Sensing Data   24     2.4.2   Local Sensing Data or Telemetry   25     2.5   Measurement using calculation for system   29     2.5.1   Water level using ultrasonic sensor   29     2.5.2   Water level using pressure sensor   30     2.6   Component used in Flood Monitoring and Alerting System   31     2.6.1   Ultrasonic sensor for water level detection   31 <th>1.1 Background</th> <th>12</th>	1.1 Background	12
1.3Project Objective151.4Scope of Project RSTITTEKNIKAL MALAYSIA MELAKA161.5Project Outline17CHAPTER 2 LITERATURE REVIEW2.1Introduction192.2Flood monitoring and warning technologies192.2.1Flood Monitoring System192.2.2Flood monitoring and warning system202.3Types of floods in Malaysia212.3.1Flash Flooding212.3.2River Flooding222.4Types of data sensing in previous technology232.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	1.2 Problem Statement	14 اود
1.4Scope of Project RSITI TEKNIKAL MALAYSIA MELAKA161.5Project Outline17CHAPTER 2LITERATURE REVIEW192.1Introduction192.2Flood monitoring and warning technologies192.2.1Flood Monitoring System192.2.2Flood monitoring and warning system202.3Types of floods in Malaysia212.3.1Flash Flooding212.3.2River Flooding222.4Types of data sensing in previous technology232.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using ultrasonic sensor292.5.2Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	1.3 Project Objective	15
1.5Project Outline17CHAPTER 2LITERATURE REVIEW192.1Introduction192.2Flood monitoring and warning technologies192.2.1Flood Monitoring System192.2.2Flood monitoring and warning system202.3Types of floods in Malaysia212.3.1Flash Flooding212.3.2River Flooding222.4Types of data sensing in previous technology232.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using ultrasonic sensor292.5.2Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	1.4 Scope of Project RSITI TEKNIKAL MALAYSIA MELA	KA 16
CHAPTER 2LITERATURE REVIEW192.1Introduction192.2Flood monitoring and warning technologies192.2.1Flood Monitoring System192.2.2Flood monitoring and warning system202.3Types of floods in Malaysia212.3.1Flash Flooding212.3.2River Flooding222.4Types of data sensing in previous technology232.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	1.5 Project Outline	17
2.1Introduction192.2Flood monitoring and warning technologies192.2.1Flood Monitoring System192.2.2Flood monitoring and warning system202.3Types of floods in Malaysia212.3.1Flash Flooding212.3.2River Flooding222.4Types of data sensing in previous technology232.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using ultrasonic sensor292.5.2Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	CHAPTER 2 LITERATURE REVIEW	19
2.2Flood monitoring and warning technologies192.2.1Flood Monitoring System192.2.2Flood monitoring and warning system202.3Types of floods in Malaysia212.3.1Flash Flooding212.3.2River Flooding222.4Types of data sensing in previous technology232.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using ultrasonic sensor292.5.2Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	2.1 Introduction	19
2.2.1Flood Monitoring System192.2.2Flood monitoring and warning system202.3Types of floods in Malaysia212.3.1Flash Flooding212.3.2River Flooding222.4Types of data sensing in previous technology232.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using ultrasonic sensor292.5.2Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	2.2 Flood monitoring and warning technologies	19
2.3Types of floods in Malaysia212.3.1Flash Flooding212.3.2River Flooding222.4Types of data sensing in previous technology232.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using ultrasonic sensor292.5.2Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	2.2.1 Flood monitoring and warning system	19
2.3.1Flash Flooding212.3.2River Flooding222.4Types of data sensing in previous technology232.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using ultrasonic sensor292.5.2Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	2.3 Types of floods in Malaysia	20
2.3.2 River Flooding222.4 Types of data sensing in previous technology232.4.1 Remote Sensing Data242.4.2 Local Sensing Data or Telemetry252.5 Measurement using calculation for system292.5.1 Water level using ultrasonic sensor292.5.2 Water level using pressure sensor302.6 Component used in Flood Monitoring and Alerting System312.6.1 Ultrasonic sensor for water level detection312.6.2 DHT11 for temperature and humidity detection32	2.3.1 Flash Flooding	21
2.4Types of data sensing in previous technology232.4.1Remote Sensing Data242.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using ultrasonic sensor292.5.2Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	2.3.2 River Flooding	22
2.4.1 Remote Sensing Data242.4.2 Local Sensing Data or Telemetry252.5 Measurement using calculation for system292.5.1 Water level using ultrasonic sensor292.5.2 Water level using pressure sensor302.6 Component used in Flood Monitoring and Alerting System312.6.1 Ultrasonic sensor for water level detection312.6.2 DHT11 for temperature and humidity detection32	2.4 Types of data sensing in previous technology	23
2.4.2Local Sensing Data or Telemetry252.5Measurement using calculation for system292.5.1Water level using ultrasonic sensor292.5.2Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	2.4.1 Remote Sensing Data	24
2.5Measurement using calculation for system292.5.1Water level using ultrasonic sensor292.5.2Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	2.4.2 Local Sensing Data or Telemetry	25
2.5.1Water level using ultrasonic sensor292.5.2Water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	2.5 Measurement using calculation for system	29
2.5.2water level using pressure sensor302.6Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	2.5.1 Water level using ultrasonic sensor	29
2.0Component used in Flood Monitoring and Alerting System312.6.1Ultrasonic sensor for water level detection312.6.2DHT11 for temperature and humidity detection32	2.5.2 water level using pressure sensor	30 21
2.6.2 DHT11 for temperature and humidity detection 32	2.0 Component used in Flood Molifioning and Alerting System 2.6.1 Ultrasonic sensor for water level detection	51 31
· · · · · · · · · · · · · · · · · · ·	2.6.2 DHT11 for temperature and humidity detection	31

PAGE

	2.6.3 Water raindrops sensor for raindrops detection	33	
2.7	Department Of Irrigation And Drainage	34	
2.8	Summary	35	
СНАР	TER 3 METHODOLOGY	36	
3.1	Introduction	36	
3.2	Project Work Flow	36	
3.3	Flow Chart	38	
3.4	Experimental setup	39	
3.5	Equipment	40	
	3.5.1 Microcontroller	41	
	3.5.2 Ultrasonic Sensor	42	
	3.5.3 Water raindrop Sensor	43	
	3.5.4 DHTTT Sensor	44	
2.6	3.5.5 ESP8266 Wifi Module	45	
3.6	Parameters	46	
	3.6.1 Calculation for water level	46	
	3.6.2 Calculation for Humidity and Temperature	4/	
20	S.0.5 Calculation of data collection	4/	
3.8	Summary WALAYSIA 4	48	
CHAP	TER 4 RESULTS AND DISCUSSIONS	49	
4.1	Introduction	49	
4.2	Indoor Testing	49	
	4.2.1 Water level via Ultrasonic Sensor	49	
	4.2.2 Result and Analysis	52	
	4.2.3 Water rain drop via raindrops sensor	54	
	4.2.4 Temperature and humidity via DHT11	55	
1.0	4.2.5 Result and Analysis	56	
4.3	Outdoor testing	58	
	4.3.1 DHT11 Temperature sensor for temperature measurement	58	
	4.3.2 Ultrasonic sensor for water level measurement A MELAKA	60	
4 4	4.3.3 Water raindrop sensor for raindrop measurement	62	
4.4	Piood Monitoring and Alerting System via Blynk Application	64	
4.5	Discussion	00 70	
4.0	Discussion //		
4./	Summary	/1	
CHAP	TER 5CONCLUSION AND FUTURE WORKS	72	
5.1	Introduction	72	
5.2	Conclusion	72	
5.3	Future Works	73	
REFERENCES 74			
APPEN	NDICES	77	

# LIST OF TABLES

TABLE	TITLE			
Table 2.1	Comparison between wireless technology used in the world			
Table 4.1	Measurement of Ultrasonic sensor (testing using object)			
Table 4.2	Measurement of Ultrasonic sensor (testing using water )			
Table 4.3	Measurement for temperature			
Table 4.4	Measurement for humidity			
Table 4.5	Data collected for water level, water raindrop, temperature, humidity and			
	heat	64		
Table 4.6	Subsystem testing <b>UTERNIA</b> اونيونرسيتي تيڪنيڪل مليسيا ملاك	65		

# LIST OF FIGURES

FIGURE	JURE TITLE		
Eiguro 2 1	Diver Flood	20	
Figure 2.1		20	
Figure 2.2	Satellite scanning the Earth's surface	24	
Figure 2.3	Flood monitoring and alert using local data sensing or Telemetry	25	
Figure 2.4	Department of Irrigation and Drainage's Flood Monitoring and Ale	erting	
	System	34	
Figure 3.1	TL estimation general process flow	37	
Figure 3.2	Flood Monitoring and Alerting System Flow Chart	35	
Figure 3.3	Experimental Setup	37	
Figure 3.4	Arduino Uno	38	
Figure 3.5	Ultrasonic Sensor	39	
Figure 3.6	Water raindrop Sensor	40	
Figure 3.7	DHT11 Sensor	41	
Figure 3.8	ESP8266RSITI TEKNIKAL MALAYSIA MELAKA	42	
Figure 4.1	Testing using object	46	
Figure 4.2	Serial monitor result in Arduino IDE	46	
Figure 4.3	Testing using water in basin	47	
Figure 4.4	Serial monitor result in Arduino IDE	47	
Figure 4.5	Testing using droplets	50	
Figure 4.6	Serial monitor result in Arduino IDE	50	
Figure 4.7	Testing with room temperature	51	
Figure 4.8	Serial monitor result in Arduino IDE	51	
Figure 4.9	Weather forecast by google	52	
Figure 4.10	Outdoor testing for DHT11	54	

