05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

DEVELOPMENT AND VALIDATION OF AN AUTOMATED CENTRALIZED REMOTE SENSING SYSTEM FOR FOREST ENVIRONMENTAL ACTIVITY

SHAHRIZUAN BIN SHAFIRIL SIVAGURU

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE (ROBOTIC TECHNOLOGY)
(MASTER BY RESEARCH)

FACULTY ART, COMPUTING AND CREATIVE INDUSTRY
UNIVERSITI PENDIDIKAN SULTAN IDRIS

2016

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

ABSTRACT

The aim of this research is to develop a remote monitoring device that could capture critical real-time data such as temperature, humidity, gaseous, fire, and rain detection that shows the current preserved natural state and habitat in the forest. The forest ecosystem is essential in supplying high natural resources for flora and fauna. This unprotected resources are exposed and susceptible to the threat of illegal logging which can lead to unhealthy phenomenon and irreplaceable assets. The methodology is to employ the rapid prototyping modeling in developing this prototype and also to include a system model that explains the implementation of the temperature, humidity, and hydrogen gaseous variables. All the readings were recorded in real-time for data management and statistical analysis by using SPSS, as well as to analyze the model based on Technology Acceptance Model (TAM) by AMOS. The paired sample T-Test and two-group MANOVA analysis showed that there are significant between mean temperature and humidity. The prototype was implemented at selected locations in the Royal Belum forest to monitor and gather data at two phases. The field experiment was conducted in April 2015. The data consisted of 60 samples for temperature, humidity and hydrogen gaseous from both the upper and the lower parts of the forest. The findings also proved by regression and covariance analysis that the lower part of the forest was more significant than the upper part of the forest area. The results obtained from this research would definitely benefit the monitoring bodies or relevant authorities in applying the system that capable to protect and preserve the forest in its natural environment.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

PEMBANGUNAN DAN PENGESAHAN SISTEM PENGESAN AUTOMATIK BERPUSAT BAGI AKTIVITI PERSEKITARAN HUTAN

ABSTRAK

Tujuan penyelidikan ini adalah bagi membangunkan peranti kawalan pemantauan bagi mengumpulkan data kritikal secara langsung seperti suhu, kelembapan, gas, dan pengesanan api dan hujan yang menunjukkan keadaan semasa alam semula jadi yang dilindungi dan habitat di dalam hutan. Ekosistem hutan adalah penting bagi membekalkan sumber semula jadi kepada flora dan fauna. Sumber yang tidak dilindungi ini terdedah kepada risiko pembalakan haram yang secara tidak langsung mengundang kepada fenomena yang tidak sihat dan khazanah yang tidak dapat dipulihkan. Metodologi kajian ini terdiri daripada model prototaip berterusan yang digunakan untuk membangunkan prototaip dan juga termasuk sistem model bagi memberi penerangan mengenai pelaksanaan terhadap pembolehubah suhu, kelembapan, dan gas hidrogen. Kesemua bacaan dihantar secara langsung untuk pengurusan data dan analisis secara statistik dengan menggunakan perisian SPSS dan menguji model yang dibangunkan berdasarkan Technology Acceptance Model (TAM) oleh AMOS. Dapatan kajian berdasarkan analisis persampelan berpasangan ujian T dan MANOVA dua kumpulan menunjukkan bahawa terdapat perbezaan signifikan diantara mean suhu dan kelembaban. Prototaip ini dilaksanakan di lokasi-lokasi yang terpilih di dalam hutan Royal Belum untuk pemantauan dan kutipan data melalui dua fasa. Eksperimen kajian telah dijalankan pada April 2015. Sampel data terdiri daripada 60 pensampelan bagi suhu, kelembaban dan gas hidrogen daripada bahagian atas dan bahagian bawah hutan. Dapatan kajian dibuktikan melalui analisis regresi dan kovarian mendapati bahagian bawah hutan adalah lebih signifikan berbanding bahagian atas hutan. Dapatan kajian daripada kajian ini diharapkan mampu memberikan manfaat kepada badan-badan pemantauan atau pihak berkuasa yang berkenaan dalam menjaga hutan di dalam habitat semula jadi.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