Figure 4.11	Serial monitor Serial monitor result in Arduino IDE		
Figure 4.12	Hardware setup for water raindrop sensor in outdoor testing		
Figure 4.13	Hardware setup for ultrasonic sensor in outdoor testing		
Figure 4.14	Serial monitor reading for water level in outdoor testing	57	
Figure 4.15	Data analysis for water level outdoor testing ing (excel)5		
Figure 4.16	Hardware setup for water raindrop sensor in outdoor testing 53		
Figure 4.17	Serial monitor reading for water raindrop sensor in outdoor testing	58	
Figure 4.18	Data analysis for water raindrop outdoor testing ing (excel) 5		
Figure 4.19	Flood Monitoring and Alerting System hardware setup in Melaka Sentral river	60	
Figure 4.20	Connection of the system through ESP8266 wifi module to Blynk applicationon serial monitor	60	
Figure 4.21	Blynk setup for notification event condition during warning condition	61	
Figure 4.22	Water raindrop reading for outdoor reading in Melaka Sentral	62	
Figure 4.23	Water level reading in Melaka Sentral river	63	
Figure 4.24	اوينوس سيتي تي Temperature, humidity and heat index	63	
Figure 4.25	Graph for water level, water raindrop, temperature, humidity and		
	heat index	64	

# LIST OF SYMBOLS



# LIST OF ABBREVIATIONS



# LIST OF APPENDICES

# APPENDIXTITLEPAGEAppendix AExample of Appendix A77Appendix BExample of Appendix B78



### **CHAPTER 1**

### **INTRODUCTION**

### 1.1 Background

Flooding is a well-known natural calamity. When the water level in dams, river beds, and other bodies of water suddenly rises, the surrounding areas suffer greatly. It has a serious harmful impact on both our environment and living organisms. In Malaysia,flooding most occur due to heavy rainfall especially during monsoon season yet it was regarded as a common disaster in Malaysia. [1] Communities in the low-lying area are at high risk of flooding-related losses. This natural disaster is unavoidable and it can be happened without any sign, but with preparation it might can be avoid. As a result, emergency notifications of the water level situation in the riverbed under varied conditions are crucial in these scenarios.[2][3]

Flood monitoring has been used in Malaysia since we have experienced 51 natural disasters between 1998 and 2018.[1] Malaysia already have the system that can be used to detect flood such as early warning system yet the recent tragedy happened in Kuala Lumpur and Selangor brought a huge impact for us to improve the system. Therefore, a lot of initiative that Government and Department of Irrigation and Drainage, Malaysia have done in order to improve the flood warning system in Malaysia.

Flood monitoring systems are one of the technologies that can be used to reduce the number of flood fatalities, particularly in east coast states such as Kelantan, Terengganu, and Pahang. The alarm system can be integrated into the system to notify the public. Flood authorities are working hard to prevent fatalities and flood monitoring system was one such system. GSM and wifi-module was the system that necessitates the use of communication

services.[1] This system's function was to measured the river's water level, and when the water level exceeds a certain threshold, a notification had been sent to the user. This system was created specifically for rescuer team and also for victim during their evacuation.

Research on this system has increased every year when many organizations try to find the best ways preventing floods. Most of the research on this project was using wireless sensor network, ultrasonic sensor, Arduino and GSM model to performed the warning SMS whether for authorities or for the victims nearest the affecting area. Moreover, it also can be found that other researcher used wifi-module that functioning similarly as GSM module. Consequently, in a recent years, the performance of flood monitoring and warning system has been continuously improved.[4], [5] However, most systems prioritize sending messages to victims using SMS and the factor taken into account for each flood incident that occurs was only the height of the water level in the affected area. In fact, the data collected was limited to the time of the incident only. As a result, the data cannot be reused for study by the authorities if any flood events occur suddenly.

The existing technology used to monitor and alert floods was divided into two categories: remote sensing data and local sensing data. In remote sensing data, satellites are typically used to record cloud images and predict rain formation. By installing sensor nodes along the river, local sensing data will be used to measure flood parameters in the study area, which was near the river. Although most industries are now making significant improvements in flood monitoring and warning systems, educational institution improvements must be accelerated in order to produce more disaster control systems, particularly floods, among the younger generation.[4], [5] Following that, Malaysia can produce numerous systems to address any problem that arises.

The goal of this project was to create a flood monitoring system and alerting system for the area near river to be monitor using local sensing data via a microcontroller system and the data that can be used for future record. The system can also measure flood parameters like water level, raindrops, temperature and humidity, but for the time being, the project is more focused on storing the data taken each time the sensor reads the data for future use. This parameter had been displayed to the user in the controlled station and also to the society used an application. The user could view the current flood status and water level in the surrounding area. When the parameter reading exceeds the threshold valued indicating dangerous flood conditions, the alarm would sounded and a warning had been sent to the user.

### 1.2 Problem Statement

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In the recent few decades, there have been several major floods. The main causes of flooding in Malaysia are increased run off rates due to urbanisation, loss of flood storage due to development extending and taking over flood plains and drainage corridors, inadequate drainage systems or failure of localised drainage improvement works extended insufficiently downstream, construction at bridges and culverts that are either undersized or partially blocked by debris buildup or other causes, and siltation in waterway channels.[6] Therefore it was hard to control the incoming flood because of numerous barrier in the system construction. However, in order to make improvement for the system the cost of equipment uses should be considered and data of everyday reading must be collected for future used..

Another important issue that people encounter during floods is that they have no idea where the incoming flood happened or which road to take to get to a new area. Because nobody knows what was going on in such a setting. If there existed a mechanism that could warn people ahead of time of a major calamity, lives could be saved, because flooding ruins the telecommunications system as well. In some cases, victims have already been warned by authorities about the flood disaster, but due to a lack of detailed information on flood scenarios, when the flood begins, and when it was fully flooded, residents disregard the information. A previous project conducted a study for a flood monitoring and alerting system, but the system design did not include data collection and instead only measured various parameters.

Therefore, we need a significantly quicker and more sophisticated technique to alert the public before the destruction takes place. Incoming flood warnings need to be highlighted ahead of time for their high quality and accuracy. As a result, there is a hole that needs filling in order to realise this objective, especially when implemented in the business world. At this juncture, both the system's performance and the source of the disruption can be pinpointed. Flood characteristics such as water level had been measured in real time by this project's low-cost monitoring and alarm system. Additionally, the user had been informed of the flooding status and the historical data had been preserved and recorded for future used

# 1.3 Project Objective

The following are the objectives of this project: LMALAYSIA MELAKA

- a) To develop flood monitoring system complete with alerting system using Arduino
- b) To integrate the system with IoT for data collection that can be saved for future use
- c) Analyze the performance of the system based on consistency and the ability of the system to provide the information.

### 1.4 Scope of Project

The following are the scope of the project:

1. Identify the parameter : water level, raindrops, temperature and humidity to detect flood nearby the river that can send the data to Blynk. It can be monitor lively and used in public with email and message notification. The comparison between the simulation and hardware setup will be performed.

2. The proposed flood monitoring and alerting system had been validated and simulated used real-time sensor data. Experiments are conducted over distances of up to 800 mm. The performance of the system with the proposed techniques was analysed and compared to existing methods using Blynk. The system data is then saved in the cloud and further data collection can be export using excel. Furthermore, the collected data can be made available to the general public. **ERSITI TEKNIKAL MALAYSIA MELAKA** 

Areas close to the river in Melaka Sentral are the primary focus of this development project. Keeping tabs on the water level required constant data collection and updates. The project uses a wifi-module to send out Blynk alerts to users if there was a flood. The authorities will also offer the current state of the impacted area, with three conditions indicated as safe, warning, and flood alert.

System construction and coding are the most crucial steps. Simulation and real-time hardware enable model identification. The monitoring and alerting system would not measured flood prevention solutions. The flood status and water level would also been recorded. Install the system near the house on a lower soil surface where floodwater enters first. However, the system device needs a suitable position. Then the user receives the reading result.

### 1.5 Project Outline

The project is structured as follows:

Chapter 2 contains a review of the literature on flood monitoring and alerting system technologies. The investigation begins with an examination of how previous researchers have modelled the system. The techniques for modelling the monitoring and alerting system are also discussed. Following that, the control techniques used are described. The discussion was divided into several categories in order to investigate the accomplishments. This chapter concludes with a system summary.

Chapter 3 was about the modelling of a flood monitoring and alerting system. The parameter using sensor will elaborate the modelling, and the performance will be analysed using Blynk. This chapter also includes the experimental setup for data collection. The methods for determining flood parameters using an ultrasonic sensor's mathematical formula are thoroughly explained. Following that, for future works, a comparison of simulations and experiments will be performed for validation. Furthermore, the preliminary design procedure of the flood monitoring and alerting system that will be used in the design of the proposed monitoring technique was included.

In chapter 4, three proposed experiments are described. The determination of the parameters involved in the design of these systems is discussed in detail. Furthermore, after the hardware setup established via the Flood Live Monitoring analysis in the Blynk, the stability of the system was shown in this chapter in the future. The proposed design's flood monitoring and alerting system results are demonstrated and analysed through simulation,

followed by experimental work in the future. The effectiveness of these techniques is evaluated under a variety of conditions. First, simulation and experiments are carried out based on various references such as circuit construction, equipment used, and how to interface data from Arduino to Blynk. Following that, the results with the threshold variation are also provided in this chapter for the purpose of analysing the system's robustness.

In chapter 5, the project findings and conclusions are summarised. Recommendations for future work are also provided.



### **CHAPTER 2**

### LITERATURE REVIEW

### 2.1 Introduction

The literature review on flood monitoring with alerting system based on data collection was presented in this chapter. The chapter begins with an examination of how previous researchers modelled the system, followed by reviews of control methods proposed by other researchers, which are described based on the components, software, and data collection. Finally, in the final subsection, these works are summarized.

### 2.2 Flood monitoring and warning technologies

There are two types of flood systems in use: flood monitoring and warning systems and flood monitoring only. Section 2.2.1 describes the flood monitoring system only, while Section 2.2.2 describes the flood monitoring system and warning system in previous projects. This project falls into the category described in Section 2.2.2, but takes a different approach to alerting via IoT application and the data collected via Blynk that can be saved in the cloud. Finally, these works are summarized in the last sub-section.