TABLE OF CONTENTS

Pages

DECLARATION **ii**

ACKNOWLEDGMENTS **iii**

ABSTRACT **iv**

ABSTRAK **v**

TABLE OF CONTENTS **vi**

LIST OF TABLES **xii**

LIST OF FIGURES **xiv**

LIST OF ABBREVIATIONS **xvii**

LIST OF APPENDIXES **xix**

CHAPTER 1 INTRODUCTION **20**

1.1 Introduction 20

1.2 Problem Statement 24

1.2.1 Direct Cause 27

1.2.1.1 Expansion of farming land 27

1.2.1.2 Forest and other plantations 28

1.2.1.3 Logging 28

1.2.1.4 Overgrazing 29

1.2.1.5 Fires 29

1.2.1.6 Quarrying 30

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

1.2.1.7 Urbanization/industrialization and infra-structure 30

1.2.1.8 Air contamination 31

1.2.1.9 Warfare and Military's role 31

1.2.1.10 Tourism 31

1.2.2 Effects of Deforestation 32

1.2.2.1 Climate change 32

1.2.2.2 Flooding, Loss of Water and Soil Resources 32

1.2.2.3 Decreased biodiversity and habitat losses 33

1.2.2.4 Economic losses 33

1.2.2.5 Social consequences 33

1.3 Purpose of the study 34

1.4 Research Objectives 35

1.5 Research Questions 36

1.6 Hypotheses 37

1.6.1 Research Hypotheses 37

1.6.2 Null Hypotheses 38

1.6.3 Alternative Hypotheses 39

1.7 Conceptual Framework 41

1.8 Significance of the study 42

1.9 Limitation of the study 43

1.10 Research Design 44

1.11 Operational Definition 45

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

1.12 Conclusion 48

CHAPTER 2 LITERATURE REVIEW 50

2.1 Introduction 50

2.2 Previous Literature Topics 50

2.3 Literature on Global Positioning System 56

2.4 Literature on GSM 58

2.5 Literature Concept 58

2.6 Summarization from previous research 67

2.7 Conclusion 72

CHAPTER 3 METHODOLOGY 73

3.1 Introduction 73

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

3.2 Flow Chart of Research Activity 74

3.2.1 Gathering Information 75

3.2.2 Remote Device Development and Fabrication 75

3.2.3 Centralized Control Development 75

3.2.4 Successful Link between HQ and Remote 76

3.2.5 Practical Run at Royal Belum forest 76

3.2.6 Test Run 76

3.2.7 Data Collection 76

3.2.8 Evaluation on Data Pattern 77

3.2.9 Final Report 77

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

3.3 Gantt chart of Research Activity 78

3.4 Milestone and Date 78

3.5 Procedure of Data Analysis 79

3.6 Validation of Standard 79

3.7 Technology Acceptance Model 80

3.8 Conclusion 84

CHAPTER 4 DEVELOPMENT 86

4.1 Introduction 86

4.2 Rapid Prototyping Modeling 87

4.3 ACRSS Development Modeling 90

4.4 Requirement Analysis and Definition 90

4.5 System Design 90

4.5.1 System Model 91

4.5.2 System Architecture 92

4.5.3 Hardware 93

4.6 Software Design 114

4.6.1 Arduino SoftwareSerial 114

4.6.2 Garmin Base-Camp 116

4.7 Implementation/Coding 116

4.8 Software Integration and Verification 119

4.8.1 Unit Test 119

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4.8.2 Unit Integration 122

4.9 System Verification 123

4.10 Operation and Maintenance 129

4.11 Conclusion 130

CHAPTER 5 DATA ANALYSIS 132

5.1 Introduction 132

5.2 Sampling Result 133

5.3 Paired Sample T-Test Analysis 133

5.4 Two-Group MANOVA Analysis 137

5.4.1 Correlation 137

5.4.2 P-Plot Normality Test 138

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

5.4.3 Descriptive Statistic 140