### 2.2.1 Flood Monitoring System

Floods are one of Malaysia's most common natural disasters, occurring nearly every year, especially during the monsoon season. The coasts of Peninsular Malaysia are especially vulnerable to flooding during the northeast monsoon season, which lasts from October to March.[7] Flood monitoring system was different because this system does not have alerting system that can notify people nearby if there was incoming flood occur.[3]. In foreign country most of them already built up their own flood monitoring system it also went to malaysia where we used it for authorities to warned people about the flood but only authorities that controlled the system would got notify the first sign of incoming flood.[8]. During my research, I discovered few projects and information about flood monitoring that did not include an alerting system, because most projects these days are focused on improving the system by adding an alerting feature. This was because the alerting function was more useful than the flood monitoring system, which had been discussed in the following paragraph.

### 2.2.2 Flood monitoring and warning system

Flood monitoring and alerting system using arduino microcontroller to control the whole system has widely used in nowadays project. Due to their special advantages that university include low cost, easy to install, and can read the data from sensor easily they have long been promoted as a low cost alternative materials handling tasks. Thus, most of the alerting system used alarm to notify public about the flood early signs.[9][3]

A sensor-based flood monitoring and warning system was one of the flood control measures. This system not only monitors the flood, but also has some type of warning or notification mechanism in place. Measures such as monitoring, forecasting, simulation, and water level evaluation help lessen flood damages.[10][1][9] One of the flood measuring systems makes use of a wireless sensor and a web-based decision support system to monitor, control, alleviate, and evaluate natural disasters, namely flood disasters. It was crucial to

implement a monitoring and flood warning system, as it requires both dependability and reliable data. One of the sensor technologies used to monitor increases in water level and air temperature was the sensor network. The sensor network is completed by a pressure sensor, a temperature sensor, and a precipitation sensor. Installing sensor nodes on trees along the river to measure the water level and air temperature, and sending the data to the base station via GPRS networks every 5 minutes..[9]

Flooding is influenced by a variety of hydrological and climatic factors. The Internet of Things (IoT) was a technology that uses embedded system hardware and a wireless communication network to send sensed data to a computing device for real-time analysis. Experts in flood prediction have shifted away from hydrological models and toward algorithm-based alternatives.[11] Artificial Neural Networks, for example, are used to anticipate floods. This paper's primary purpose was to monitor humidity, temperature, pressure, precipitation, and river water level and to determine their temporal correlations for flood prediction analysis and protection.[2][12][7][13][10][1][9]

### UNIVERSITI TEKNIKAL MALAYSIA MELAKA 2.3 Types of floods in Malaysia

This sub-section outlines the several types of floods that commonly occur in Malaysia which are detailing in subsection 2.3.1 Flash Flooding and subsection 2.3.2 River Flooding. The reason of each flood are also explained in this section.

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### 2.3.1 Flash Flooding

Flash floods are most common in areas that are rapidly developing. Flash floods are distinguished by a sudden increase in water level, rapid movement, and large amounts of debris. Intensity and duration of precipitation, as well as the steepness of watershed and stream gradients, all contribute to the occurrence of flash floods. Due to the loss of vegetation, paving, and replacement of ground cover with impermeable surfaces that increase runoff, and the development of drainage systems that enhance the velocity of runoff, flash flooding in urban areas was becoming an increasingly critical problem.[8]

### 2.3.2 River Flooding

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Floods primarily affect Peninsular Malaysia's east coast and southern parts, as well as Sabah and Sarawak, from December to January, when the northeast monsoon is in effect. River flooding was caused by heavy rainfall, just like monsoon flooding.[7] River floods occur when there was an excess of water in the river catchment, or the zone of land that feeds water into the river and streams, such as through precipitation. During heavy rain, the river was unable to adjust precipitation, and the extra water causes the river's water level to rise and floods to occur. River floods can happen anywhere along the river's path.

When a river or stream reaches its flood stage, the water level rises and overflows the river's banks, resulting in flooding. Typically, the number of river floodings generated by precipitation is influenced by a river's catchment area, the amount of time it takes for rain to collect until local soil saturation, and the land around the river system. A river or stream on a broad, flat floodplain, for instance, will frequently produce a continuous flood and floodwaters in an area that does not subside for many periods. Most river flooding occurs in low-lying locations adjacent to the river. In the diagram below, a river flood is illustrated. Rapid flooding of a river can have deadly implications.



Source : BBC Bitesize

Figure 2.1 River Flood

# 2.4 Types of data sensing in previous technology

This section describes data sensing in prior technology using journals and thesis from previous researchers. The flood monitoring and alerting system employed data sensing for data collecting and prediction in numerous academic publications. Most of the system used either remote or local sensing data to monitor and predict the flood around the selected area that would be detailing the subsection 2.4.1 Remote Sensing Data and 2.4.2 Local Sensing Data or Telemetry.

# 2.4.1 Remote Sensing Data

Satellite remote sensing can predict floods. Figure 2.2 shows how a satellite can monitor the earth's surface multiple times a day.



Source : Flooded areas in Section 24, Shah Alam, December 20, 2021. — Picture from Facebook/Mosti Figure 2.2 Satellite scanning the Earth's surface.

The satellite remote sensor keeps track of variables using information on rainfall, surface water body changes, and soil moisture. They use weather monitoring, long-range photography, and a high temporal and spatial resolution to improve flood prediction. Satellite remote sensing data can be used to forecast flooding by comparing the real-time data image to the normalised image. The incidence angle of the satellite system, polarisation effects, spatial resolution, and wavelength all affect how precise the approach is. In flood-prone zones, the flood monitoring system is an absolute requirement. The data and information must be shared or provided in a timely and accurate manner to the individual with whom this system has been entrusted. The individual would examine the output of the system and communicate predicted local news

### 2.4.2 Local Sensing Data or Telemetry

Utilizing local sensory data or a telemetry system, embedded system technology had been utilised to implement the mechanism in the environment. Electronics has witnessed an increase in the prevalence of embedded systems in recent years. Due to its extensive adoption and use, the popularity of embedded systems is increasing rapidly. There are three primary components of any local sensing data or Telemetry system: the sensors, the data processing and transmission, and the actual use of the data.

### 1. Sensor Network

A wireless sensor network (WSN) includes a sensing component called a sensor. A UNIVERSITITEKNIKAL MALAYSIA MELAKA system's output accuracy depends on the sensors it uses. For flood monitoring and alarm, it was necessary to keep an eye on a few different variables. In this case, we're looking at hydrological, metrological, and lanslide characteristics.

• Hydrological: The purpose of the hydrological sensor is to measure the speed at which the river is moving. The sensor has been set up on the bank of the river.

• Metrological: The metrological sensor measures the ambient light intensity, temperature, humidity, barometric pressure, wind direction, and wind speed.

• Landslide: The geophone and moisture-detecting sensor. A sensor of this type has been set up on the mountain near the river.

The sensors must be carefully placed in order to analyse reliable data. In addition, the sensors or system installed near the river must be resistant to the monsoon, which may or may not occur in that area. Occasionally, the failure of a system can be avoided by employing coated and moisture-proofed exposed material. This method was tough since it requires data collection in a river environment. Along the river, there was an absence of communication and electricity. It would therefore been tough to implement the flood monitoring and alert system. A precise environmental sensor network necessitates a complex system that can operate for an extended period of time and support all of the sensors of the parameter to detect the commencement of flood occurrences. In several known cases, the flood destroyed the device, necessitating its reinstallation.

### 2. Processing and Transmission

Information from a node installed in a remote area must undergo significant processing and transmission before it can be accessed by the end user. The flood monitoring and alert system relies on wireless sensor networks for data transfer (WSN). WSN's widespread adoption in flood-prone areas can be attributed, in part, to its low cost and rapid, trustworthy data delivery. The deployment of WSNs is skyrocketing in numerous economic and social contexts. The gadget can monitor everyone's movements in real-time. As can be seen in Table 2.4.2(b), there is a wide variety of WSNs (communication standards) available. These include 3G, Bluetooth, GSM, ZigBee, and Wi-Fi .

Wireless	Range	Data rate	Benefits	Media
Technology				
3G	Limited	2 megabits per	1. Online service	Too much
		second	2. Proper for download or	memory
			receive large file	needed
Bluetooth	100 meters	700 kilobits	1. Wireless	One to one
		per second	2. Low energy consumption	connection
GSM	Fixed	9.6 kilobits	1. Availability	There is no
	maximum call	per second	2. Wireless	end-to-end
	sites range up	KA		encryption of
	to 35 km that		<i>iem</i>	user data.
	is very		Z	
	limited.	نيكل ما	اوىيۆم,سىتي ئىڭ	
ZigBee	100 meters	250 kilobit per	1. Availability MELAKA	Wireless mesh
		second	2. Wireless	network
Wi-Fi	Internet	2.4 gigahertz	1. Wireless	Don't need
			2. Database	extra cables or
				adaptors

Table 2.1Comparison between wireless technology used in the world

### 3. Application

The result is then displayed to the user, either on the user's local machine or on a remote server. The built system needs to be able to make decisions rapidly and accurately detect and predict potential disasters. In most cases, the first phase of a local data sensing or telemetry system is to have a microcontroller measure and process parameters to generate digital data. The nodes would handle all of the communication between the installation site and the controlled room. Data had been evaluated in the controlled room, and if a given parameter

was



determined have been out of range, the user had been warned. In Figure 2.3 we see a UNIVERSITI TEKNIKAL MALAYSIA MELAKA schematic of the entire system .

Source : Samuji, M.F. (2016). Flood Monitoring and Alert System Using Wireless Sensor Network.

Figure 2.3 Flood monitoring and alert using local data sensing or Telemetry

### 2.5 Measurement using calculation for system

This sub-section determines the measurement take place in water level parameter in previous flood monitoring and alerting system. 2.5.1 measurement using ultrasonic sensor for water level and 2.5.2 shows the measurement using pressure sensor for water level.