5.4.4 Box's Test of Equality of Covariance 142

5.4.5 Multivariate Tests 142

5.4.6 Levene's Test of Equality 143

5.4.7 Test of Between-Subject Effect 144

5.5 Amos Statistic Analysis 144

5.6 Conclusion 147

CHAPTER 6 RESULT AND CONCLUSION 149

6.1 Introduction 149

6.2 Hypotheses Testing 150

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

6.3 Revisiting the Original Research Proposal 152

6.3.1 Research Questions 152

6.3.2 Aims 153

6.3.3 Research Objective 154

6.3.4 Validation of Standard 156

6.4 Limitations 157

6.5 Further Research 159

6.6 Conclusion 160

REFERENCES **162**

APPENDIX **171**

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

LIST OF TABLES

No. of Table		Pages
1.1	Conversion in forest from 1990-2010 (Source: Anon., 2010)	26
2.1	ACRSS Research Gap	70
2.2	ACRSS Research Gap (Continued from Table 2.1)	71
4.1	Arduino Technical Comparison	95
4.2	Arduino Technical Comparison (Continued from Table 4.1)	96
4.3	Temperature and Humidity Technical Comparison	98
4.4	Gas Sensor Technical Comparison	100
4.5	Rain Detection Technical Comparison	103
4.6	Fire Detection Sensor Technical Comparison	105
4.7	GSM module Technical Comparison	108
4.8	GSM module Technical Comparison (Continued from Table 4.7)	109
4.9	GPS Modul Technical Comparison	112
5.1	Paired Sample T-Test	133
5.5	Correlations	137
5.6	Between-Subjects Factors	141

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

5.7	Descriptive Statistic	141
5.8	Box's Test Equality of Covariance	142
5.9	Multivariate Tests	143
5.10	Levene's Test of Equality	143
5.11	Test of Between-Subject Effect	144
5.12	The significant paths for the regression data (identified by √)	146

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

LIST OF FIGURES

No. of Figure		Pages
1.1	ACRSS Conceptual Framework	41
2.1	VRS Technology. (Source: Kamburov, 2010)	57
2.2	WSN detecting trunk. (Source: Wang, Wang, Wang, & Liu, 2012)	59
2.3	Demonstration Scenario using WSN. (Source: Mittal et al., 2012)	60
2.4	Simplified WSN hierarchical network structure. (Source: Sidén, 2007)	61
2.5	Wireless Node Structure. (Source: Yatskiv & Sachenko, 2014)	62
2.6	Wireless sensor with structure. (Source: Babiš et al., 2011)	63
2.7	Deployment of sensor in the forest. (Source: Kirubaharan et al., 2014)	65
2.8	PCB Board of the System Hardware. (Source: Sidek et al., 2014)	66
2.9	The System GUI. (Source: Sidek et al., 2014)	66
2.10	System Architecture (Source: Yusoff, Shafiril, Abas, & Yusoff, 2015)	67
3.1	Research Flow Chart	74
3.2	Research Gantt Chart	78
3.3	Model Developed	82
3.4	Upper Part Location of Royal Belum Forest	83

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

3.5	Lower Part Location of Royal Belum Forest	84
4.1	Rapid Prototyping Modeling	89
4.2	System Model	92
4.3	System Architecture	93
4.4	Arduino Uno	94
4.6	DHT 11 Temperature and Humidity Sensor	98
4.7	Analog Gas Sensor	99
4.8	Rain Sensor Module	102
4.9	Future electronic flame sensor	104
4.10	GSM Module	107
4.11	GPS Module	111
4.12	Solar Panel with JST pin	113
4.13	Lithium Polymer Battery	114
4.14	Arduino Software-Serial	115
4.15	Garmin Base-Camp	116
4.16	Flow Chart of the Coding	118
4.17	Temperature and Humidity code testing	120
4.18	Schematic for DHT11 sensor and LCD	121