### 2.5.1 Water level using ultrasonic sensor

[4], [5]measured the distance of the river's water level using an ultrasonic sensor. Two transducers are used in the PING ultrasonic sensor. Each transducer has a specific function. A transducer was a device that releases a pulse of high frequency sound waves and detects sound waves that have been reflected from a surface, such as the water level. The time between transmitting the pulse and receiving the reflection or echo can be utilised to determine ultrasonic distance, which was then translated to the speed of sound. In any application, this sensor can be used to measure moving or stationary objects. The 40Hz signal of the ultrasonic transmitter, as processed by the transmitter circuit. With sound speed, the transmission range was 340 metres per second The ultrasonic receiver would analyse the signal's reflection to estimate the distance. S = 340t/2 where S was the distance between the transmitter and the reflected field and t was the timing difference between the transmitter and the receiver.

[14] The ultrasonic sensor HC SR04 has a measurement range of 2cm to 4m and an accuracy of 2mm. It generates ultrasonic sound that travels through air at 14000/4 Hz. If an object is present, sound was reflected back to sonar. Using the receiving time of sound and the speed of sound, we can calculate the distance of an object from sonar. Sound velocity =340m/s=0.034 cm/microsec or 29 microsec/cm Distance/Speed = Time The time received

was twice the actual time because sound waves travel froth and bounce back from objects. Thus, distance in cm=time\*0.034/2 or distance in cm=time/29/2 The height of the water was calculated based on the distance.

To summarise, ultrasonic technology can detect distance. The ultrasonic sensor functions as a trigger and echo pin. Every 10 microseconds, the Arduino sends a high signal to this pin. When the HC-SR04 was turned on, it sends eight 40KHz sound waves to the surface of the water. The wave was echoed back to the sensor when it reaches the water's surface, and the Arduino reads the echo pin to calculate the time between triggering and receiving the echo. Use the formula distance = (time/2)\*speed of sound to calculate the distance between the Ultrasonic and Max water levels.

### 2.5.2 Water level using pressure sensor

Diverse types of sensors, such as level sensors and ultrasonic sensors, were also examined. The problem with ultrasonic and level sensors is that their measuring ranges are extremely limited. Typically, a 5V ultrasonic sensor has a range between 2 cm and 3 m. Extreme flooding causes the water level to climb well over the average 5 m. If such sensors were utilised, they had been positioned around 3 metres above the normal water level, resulting in an imperfect monitoring system. A level sensor detecting heights larger than 5m requires AC input because these are typically industrial-grade, high-power sensors.

Once the system is connected to the wider network, it loses its independence. Locations remote from any population centre may appear like a waste of money given the necessity of connecting them to the national grid. There would also been issues if the closest power source was more than a few kilometres away. The used barometric pressure sensor makes efficient use of a large measuring range (3kPa to 110kPa) with a high resolution (0.2Pa). It contains an onboard A/D converter and requires a 3.3V power supply to function. The air can be confined in a pipe cylinder. An extended pipe length allows for measurements to be taken at deeper water levels. Changes in water pressure allow for an approximation of the water level.[6]

Pressure -100717Pa /8084 = Level Height Inputting the current pressure reading value into the equation yields the level height value. In this scenario, the initial pressure at the site where the system will be placed is 100717 Pa, so that value must be substituted into the y-intercept of the gradient equation.

### 2.6 Component used in Flood Monitoring and Alerting System

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This section would cover the previous project's of same components in further detail. Each paragraph provides a detailed examination of a system component's function and its working.

# 2.6.1 Ultrasonic sensor for water level detection

The previous project largely relied on hardware, such as an Arduino Uno, an ultrasonic sensor, a liquid crystal display (LCD), a GSM SIM900A module, and a Piezo buzzer alarm. The ultrasonic sensor was a vital instrument for measuring the height of rising flood waters. This sensor can accurately measure enormous distances. The ultrasonic sensor's emitted sound wave can also be utilised to determine distances.[5][4][1][6] When the system begins with an ultrasonic sensor and the GPS module sends water level data and flood location coordinates to Arduino Uno as data processor, the construction of integrated components in[9]can be explained. These data are conveyed as SMS messages to the receiving
information system node of the modem. A computer and processor gather data and then construct a water level information system using Google Maps.

According to [9]the ultrasonic sensor used functions similarly to the ultrasonic radar principle. The ultrasonic wave was transmitted, and the ultrasonic receiver receives it. Transmit-receive time was used to represent distance. This sensor was capable of electrical distance measurement. HC SR04 ultrasonic sensors measure distances between 2 cm and 4 metres with a precision of 2 mm. The air was permeated with ultrasonic 14000/4 Hz sound. Sonar reflects sounds emitted by objects. The speed and duration of sound reception can be used to calculate sonar range. Sound speed=340m/s=0.034 cm/sec or 29 microsec/cm. Distance/speed=time. The time received is doubled when sound waves bounce off of objects. Consequently, cm=time\*0.034/2 or cm=time/29/2. Distance determines water height.

## 2.6.2 DHT11 for temperature and humidity detection

The NTC Thermistor and humidity sensor of DHT11 sensors. In a recent project, humidity was monitored via a sensor element comprised of two electrodes and a moistureretentive substrate. The conductivity and resistance of a substrate are influenced by humidity. The controller reads the resistance change from the board or PCB of the device. The NTC (Negative Temperature Coefficient) Thermistor measures temperature by decreasing resistance with an increase in temperature and increasing resistance with a decrease in temperature.

The PCB detects resistance and transmits digital information to the microcontroller board. Temperature and humidity measurements from the DHT11 are accurate and dependable. DHT11 has an accuracy of 2 degrees and a temperature range of 0–50°C. The humidity range of this sensor is 20–80%, and its precision is 5%. The sampling rate of 1Hz

provides one reading every second. DHT11 is tiny and operates at 3 to 5 volts. Measurements utilise 2.5mA max.

Single-wire or serial communication is utilised by the DHT11 module. At predetermined intervals, this module delivers data in the form of pulse trains. Before transferring data to Arduino, it was necessary to execute several initialization commands with a wait. Moreover, the whole duration of the process was approximately 4 milliseconds. The single-wire serial interface makes system integration quick and easy. Due to its tiny size, low power consumption, and signal transmission range of up to 20 metres, it was the finest choice for a wide range of applications, including the most demanding. A single row of four pins was used to package the component. It was easy to join, and consumers can request particular programmes.

#### 2.6.3 Water raindrops sensor for raindrops detection

The rain sensor module readily detects precipitation. It measures the intensity of rainfall and switches when raindrops pass a rainy board. The module features a separate rain board, control board, power indication LED, and potentiometer-adjustable sensitivity for the sake of simplicity. Analog output detects raindrops. A raindrop sensor was a type of sensing device that was primarily used to detect whether or not it was raining, as well as the amount of precipitation. It was frequently utilised in modern projects, including vehicle automatic wiper systems, intelligent lighting systems, and intelligent sunroof systems. It consists of a sensor panel for sensing rainwater and a control module for converting the detected signal into an electrical signal.

The sensor for raindrops features a control module with four outputs. VCC and GND are connected to a 5V power source and GND. The D0 pin of the microcontroller is

connected to the digital output pin. The analogue pin can be utilised as the analogue output. The A0 pin can be linked to any microcontroller's ADC pin in order to utilise the analogue output. The sensor module includes a potentiometer, an LM393 comparator, LEDs, capacitors, and resistors. Copper rails serve as variable resistors and compose the rainboard module. Its resistance changes depending on the rainboard's moisture content.

#### 2.7 Department Of Irrigation And Drainage

Information on the Department of Irrigation and Drainage's Flood Monitoring and Alerting System was provided. The purpose of this department was to monitor the river's water level and report any significant changes. Telemetry, in which a sensor was placed beneath the pump house, was used as one of several methods by the Malaysian Drainage And Irrigation Department (JPS) to gauge the height of water in the riverbank. As soon as the sensor was exposed by the watered's surface, telemetry was activated and data were transferred to the host. The watered leveled could also been monitor publicly.

	State:	Melaka	* *	District:	ALL	-	Station:	ALI		Y	
No	Pastion ID	UNIVE	RSITI	TEKN	IKAL M	ALAYS	Water Level (m)	LAK	An	reshold	
NO.	Station ID	Station Name	District	Main Basin	Sub River Basin	Last Opdated	(Graph)	Normal	Alert	Warning	Danger
1	2322412	Sg. Melaka di Melaka Pindah	Alor Gajah	Sungai Melaka	Sg. Melaka	31/05/2022 14:55	<u>10.19</u>	10.00	11.30	11.48	11.90
2	2222413	Sg. Melaka di Durian Tunggal U/S	Alor Gajah	Sungai Melaka	Sg. Melaka	31/05/2022 14:55	2.68	3.00	3.70	3.79	4.00
3	2222412	Sg. Melaka di Durian Tunggal D/S	Alor Gajah	Sungai Melaka	Sg. Melaka	31/05/2022 14:55	<u>0.88</u>	3.00	3.70	3.79	4.00
4	2225444	Sg. Chohong	Jasin	Sungai Kesang	Sg. Chohong	31/05/2022 14:55	8.89	11.30	12.80	12.98	13.40
5	2125002	Sg. Kesang di Telok Rimba	Jasin	Sungai Kesang	Sg. Kesang Melaka	31/05/2022 14:55	1.57	2.20	3.05	3.25	3.70
6	0300071WL	Tehel, Sg. Air Panas	Jasin	Sungai Duyong	Sg. Duyong	31/05/2022 15:05	0.52	0.00	0.00	0.00	0.00
7	0300061WL	Bukit Katil, Sg. Duyong	Melaka Tengah	Sungai Duyong	Sg. Duyong	31/05/2022 02:45	0.20	0.00	0.00	0.00	0.00
8	2223423	Sg. Duyong	Melaka Tengah	Sungai Duyong	Sg. Duyong	31/05/2022 14:55	0.23	0.25	1.20	1.38	1.80
9	2222403	Cheng U/S	Melaka Tengah	Sungai Melaka	Sg. Melaka	31/05/2022 14:55	0.69	1.70	2.20	2.85	3.50
10	2222404	Cheng D/S	Melaka Tengah	Sungai Melaka	Sg. Melaka	31/05/2022 15:05	0.66	1.70	2.20	2.29	3.50
11	2222433	Sg. Melaka di Batu Hampar	Melaka Tengah	Sungai Melaka	Sg. Melaka	31/05/2022 15:05	<u>1.36</u>	1.30	1.60	1.72	2.00
12	2222402	Lencongan Sg. Malim di Klebang Besar U/S	Melaka Tengah	Sungai Malim	Sg. Air Salak	31/05/2022 14:55	<u>1.20</u>	0.50	1.40	1.58	2.00
13	2222401	Lencongan Sg. Malim di Klebang Besar D/S	Melaka Tengah	Sungai Malim	Sg. Air Salak	31/05/2022 14:55	<u>-0.54</u>	0.50	1.40	1.58	2.00
14	0290271WL	Sg. Batang Tampin Di Tanjung Rimau	Alor Gajah	Sungai Melaka	Sg.Tanjung Rimau	31/05/2022 15:05	4.27	5.00	6.00	7.00	8.00