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4.19	Unit Test for DHT11 sensor readings	122
4.20	Main Page of ACRSS	123
4.21	Side View of ACRSS	124
4.22	Front View of ACRSS	124
4.23	Top View of ACRSS	125
4.24	Temperature Data Interface	125
4.25	Humidity Data Interface	126
4.26	Gaseous Data Interface	127
4.27	GPS Coordination Data	128
4.28	Real Time Data Capture Interface	129
4.29	The implementation of the prototype at Royal Belum	130
5.1	Graph of Temperature Statistic	134
5.2	Graph of Humidity Statistic	135
5.3	Graph of Hydrogen Statistic	136
5.4	Temperature Normal P-P Plot	139
5.5	Humidity Normal P-P Plot	139
5.6	Hydrogen Normal P-P Plot	140
5.7	The standard output estimates	145

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

LIST OF ABBREVIATIONS

A/D	Analog to Digital
AC	Alternate Current
CFS	Central Forest Spine
CLASlite	Carnegie Landsat Analysis System
DC	Direct Current
GFCD	Global Forest Change dataset
GIS	Geographic Information System
GPS	Global Positioning System
GSM	Global System for Mobile Communication
I/O	Input/Output
ID	Instructional Design
IHR	Indian Himalayan Region
LCD	Liquid Crystal Display
MANOVA	Multivariate of Covariance Analysis
MODIS	Moderate Resolution Imaging Spectroadiometer
PLC	Programmable Logic Circuit
PPM	Part Per Million
RP	Rapid Protoyping
RS	Remote Sensing
RX	Receive
SMS	short message service
SPSS	Statistical Package for Science Sosial

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

TX	Transmit
USB	Universal Serial Bus
VCF	Vegetation Continuous Fields

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

LIST OF APPENDIXES

Appendix		Pages
A	Permission Letter to Conduct Research	171
B	Royal Belum Map	172
C	EduInERI participant certificate	173
D	EduInERI Bronze Medal Certificate	174
E	ICESR Letter of Acceptance	175
F	List of Publications, Exhibition, Conferences	176
G	SPSS Paired Sample T-Test Analysis	177
H	Two Group Manova Analysis	179
I	First Order Structure Analysis using AMOS	183
J	Turnitin Digital Receipt	184
K	Proofread Receipt	185

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

CHAPTER 1

INTRODUCTION

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

1.1 Introduction

The ecosystem and the natural environment of the Earth have gradually becoming eradicate due to negligence and total lack of control by human population, thus affecting our rainforest ecosystem that is not just for shelter to the biodiversity of flora and fauna, but on the contrary and more crucially, to establish an equilibrium ecosystem to us human too. Moreover, it would be incapable for rainwater to be stowed, filtered down to the ground, and flowed to the dam without the rainforest. In fact, the Royal Belum Forest is the oldest rainforest in the world and it has been thriving for more than 100 million years. The rainforest covers about 117, 500ha of land in Perak and it is the biggest in Malaysia (Malaysia Natural Heritage, 2013). It contributes rainwater to water catchment areas at Ahning, Pedu, and Muda dams. Unfortunately, the present forest ecological system has been heavily damaged since human has begun exploiting forests

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

disorderly, especially through illegal logging, which has become a primary factor of deforestation.

As a result, it has created widespread environmental damage, irreversible climate change, contamination of air and surrounding rivers, recurrent avalanches, as well as deterioration of the colony regions and the living conditions among Aborigines (Singh & Abdullah, 2013). Furthermore, an interesting study by Daily (2007) revealed that half of the land on the Earth has been used up by human. Besides, nearly 30% of carbon dioxide occasioned from human acts has filled up the earth. Thus, crucial inquiry has to be carried out urgently in order to conserve the ecosystem of our Earth. In fact, two methods are available to prevent illegal logging activity. The first method is enforcing stricter forest preservation regulation to punish those who commit it, while the second method is tightening the observation of illegitimate forest harvest. Nonetheless, conventional method for monitoring large-scale forests, which saves time and labor resources is by keeping the ranger manually patrolling the area. Moreover, the desolate state of the forest ecosystem is also making it too harsh to constant patrol. Therefore, the purposes of this study had been to maintain the ecosystem of the Earth by preserving and regulating our treasured forest, especially the Malaysian rainforest at Royal Belum Forest, through a new technology that could assist in alerting real-time, as well as to provide faster response to the authority to act on these illegal activities.

Furthermore, the concept of ecosystem complexity, consisting of mapping and modelling including their overtime rate of changes is the main issue in biogeography and spatial ecology. Besides, remote monitoring has been recognized as one of the most dominant methods to map abiotic and biotic ecosystems' components for example, land

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

use, soils, land cover and vegetation as well as estimating their changes over time (Rocchini et al., 2013). In addition, remote sensing and alerting have existed since a long time and they have been used to enhance the quality of monitoring and alerting. Moreover, because of the advancement of wireless sensor technology and innovation in communication, it is now likely for business users to implement this technology for their productions (Hema, Murugan, & Priya, 2014). In addition, providing cellular network saturation into rural areas has made remote sensing a better option. Therefore, applying remote sensing to forestry and agricultural sectors is recommended as it is feasible.

The research depicts the development of an automated centralized remote monitoring system for detecting rainforest activities. The main focus for developing this device was to measure current temperature, humidity, and hazardous gas, such as carbon monoxide, butane, propane, methane, and smoke. In addition, the device could detect fire and rain, where all the data gathered from the device were transmitted to GSM by sending messages in near real-time and then, the data were sent to database, which after that, displayed all the data captured on the website that had been developed. The device was also equipped with GPS functionality to track the location of the device by its latitude and longitude. The implementation of the device was done within the Royal Belum preserved forest. In fact, the sensor had the main role in this research as the data gathered had to be accurate and validated by calibrating the sensor. After obtaining the real calibration of the sensor, the device was compared with a multifunctional environment meter and a handheld gas monitor to ascertain the validation of the data values.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Moreover, the microcontroller and the shield used in the development of this system have often been used by engineers to design and develop a technology that is based on the field of robotic technology. Not only that, the microcontroller that was used to develop the system displayed numerous potential for innovation of various kinds of beneficial products that can be implemented to the society. Furthermore, in this research, green energy was employed to replace electric energy. In this case, this device used the solar energy gained from the sun, which was absorbed by the solar panel, and then, the energy flowed through another shield that converted the solar energy to current before being supplied to the microcontroller used in this device. Through the use of this green energy, the rate of using electrical energy had been reduced and thus, can help save the Earth, besides offering healthy environmental conditions (Hammer et al., 2003).

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

This prototype highlights the initiative to prevent illegal logging. Even though the developed device cannot be compared to remote sensing with high resolution, such as satellite imagery, it is more affordable and easy to use. Besides, the combination of all of the features within the hardware and the software, such as Arduino as the main component, generated the new device. Other components, such as sensor, GPS, and GSM, played their own role towards the development of this prototype. Furthermore, if this prototype could be developed and function as specified; then the combination of separate devices, such as those at the Meteorological department, could be transformed into one single handy device that should be able to capture and measure the collected data, thus generating a new technology that is affordable as well as easy to be use compare high resolution remote sensing components, such as satellite image and radar

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

which is need an understanding in order to be use or if researcher is someone who is an expert a field regarding to Geographical Information System (GIS).

1.2 Problem Statement

Deforestation can be simplify as a transformation of forest into alternate non-forested permanent land that been used as development of an urban area, gazing or for agriculture purpose (van Kooten & Bulte, 2000). The main concern about deforestation is involving emerging tropics countries (Myers, 1994) as the areas of the tropical forest has been lessening (Barraclough & Ghimire, 2000) initiating damage within biodiversity and increasing the effect of greenhouse (Angelsen et al., 1999). Food and Agricultural Organization (FAO) has suggested to establish a tree plantation in order to be forest for timber production and consequently it does not categorize as a forest alteration to estate by way of deforestation (however it is still consider to damage the natural forests). However, tree plantation cannot be cogitate for supplying non-timber produces to be forest though rubber plantations been classify as a forest as stated by FAO. Forest dilapidation happens when the functionality of ecosystem are ruined however where the remnants of forested area rather cleared (Anon., 2010).