Source : The Official Web Of Public Infobanjir, Ministry Of Natural Resources, Environment And Climate Change

Figure 2.4 Department of Irrigation and Drainage's Flood Monitoring and Alerting System

#### 2.8 Summary

A comprehensive literature evaluation of flood monitoring and alerting systems using IoT technologies has been conducted. Previous researchers presented a number of methods for modelling the flood monitoring and alerting system in both realistic and simulated settings. The initial investigation into these technologies was based on the setting in which they were deployed. The investigations are continued by subsequent scholars, who provide new methods for measuring the parameter and designing flood and monitoring systems. From a survey of the research done on this flood and monitoring system, most of the attention has been placed on identifying many different components that contribute to floods and developing methods to measure them. The major purpose of most modern projects was now to informed the public by sms and alarm, and very few projects actually collected data. This improvement was seen as a novel contribution to the field, and the efficiency of the system in a real-world setting had been assessed. The threshold-variation robustness of the system was also studied. Following this introduction, further chapters would went into greater depth regarding the approached, system design, and implementation.

#### **CHAPTER 3**

## METHODOLOGY

## 3.1 Introduction

The foundation of the system, including data collection, was laid out in this chapter. The physical model's attribution was discussed here as well. To demonstrate the system's efficacy, we will describe how it works in practise and run a full set of experiments involving both simulation and hardware.

## 3.2 **Project Work Flow**

This section goes over the project flow for this study. This project includes four critical activities: a literature review to define the problem, the construction of a flood monitoring and alerting system, a flood monitoring and alerting system based on simulation, **DERSTITIENT REVIEWALL MALAYSEA FLAKA** and the setup of a circuit for both flood monitoring and flood alerting systems. The flow of this research was depicted in Figure 3.1



Figure 3.1 TL estimation general process flow

#### 3.3 Flow Chart



Figure 3.2 Flood Monitoring and Alerting System Flow Chart

According to the flowchart in Figure 3.3, the Flood Monitoring and Alerting System was designed to notify the public in the area of an impending flood. The process begins when the system was ON and connected to the setup wifi connection . Blynk Application would start to read the data based on the data interfacing collection through the reading of each sensor .Ultrasonic sensor would measures the distance between the river and the sensor. While the other sensor would keep monitoring and read the data. DHT11 would read the data of temperature and humidity in the area and water raindrops sensor would sense and works for determine the quantity of raindrops which may be one of the factors contributing to the occurrence of floods. It works in the same way to detect water level. Ultrasonic sensor would detect if the distance closest to the sensor less or equal to 7 cm (indoor testing), the water level rises and would alert the nearby residents by activate the alarm and can be alert

using the Blynk application and data can be sent by mesage or email to public. As a result, the serial monitor would display "Flood Alert!!! Evacuation !!" the red LED would illuminate, and the alarm (buzzer) would sound. The system would keep read the data which are water level, water raindrops, temperature and humidity unless the system are OFF.

The microcontroller receives the sensor readings and sends it to the cloud, which can be seen via the Blynk server or app. The data would then be examined and compared. At regular intervals (every 10 seconds), Blynk would analysed the data and report on the current flood situation. Time may be tracked in real time thanks to a customizable time zone that displays local time regardless of where the reader was located. The data was recorded and can be transferred to excel for future recordings, facilitating rescuer analysis of oncoming flood variables and conditions using data from the based station. Blynk's serial monitor and web server would then show information on the current water level, the amount of rain, the temperature, and the relative humidity. A buzzer would indicate the current water level. Also, the alarm will sound instantly to notify the public if the alert threshold value was surpassed. This means people would be ready to evacuate before a flood hits. Further, email notifications can be sent to anyone in the immediate vicinity to share the latest updates.

## **3.4** Experimental setup

The apparatus of Development of Flood Monitoring System with Alerting System based on data collection via IoT Application as shown in Figure 3.4 is a setup to conduct the experiments with wifi module and interfacing using serial connection. The system consists of:.

- 1) Arduino Uno
  - d) ESP8266 wifi module

- e) Ultrasonic sensor HC-SR04
- f) Water raindrop sensor
- g) DHT11
- h) Led
- i) Buzzer



## 3.5 Equipment

Sensor data was sent to the microcontroller and presented on the Blynk web server or application installation. Next, data would be compared. Data from Blynk would assess flood status every 1 seconds. It can be monitored while time was displayed on the readout since the time zone may be changed and set based on the place chosen. Rescuers can use station data to analyse incoming flood variables and conditions by exporting it to Excel. Blynk's serial monitor and web server would show water level, raindrops, temperature, and humidity. Water level would be buzzed. The alarm would also sound when the alert threshold was surpassed. Thus, residents would be prepared for flood evacuation. Emailing the current status can also notify nearby folks.

#### 3.5.1 Microcontroller



## Figure 3.4 Arduino Uno

As a data processor, an Arduino Uno was used in this project's system design. The Arduino Uno is a processing board powered by an 8-bit Atmega328 Microcontroller, as shown in Figure. The Arduino Uno was powered by a 5 volt supply. The Arduino has 14 digital pins, 6 analogue pins, 32 kB flash memory, 2 kB SRAM, 1 kB EEPROM, a USB connection, and a 16 MHz clock speed. (Vishwakarma and colleagues, 2020) A microcontroller was a collection of microchips that can read and write data, store information in memory, and take input to synthesise or produce output. All of these components are housed on a single board known as the Arduino. It can even drive motor or read information through the sensor, but the specification of the item must meet the basic need of an Arduino.[3]

## 3.5.2 Ultrasonic Sensor



Figure 3.5 Ultrasonic Sensor

The ultrasonic sensor HC SR04 can measure distances ranging from 2cm to 4m with a 2mm accuracy. It emits ultrasonic sound at 14000/4 Hz, which travels through air. If an object was detected, sound was reflected back to sonar.can calculate the distance of an object from sonar by using the receiving time of sound and the speed of sound.[6][8], [14]–[20]

Sound speed =340m/s=0.034 cm/sec or 29 micro sec/cm Distance/speed = time. LINIVERSITI TEKNIKAL MAL AVGIA

Because sound waves travel froth and bounce back from objects, the time received was twice as long as the actual time. As a result, distance in cm=time\*0.034/2 or distance in cm=time/29/2.Water height was calculated based on distance.

#### 3.5.3 Water raindrop Sensor



Figure 3.6 Water raindrop Sensor

A rain sensor was one type of switching device that was used to detect rain. It functions as a switch, and the operating concept of this sensor was that whenever it rains, the switch was generally closed. The module/board for the rain sensor was depicted below. This circuit board consists of nickel-coated conductors and operates on the basis of resistance. This sensor module enables the measurement of humidity via analogue output pins and provides a digital output when the humidity threshold is exceeded. This module is comparable to the LM393 integrated circuit in that it contains both the electronic module and a PCB. PCB is used to catch rainwater in this situation. When precipitation falls on the circuit board, it generates a parallel resistance route for calculation by the operational amplifier.

This sensor was a resistive dipole, and based on the moisture only it shows the resistance. For example, it shows more resistance when it was dry and shows less resistance when it was wet.

#### 3.5.4 DHT11 Sensor



Figure 3.7 DHT11 Sensor

An NTC Thermistor and a component for measuring humidity are both present in the DHT11 sensor. A recent project used a humidity sensing element, which consists of two electrodes with a moisture-holding substrate in between them, to measure humidity. The conductivity of the substrate or the resistance between the electrodes both change as a result of changes in humidity. The PCB or board connected to it measures this change in resistance, which was then sent to the controller for reading. The NTC (Negative Temperature Coefficient) Thermistor was used to measure temperature; this thermometer's resistance decreases with rising temperature and rises with falling temperature, as implied by its name, which was negative.

This variation in resistance was also measured by the PCB, which then sends the information in digital form to the microcontroller board. Assuring high dependability and long-term stability, the DHT11 reads in extremely precise humidity and temperature values. DHT11 has a 2-degree accuracy and a temperature range of 0 to 50 degrees Celsius. This sensor has an accuracy of 5% and a humidity range of 20 to 80%. This sensor gives one reading every second because of its sampling rate of 1Hz. Having a working voltage range of 3 to 5 volts, DHT11 was a small device. When measuring, a maximum of 2.5mA is used.

The DHT11 module communicates serially, or via a single cable. This module delivers data at predefined intervals as pulse trains. Before transferring data to Arduino, various initialization commands with a time delay are required. In addition, the complete operation takes around 4ms. Thanks to the single-wire serial interface, system integration was speedy and easy. Due to its tiny size, low power consumption, and signal transmission distance of up to 20 metres, it was the finest alternative for a variety of applications, including the most demanding. With a single row of four pins, the component was packed. The connection process was straightforward, and users can request specific packages.



3.5.5 ESP8266 Wifi Module

Figure 3.8 ESP8266

The ESP8266 was a low-cost Wi-Fi microchip with a complete TCP/IP stack and a microcontroller. Using Hayes-style commands, this small module allows microcontrollers to connect to a Wi-Fi network and establish basic TCP/IP connections. The ESP8285 was an ESP8266 with 1 MiB of on-chip flash that enables single-chip Wi-Fi connectivity. Many hackers were drawn to the module, chip, and software on it because it had few external components, implying that it could eventually be very cheap in volume. Although the coverage area of this wifi module is small, the area to be focused on this project is also small. Hence, the used of this wifi module can be approved based on its small area coverage but low cost.[8], [14]–[20]

This project's objective was to warn the community about the impending flood tragedy. The preferred mechanism for use in this project is ESP8266. The system would provide real-time notifications to the user. The ESP8266 wifi module seen in Figure 3.4.3 would issue an alert via Blynk when the measured values of parameters surpass the threshold values that have been established.[21].

#### 3.6 Parameters

This subsection shows the calculation for all parameters involved in this project that needed calculation to get the result. The error of actual and measured using sensor calculation show in subsection 3.5.2 Calculation of data collection while subsection 3.5.1 Calculation for water level because only ultrasonic sensor use the calculation to get the result.

# 3.6.1 Calculation for water level

For this section, it would only display the calculation coding in Arduino IDE for water level as the sensor only detects distance between river and the sensor. Then the distance would be converted in percent alert about the current water level. The calculation for the water level shows below :

duration = pulseIn(echoPin,HIGH);

distance=(duration\*0.034)/2;

#### **3.6.2** Calculation for Humidity and Temperature

The DHT11 measures electrical resistance between electrodes to detect water vapour. Electrode-covered moisture-holding substrates are humidity sensors. Water vapour absorption by the substrate releases ions, increasing electrode conductivity. Relative humidity affects electrode resistance. Lower relative humidity raises electrode resistance, while higher humidity decreases it.

The DHT11 measures temperature with a surface mounted NTC temperature sensor (thermistor) built into the unit. Before using the DHT11 on the Arduino, DHTLib library need to install in Arduino IDE. It has all the functions needed to get the humidity and temperature readings from the sensor.

## 3.6.3 Calculation of data collection

The experiment would be repeated 10 times, and the data would be recorded on the UNIVERSITI TEKNIKAL MALAYSIA MELAKA object and water's surface using an ultrasonic sensor. Different levels of water testing values were recorded using the Ultrasonic sensor, with the actual value being the value measured using a ruler from the sensor to the water surface.

*Percentage Error* = *Mean measured value* - *actual*  $\times$  100

actual

#### 3.8 Summary

The estimation-based experimental setup was reviewed and derived. Previous researchers' water level formulae are described. The hardware arrangement used USB to monitor the model's simulation, and Arduino IDE was used to code the system. The experiments capture data for Blynk web server's future monitoring system and can be notified via notification alert. Simulations and further experiments verified the proposed technique's performance. Blynk data and advanced analysis would be used to make the system more robust and error-free when simulating. Next, this system would be improved.



## **CHAPTER 4**

## **RESULTS AND DISCUSSIONS**

### 4.1 Introduction

The results of the experiments are presented in this chapter. Three experiments were carried out. The first experiment was carried out by testing the sensitivity of each sensor before modelling the prototype. The second experiment investigates the system implementation in the field in order to observe the behavior of these sensors. The third experiment's goal was to integrate the sensor and create a flood monitoring system in the real world using a wired connection.

## 4.2 Indoor Testing

To test the functionality and accuracy of the sensors, three indoor experiments were conducted: ultrasonic sensor, temperature sensor, and water flow sensor . In this section, university technical malaxista melaka the output of the testing would be shown.

#### 4.2.1 Water level via Ultrasonic Sensor

The experiment's goal was to verify coding correction and test the sensor's operation. During the testing process, an ultrasonic sensor is used to detect an object before it was used to detect the river's water level. The code works well with the hardware shown in Figure 4.1, and the output result is shown in Figure 4.2 on the serial monitor of the Arduino IDE software.



Figure 4.1 Testing using object



Figure 4.2 Serial monitor result in Arduino IDE

The Ultrasonic Sensor would then be tested on the surface of the water in the basin and then in the river. The experiment was carried out to demonstrate whether or not the sensor can detect water level. The distance between the sensor and the water surface can be displayed on the serial monitor, demonstrating that the Ultrasonic Sensor can be used to monitor the water level shown in figure 4.3.



Figure 4.3 Testing using water in basin



Distance = 28 cm - 15 cm = 13 cm

This was the calculation for result in actual value.

Distance = Value water level at the bottom of the bucket - high of water level

## 4.2.2 Result and Analysis

The selected distance of an object 11 cm was used to compute the percentage error between the measured and actual value. The experiment was being repeated 4 times and the data was recorded in the Table 4.1 Measured value was the value recorded using the ultrasonic sensor where actual value was the value measured using measuring tape from the sensor to the object.

Test	Measured Value (cm)	Measured Value (cm)
Test 1	13	11
Test 2	WALAYSIA 412	11
Test 3	11,	11
Test 4	11	11
Mean	11.75	11
	Die Junio 15	اه نیم سید . ت

Table 4.1 Measurement of Ultrasonic sensor (testing using object)

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Percentage error for 11 cm was 6.82 % and is calculated by:

*Percentage Error* = *Mean measured value* - *actual*  $\times$  100

	actual	
Percentage Error =	11.75 cm – 11 cm	× 100

11 cm

Percentage Error = 6.82 %

The selected water level of 13 cm was used to compute the percentage error between the measured and actual value testing on water surface. The experiment was being repeated 4 times and the data was recorded in the Table 4.2. Measured value was the value recorded using the ultrasonic sensor where actual value ws the value measured using measuring tape from the sensor to the water surface.

Test	Measured Value (cm)	Measured Value (cm)
Test 1	14	13
Test 2	14	13
Test 3	13 MALAYSIA 4	13
Test 4	13	13
Mean	13.5	13

Table 4.2 Measurement of Ultrasonic sensor (testing using water)

Percentage error for 13 cm was 3.85 % and was calculated by: UNIVERSITI TEKNIKAL MALAYSIA MELAKA

*Percentage Error* = *Mean measured value* -  $actual \times 100$ 

 $Percentage \ Error = \underbrace{13.5 \ cm - 13 \ cm}_{13 \ cm} \times 100$ 

Percentage Error = 3.85%

The ultrasonic sensor was trustworthy due to its percentage error below 10% for object and

water level at 11 cm and 13 cm, respectively.

# 4.2.3 Water rain drop via raindrops sensor

The experiment's goal was to verify the sensitivity and test the sensor's operation. During the testing process, a water raindrops sensor was used to detect an object before it was used to detect the raindrops during outdoor testing in Figure 4.5. Figure 4.6 shows on the serial monitor of the Arduino software and the hardware testing on water raindrops sensor.



Figure 4.6 Serial monitor result in Arduino IDE

# 4.2.4 Temperature and humidity via DHT11

Figure 4.7 shows the construction of the circuit testing in room temperature to test the sensitivity of DHT11 sensor.



Figure 4.7 Testing with room temperature

Humidity:	95.00	8 9	Temperature:	30.20	*C	86.36	1° *F	Heat	index:	109.98	- r + F
Humidity:	95.00	e	Temperature:	30.40	*C	86.72	*F	Heat	index:	111.46	* F
Humidity:	95.00	÷	Temperature:	30.40	*C	86.72	*F	Heat	index:	111.46	*F
Humidity:	95.00	8	Temperature:	30.40	*C	86.72	*F	Heat	index:	111.46	*F
Humidity:	95.00	÷	Temperature:	30.50	*C	86.90	*F	Heat	index:	112.21	*F
Humidity:	95.00	8	Temperature:	30.50	*C	86.90	*F	Heat	index:	112.21	*F
Humidity:	95.00	8	Temperature:	30.50	*C	86.90	*F	Heat	index:	112.21	*F
Humidity:	95.00	÷	Temperature:	30.50	*C	86.90	*F	Heat	index:	112.21	*F
Humidity:	95.00	8	Temperature:	30.50	*C	86.90	*F	Heat	index:	112.21	*F
Humidity:	95.00	S	Temperature:	30.50	*C	86.90	*F	Heat	index:	112.21	*F
Humidity:	95.00	8	Temperature:	30.50	*C	86.90	*F	Heat	index:	112.21	*F
Humidity:	95.00	÷	Temperature:	30.60	*C	87.08	*F	Heat	index:	112.98	*F
_	_					_					

As depicted in Figure 4.9, the temperature data from the sensor was compared to the internet source produced by Google. The experiment was repeated four times, and the results are presented in Table 4.3.



Source : Google weather forecast

Figure 4.9 Weather forecast by google

# 4.2.5 Result and Analysis

Test	Measured Value (°C)	Actual Value (°C)
Test 1	30.40	30
Test 2	30.40	30
Test 3	30.50	30
Test 4	Mohunda Sico	او بية م سيت ت
Mean		

Table 4.3 Measurement for temperature

Percentage error for 30  $^\circ C$   $\,$  was 1.5  $\,\%$  and was calculated by:

 $\textit{Percentage Error} = \textit{Mean measured value} - \textit{actual} \times 100$ 

	actual	
Percentage Error =	$30.45 \ ^{\circ}C - 30 \ ^{\circ}C$	× 100
	30 °C	

Percentage Error = 1.5%

Based on the small error calculated for temperature, the temperature sensor was reliable due to its percentage error below 10%.

Test	Measured Value (%)	Actual Value (%)
Test 1	95	90
Test 2	95	90
Test 3	95	90
Test 4	95	90
Mean	95	90

Table 4.4 Measurement for humidity



Percentage Error = 5.56%

Based on the small error calculated for humidity, the sensor was reliable due to its percentage error below 10%.