Deforestation happened with a frequency of 9.2 million hectares for each year since 1980 until 1990 while from 1990 until 2000, the rate increased about 6.8 million to be 16 million hectares for each year and in 2000 until 2010, the rate decreasing toward 13 million hectares for each year. The net conversion for the area of the forest throughout the last period was probably around -5.2 million hectares per annum which

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

the area of the loss are equal around 140km2 of forest each a day or approximately about the size of Costa Rica, though reduced than that stated in 1990-2000 which was 8.3 million hectares per annum equal to 0.20 per cent loss for the remaining of forest area each year. The recent annual net loss is 37 per cent slighter than that in the 1990s and equivalents a loss of 0.13 per cent for the remaining of forest area a day respectively during this period. By dissimilarity some smaller countries have great losses per annum plus they are in jeopardy of practically losing their entire forests in the following decade doubly if existing proportions of deforestation are continued. Undeniably, an approximate of 31 countries do not even reach to the list since they have now removed most of their forest and even the remain are completely degraded and fragmented. The changes in area of forest by region and sub-region are shown in **Table 1.1** below.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 1.1

Conversion in forest area from 1990-2010 (Source: Anon., 2010)

	1990-2000		2000-2010	
Region/sub-region	1 000 ha/year	%	1 000 ha/year	%
Eastern and Southern Africa	-1841	-0.62	-1839	-0.66
Northern Africa	-590	-0.72	-41	-0.05
Western and Central Africa	-1637	-0.46	1535	-0.46
Total Africa	**-4067**	**-0.56**	**-3414**	**-0.49**
East Asia	1762	0.81	2781	1.16
South and Southeast Asia	-2428	-0.77	-677	-0.23
Western and Central Asia	72	0.17	131	0.31
Total Asia	**-595**	**-0.10**	**2235**	**0.39**
Russian Federation (RF)	32 n.s.	n.s.	-18	n.s.
Europe excluding RF	845	0.46	694	0.36
Total Europe	**877**	**0.09**	**676**	**0.07**
Caribbean	53	0.87	50	0.75
Central America	-374	-1.56	-248	-1.19
North America	32	n.s.	188	0.03
Total North and Central America	**-289**	**-0.04**	**-10**	**-0.00**
Total Oceania	**-41**	**-0.02**	**-700**	**-0.36**
Total South America	**-4213**	**-0.45**	**-3997**	**-0.45**
World	**-8327**	**-0.20**	**-5211**	**-5211**

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Myers (1992) stated in his article that the current existing tropical forest that we currently have are about half of it thus making it difficult in order to continue saving the world's rainforest and other forest and there is an increasing global concern regarding this issue. In order to protect the forest, it is essential to understand why they are being eradicate. Distinctive among deforestation agents and its sources is very crucial in order to comprehend the key factors of deforestation. Loggers, commercial farmers, slash and burn farmers, ranchers, firewood collectors, infra-structure developers and others who are depleting down the forests are the causes of deforestation. The sources of deforestation are the forces that prompt the agents to clear the forests. Nevertheless, the utmost of the present literature characteristically separates amid two stages of particular elements: direct and indirect sources of deforestation. Direct agents and sources of deforestation, also usually stated to as causes of deforestation, primary level or adjacent causes (Panayotou, 1990; Barbier et al., 1994; Caviglia, 1999) are quite easy to categorize but the indirect causes which are commonly the foremost divers of deforestation are the ones that cause most divergence and the ones that are firmest to measure (Bhatnagar, 1991; Mather, 1991; Humphreys, 2006; Sands, R. 2005).

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

1.2.1 Direct Cause

1.2.1.1 Expansion of farming land

Approximately 60 per cent of the unauthorized clearance of tropical forests is for agricultural settlement (Myers, 1994; Anon., 1991) with logging and other reasons like, Fuelwood, urbanization and roads accounting for the rest (Anon., 1994b). The last

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

boundaries of Tropical forests are one of the in the exploration for subsistence land for the most vulnerable people worldwide (Myers, 1992). Deforestation is substitutions in order to expanse an agricultural land. The reason to extend an agricultural land is commonly seen as the core source of deforestation causative around 60 per cent of entire tropical deforestation.