## 4.3 Outdoor testing

The experiment was carried out in the real world to observe the behavior of the sensors for future work using the hardware setup. The ultrasonic sensor was tested, and the results would be documented. The outdoor experiment would last three days, and the data would be tabulated later.

## 4.3.1 DHT11 Temperature sensor for temperature measurement

As depicted in Figure 4.10, the temperature sensor can be used anywhere without considerable modification as long as the connection was correct and it was furnished with a power source. It was necessary to protect the sensor from the water droplet since it could prevent the sensor from accurately measuring the temperature parameter.



Figure 4.10 Outdoor testing for DHT11

l												Send	
Humidity:	77.00	*	Temperature:	33.70	*C	92.66	*F	Heat	index:	120.77	*F		~
Humidity:	76.00	*	Temperature:	34.00	*C	93.20	*F	Heat	index:	121.88	*F		
Humidity:	74.00	*	Temperature:	34.10	*C	93.38	*F	Heat	index:	120.61	*F		
Humidity:	73.00	*	Temperature:	34.20	*C	93.56	*F	Heat	index:	120.30	*F		
Humidity:	72.00	*	Temperature:	34.20	*C	93.56	*F	Heat	index:	119.34	*F		
Humidity:	72.00	*	Temperature:	34.20	*C	93.56	*F	Heat	index:	119.34	*F		
Humidity:	73.00	*	Temperature:	34.20	*C	93.56	*F	Heat	index:	120.30	*F		
Humidity:	74.00	*	Temperature:	34.20	*C	93.56	*F	Heat	index:	121.28	*F		
Humidity:	73.00	*	Temperature:	34.20	*C	93.56	*F	Heat	index:	120.30	*F		
Humidity:	73.00	*	Temperature:	34.20	*C	93.56	*F	Heat	index:	120.30	*F		
Humidity:	72.00	*	Temperature:	34.20	*C	93.56	*F	Heat	index:	119.34	×F		
Humidity:	72.00	**	Temperature:	34.20	*C	93.56	*F	Heat	index:	119.34	ŤF		
Humidity:	72.00	*	Temperature:	34.10	*C	93.38	*F	Heat	index:	118.69	*F		
Humidity:	72.00	*	Temperature:	34.00	*C	93.20	*F	Heat	index:	118.04	*F		
Humidity:	73.00	\$	Temperature:	34.00	*C	93.20	*F	Heat	index:	118.98	*F		~
Autoscrol	l 🔄 Sho	ow timest	amp			E	ioth M	JL & CR	~ 96	500 baud	~	Clear output	

Figure 4.11 Serial monitor Serial monitor result in Arduino IDE

Figure 4.11 show the result of serial monitor for temperature and humidity sensor in



MALAYSI



Figure 4.12 Data analysis for temperature and humidity outdoor testing (excel)

Figure 4.12 show the data analysis for temperature and humidity obtain in outdoor for real time data. This data collected during sunny day. The reading for temperature and humidity would be recorded frequently to see whether the system running smoothly or not.

#### **4.3.2** Ultrasonic sensor for water level measurement

Ultrasonic sensors must be utilised in a dry environment. Because the sensor would malfunction everytime it comes into contact with water or another liquid. Consequently, Figure 4.13-style modifications must be made to the sensor. A distance was maintained between the sensor and the water's surface, and the transducer must be oriented perpendicularly to the water's surface. During a flood, the water level might rise by one metre compared to its typical level. In order for the system to function properly, the distance between the sensor and the water's surface must be greater.



Figure 4.13 Hardware setup for ultrasonic sensor in outdoor testing

💿 сомя			
Distance	=	49	cn
Distance	=	49	cm
Distance	=	48	cm
Distance	=	49	cm
Distance	=	48	C11
Distance	=	49	cm
Distance	=	49	C11
Distance	=	48	cm
Distance	=	49	cm
Distance	=	48	Cm
Distance	=	47	Cm
Distance	=	47	Ch
Distance	=	49	cm
Distance	=	47	cm
Distance	=	47	Ch
Distance	=	47	cm
Distance	=	48	CIL
Distance	=	47	CIL
Distance	=	47	CIL
Distance	=	47	CD
Distance	=	47	Cm
Distance	=	47	CIL
Distance	=	47	Cn Waterold
Distance	=	47	Cm and a second s
Distance	=	47	
Distance	=	47	
Distance	-	47	

Figure 4.14 Serial monitor reading for water level in outdoor testing



Figure 4.15 Data analysis for water level outdoor testing (excel)

Figure 4.15 show the data collected of water level for outdoor testing. Figure above show the data detected using ultrasonic sensor might be plus minus two value different because of the sensitivity of the ultrasonic sensor are can achieve 0.1-0.2%.

#### 4.3.3 Water raindrop sensor for raindrop measurement

An external water rainrop was used to measure the amount of precipitation falling on the board. For this model, the sensor was positioned at the very top so that it could detect the falling droplet of water. Outdoor testing is not conducted on rainy days, although water spray can be used to detect water droplets.



Figure 4.16 Hardware setup for water raindrop sensor in outdoor testing

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Moderate	Rain
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Figure 4.17 Serial monitor reading for water raindrop sensor in outdoor testing

Figure 4.17 show the reading for water raindrop sensor in outdoor testing . Data show the analog reading for the water raindrop sensor if data read <300 it will appear heavy rain, if data read <500 it would display moderate rain else the data would display no rain.



Figure 4.18 Data analysis for water raindrop outdoor testing(excel)

Figure 4.18 shows data analysis for certain time and this data collected for every one second at the same day. This data was taken in analog reading so there was no unit for the data collected because the raindrop sensor use are collected the data by connection to Arduino Uno analog pin.

## 4.4 Flood Monitoring and Alerting System via Blynk Application

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Monitoring system using Blynk had been done by interfacing all of the sensor use which are ultrasonic sensor, water raindrop sensor and DHT11. ESP8266 was used to connect the wifi for transfering the data from Arduino Uno to the Blynk web server. The hardware completed and need to be check the robustness by real-time environment of the system. Figure 4.19 shows the hardware setup in real environment and data collection of water raindrop, water level, temperature, humidity and heat index via Blynk application would be present in the next section .



Figure 4.19 Flood Monitoring and Alerting System hardware setup in Melaka Sentral river

Output Serial Monitor x		× 0	≣
Message (Enter to send message to 'Arduino'Uno on 100h/9)	Both NL & CR 🔹	9600 baud	
Initializing [0] / _ / / / / / / / / / / / / / / / / / /	]		
[13114] + CIFSRI STAILP, "192, 188.203.245" (TISSRI STAILP, "192, 188.203.245" [13126] Connected to USF1 [13126] Connected to USF1	او		

UNIVERSITI TEKNIKAL MALAYSIA MELAKA Figure 4.20 Connection of the system through ESP8266 wifi module to Blynk application

on serial monitor

Figure 4.20 show the coonfiguration of the system when the wifi has been connected to the Blynk application. When wifi was connected ,the sensor of the system would start to operate and read the parameter which are water level, water raindrop, temperature and humidity.

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efault recipients			
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Figure 4.21 Blynk setup for notification event condition during warning condition

In figure 4.21 it can be shown that the notification of the system would be pop up when the water level in warning condition. The owner of the system can email or sms the contact number to whom the notification would be sent. Here, the important part for the system was to notify nearest people about the incoming flood so preparation can be made for evacuation to lessen the destruction of property.

## 4.5 Performance Analysis

In this section, the analysis of the monitoring system in above section would be displayed and from the hardware setup the system can be tested for it stability. The system then can be set for public view .The data can be export and saved in the cloud. Thus, the flood monitoring and alerting system would display the time zone based on location selected.



Figure 4.22 Water raindrop reading for outdoor reading in Melaka Sentral.

Figure 4.22 show the reading for water raindrop sensor in Melaka Sentral river . This was a reading taken when there was no rain and the reading was obtained by dropping a few drops of water on the sensor to detect the sensor's activity when rain was detected.

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Figure 4.23 Water level reading in Melaka Sentral river.

Figure 4.23 show the water level reading in Melaka Sentral river that collected in real time environment and the monitoring of this system was collected every 1 second and the data can be read and refer for future used for flood prediction. The water level would always read by ultrasonic sensor to predict the causes of flood.

# Temperature Humidity Heat index 30.70°C 95.00% 113.77°F

Figure 4.24 Temperature, humidity and heat index

Figure 4.24 show the data for temperature, humidity and heat index. This data can be collected for future used and data can be export to excel. This data was collected using

DHT11 and can be calculated by installing DHT.lib in Arduino IDE. This process was directly measure because

Day	Water Raindrop	Temperature °C	Humidity (%)	Water level (cm)	Heat
					Index F
Day 1	969	31.60	95	45	121.20
Day 2	874	33.70	77	50	120.77
Day 3	962	34.20	73	47	120.30
Day 4	555	34.10	76	55	121.88

Table 4.5 Data collected for water level, water raindrop, temperature, humidity and heat

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The full system has undergone a four-day outdoor experiment, and the results are given in Table 4.5. The experiment was done for three hours per day, with a one-second interval between data recordings. The data presented in Table 4.5 represents the average for each day. The data were then presented in the graph depicted in Figure 4.25.







For time being the experiment done only simulation as the system need to simulate using hardware and need to be observed when the circuit tested in the real environment. Table 10 4604

Material	Tested	Remark
Ultrasonic sensor	/	Object
	/	Water surface
	/	Outdoor
Water raindrop sensor	/	Indoor
	/	Outdoor
DHT11	/	Room temperature
	/	With lighter

Subsy	stom tosting	based on the h	Jinan,	
2				
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	/	Outdoor
Arduino UNO	/	Sensor
Wifi-module	/	Transfer data from arduino
		to Blynk
Computer	/	Analysed the monitoring
		system
Phone	/	Monitor and alert using IoT
		application

Table 4.6 Subsystem testing

# 4.7 Summary

This chapter discusses the result and the construction of the monitoring systemand alerting in the Blynk. The comparison between hardware and simulation results then was shown. The input parameter that have been used to examine the system performance are selected in the first section of this chapter. The improvement on this project would be discussed in next chapter.

#### **CHAPTER 5**

#### **CONCLUSION AND FUTURE WORKS**

### 5.1 Introduction

The working system for the development of a flood monitoring and alerting system based on data collection via an IoT application was studied in this project. The research topic includes a review of previous works' literature, system components for the experimental setup, flood monitoring and alerting system models of both simulation and physical setup for the future, monitoring system on existing and newly proposed methods, analysis and comparison, and performance evaluation. These conclusions are meant to summarise the overall accomplishments of the project that was subject to the outlined objectives. Based on these, the following conclusions and future work would be presented.

# 5.2 Conclusion

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The development of a flood monitoring and alerting system based on data collection via IoT applications was critical because it addresses flood disasters that occur every year in Malaysia, particularly in Melaka. The flood monitoring and warning system was making a significant difference in alerting residents to impending disasters. Flood information would be obtained in real time without delay, and actions such as relocating residents and their property can be planned ahead of time. To conclude the development of flood monitoring system with complete alerting system using Arduino has accomplished. The integration of the system with IoT for data collection can be saved in Blynk cloud for future use was obtained by monitoring the water level, raindrop, temperature and humidity reading everyday in outdoor using real time system. The data then can be export to excel as recorded. In addition, the performance of the system based on consistency and the ability of the system to provide the information was working successfully.

#### 5.3 Future Works

For future improvements, accuracy of the simulation and hardware estimation results could be enhanced as follows:

- The equipment reading for water level, raindrop, temperature and humidity used need to be precise when measure the reading.
- ii) Performance analysis of the data via IoT application can be performed and the stability of the system determined by monitor it consistently.
- iii) The purpose of system can be presented in the real environment by collaborating with industry like FEMA for future.
- iv) Use more alerting indicator for project improvement such as notification alert that would activate to alert current condition to public .

This project can only be completed if real-time river data was collected often. Data transfer was the hardest subsystem since the ESP8266 wifi module was delicate and prone to failure. Arduino IDE frequently froze when uploading code to the device. To avoid system failure, purchase a certified ESP8266 wifi module and study the communication system's behaviour. Systems like the ESP8266 wifi module and those with a longer node-to-node communication range are also recommended. To improve accuracy and sensitivity, the flood monitoring and alert system can include barometric pressure, wind direction, wind speed, etc.

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### APPENDICES

### Appendix A

//Flood Monitoring and Alerting System

#define BLYNK\_TEMPLATE\_ID "TMPLmgQVBLFf"
#define BLYNK\_DEVICE\_NAME "Quickstart Device"
#define BLYNK\_AUTH\_TOKEN
"KBLEiG0Wc5SaV\_EwuB\_rWBIBA1EUVN2V"
#define BLYNK\_PRINT Serial
#include <ESP8266\_Lib.h> //blynk lib
#include <BlynkSimpleShieldEsp8266.h>
#include <SoftwareSerial.h> //serial connection

#include <DHT.h> //DHT.lib
#include <DHT\_U.h>
#define DHTPIN 5 // DHT data pin connected to Arduino pin 5 for humidity pulse
https://www.circuitbasics.com/how-to-set-up-the-dht11-humidity-sensor-on-an-arduino/
#define DHTTYPE DHT11 // DHT11 (DHT Sensor Type )
DHT dht(DHTPIN, DHTTYPE); // Initialize the DHT sensor

//declaration for ultrasonic sensor #define SOUND\_SPEED 0.034 #define trigPin 13 // trigpin on arduino uno #define echoPin 12 //echopin on arduino uno

#define buzPin 8 //alert when distance range 0-7 cm
#define LED 9 //alert when rain detected
#define rainfall A0 //rain detection using analog reading (no unit)

float temp,hum,fahrenheit; //declaration for temp,hum,fahrenheit datatype

//declaration datatype for distance,value,duration
int distance,value;
long duration;
int digitalWrite();

#define ESP8266\_BAUD 9600 //baudrate setting 9600 for esp8266 wifi module

SoftwareSerial EspSerial(2, 3); // RX, TX

//Blynk auth token

char auth[] =
"KBLEiG0Wc5SaV\_EwuB\_rWBIBA1EUVN2V";//9jLsfc6P5UxO0lwVyXhnXlulLDeSU
IAm
//Replace with your WIFI ssid and password
char ssid[] = "Atikah";
char pass[] = "Atikah\_64";

ESP8266 wifi(&EspSerial);

void setup() {
 Serial.begin(9600);
 Serial.println("Initializing");
 EspSerial.begin(ESP8266\_BAUD);

//setup input and output of the system pinMode(trigPin,OUTPUT); pinMode(echoPin,INPUT); pinMode(buzPin,OUTPUT); pinMode(LED, OUTPUT); pinMode(value,INPUT); pinMode(7, OUTPUT); dht.begin();

Blynk.begin(auth, wifi, ssid, pass); //blynk connection

void loop() {
 //Blynk.run();

value = analogRead(rainfall); // declaration for analog read value = map(value,0,1023,225,0); //mapping value digitalWrite(trigPin,LOW); delayMicroseconds(2); digitalWrite(trigPin,HIGH); delayMicroseconds(10); digitalWrite(trigPin,LOW); duration = pulseIn(echoPin,HIGH); //pulse in detected in echopin distance = duration\*SOUND\_SPEED/2; //calculation for distance

```
// analog output
if(analogRead(0)<300) //heavy rain
{
    //heavy rain condition LED will ON to alert currently is rainy day
    Serial.println("Heavy Rain");
    digitalWrite(LED,HIGH);</pre>
```

//water level will be measured continuosly whether it is rainy or not if (distance<=7 && distance >=0) // water level alert condition {

// water level alert condition buzzer will ON

```
Serial.println("Flood Alert !!! Evacuation ");
  Serial.println("Water level danger");
  digitalWrite(buzPin,HIGH);
 else if (distance<=10 && distance>=8) // water level moderate condition
  Serial.println(" Warning !! Prepare for evacuation ! ");
  Serial.println("Water level moderate");
  digitalWrite(buzPin,LOW);
 }
 else
 {
  Serial.println("Safe"); //water level safe condition
  Serial.println("Normal Condition");
  digitalWrite(buzPin,LOW);
 }
// Serial monitor display on web station
 Serial.print("Distance : ");
 Serial.print(distance); AYSIA
 Serial.println(" cm");
 Serial.print("Duration : ");
 Serial.print(duration);
 Serial.println(" ms");
}
else if(analogRead(0)<500) // hujan moderate
{
 //moderate rain LED will also turn ON
Serial.println("Moderate Rain");
digitalWrite(LED,HIGH);
                                   KNIKAL MALAYSIA MELAKA
if (distance<=7 && distance >=0)
 {
  Serial.println("Flood Alert !!! Evacuation ");
  Serial.println("Water level danger");
  digitalWrite(buzPin,HIGH);
 else if (distance<=10 && distance>=8)
 ł
  Serial.println(" Warning !! Prepare for evacuation ! ");
  Serial.println("Water level moderate");
  digitalWrite(buzPin,LOW);
 }
 else
 {
  Serial.println("Safe");
  Serial.println("Normal Condition");
  digitalWrite(buzPin,LOW);
```

```
}
// Serial monitor display on web station
 Serial.print("Distance : ");
 //str=String(distance);
 Serial.print(distance);
 Serial.println(" cm");
 Serial.print("Duration : ");
 //str=String(distance);
 Serial.print(duration);
 Serial.println(" ms");
 }
 else //no rain condition
 {
 //no rain condition LED will turn OFF
 Serial.println("No Rain");
 digitalWrite(LED,LOW);
 // water level detection is the same for each state when heavy, moderate and no rain
condition for monitoring the flood causes.
 if (distance \leq 7 && distance \geq 0) // water level detection
 {
  Serial.println("Flood Alert !!! Evacuation ");
  Serial.println("Water level danger");
  digitalWrite(buzPin,HIGH);
 }
 else if (distance \leq 10 & distance \geq 8)
  Serial.println("Warning !! Prepare for evacuation ! ");
  Serial.println("Water level moderate");
                                                MAL
                                                       AYSIA MELAKA
  digitalWrite(buzPin,LOW);
 }
 else
 ł
  Serial.println("Safe");
  Serial.println("Water level normal");
  digitalWrite(buzPin,LOW);
 }
// Serial monitor display on web station
 Serial.print("Distance : ");
 //str=String(distance);
 Serial.print(distance);
 Serial.println(" cm");
 Serial.print("Duration : ");
 //str=String(distance);
 Serial.print(duration);
 Serial.println(" ms");
 }
```

// dht read from pin 5 because arduino send pulse to read the temp & humidity

```
temp = dht.readTemperature();
hum = dht.readHumidity();
fahrenheit = dht.readTemperature(true);
// Check if any reads failed and exit early (to try again).
if (isnan(hum) || isnan(temp) || isnan(fahrenheit))
{
//serial monitor display when there is error on DHT11 sensor
Serial.println("Failed to read from DHT sensor!");
return;
}
```

// Compute heat index
// Must send in temp in Fahrenheit!
float hi = dht.computeHeatIndex(fahrenheit, hum);



//virtual pin setup in Blynk application and webserver indicates each raeding
Blynk.virtualWrite(V0,value);
Blynk.virtualWrite(V1,distance);
Blynk.virtualWrite(V2,temp);
Blynk.virtualWrite(V3,hum);
Blynk.virtualWrite(V4,hi);
Blynk.virtualWrite(V5,fahrenheit);

if (distance<=10 && distance >=8) // warning logevent for blynk notification before flooding occur

{
 Blynk.logEvent("water\_level\_warning","WATER LEVEL WARNING!PREPARE FOR
 EVACUATION!");

}

delay(1000); // delay to avoid the system to reset because too fast of reading }

# Appendix B