1.2.1.2 Forest and other plantations

The growth in an Agricultural estate not only can offer advantages and should assist in reducing the frequency of deforestation activity. The reality is that the plantations eliminate the lumber pressure on natural forests does not translate eventually into less, but actually more towards deforestation. Certainly, it is dreaded that increase within agricultural can be claimed as major cause of deforestation in the tropics have a potency to swap forestry in the left-over of the natural forests (Anon., 2002; Cossalter and Pye-Smith, 2003; Anon., 2005). The effect of lumber plantations could thus turn out to be somewhat harmful to tropical forest environments (Kartodihardjo and Supriono, 2000).

1.2.1.3 Logging

Deforestation does not necessarily cause by loggers. Nevertheless, degrade forests can occurred due to serious logging activity (Putz et al., 2001). In Southeast Asia, logging is more concentrated and can be quite damaging. Though, access roads provided by logging to follow-on settlers and log scales can help funding the cost of clearing left

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

over of the trees and reserve the land for sowing of harvests or meadow. Logging consequently catalyzes deforestation (Chomitz et al., 2007).

1.2.1.4 Overgrazing

Overgrazing can be mentioned as more regular in tropics drier areas where degrading meadows affected by overgrazing are matter of soil erosion. Chopping out trees by means to offer silage for grazing faunas can also set a drawback in some tropics dry areas yet it is still perhaps not a major cause of deforestation.

1.2.1.5 Fires

Flames are the main tool that been implement for forest clearing process as it is for shifting and developing meadows and for constant agriculture. Eventhough flame can be consider as a good servant but it has a poor master. If fire been used wisely it can be a valued tool in forest management and agricultural but if it been misused, it can be a caused for significant deforestation (Repetto, 1988; Rowe et al., 1992). According from an existing data from 118 countries signifying 65 per cent of the worldwide forest area, a typical amounts of 19.8 million hectares or one per cent of all forests were told to be considerably pretentious each year by forest fires (Anon., 2010).

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

1.2.1.6 Quarrying

Quarrying is very serious and very damaging (Mather, 1991; Sands, 2005). The part of the land involved is rather insignificant and it is not perceived as a main source of crucial deforestation although quarrying is a profitable activity which endorse in development that draw growth of populace thru resultant deforestation. The production of railways, airfields, flyovers, and roads brings growing numbers of societies to the forest frontier and opens up the land to development. Conditionally, timber is exploited as fuel in quarrying processes and it is sources from plantations established for the purpose, it can cause serious deforestation in the region.

1.2.1.7 Urbanization/industrialization and infra-structure

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

City and town growth needed a land to establish the infrastructures necessary in order to assist increasing in populations that can be achieve by clearing the forests (Mather, 1991; Sands, 2005). Tropical forests are the main goal for developing an infrastructure for oil utilization, concessions of logging or construction of hydropower dam which unavoidably carries the increase of the path network and roads constructions in untouched areas (Kaimowitz and Angelsen, 1998). By constructing the roads, railways, bridges, and airports opens up the land to development and brings increasing numbers of people to the forest frontier. Whether supported or not by the governmental programmes, these settlers have usually colonized the forest by using logging trails or new roads to access the forest for subsistence land (Wilkie et al., 2000; Amor, 2008; Amor and Pfaff, 2008). (Wilkie et al., 2000; Amor, 2008; Amor and Pfaff, 2008).

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

1.2.1.8 Air contamination

Air contamination is related with degradation of some European and North American forests. The set of symptoms is called “Waldsterben” or forest demise. In 1982, eight per cent of all West German trees unveiled damage that increase to about 52 per cent by 1987 (Raloff, 1989) and part of the trees stated dying of Waldsterben in the Alps (Lean, 1990). High elevation forests demonstrate the promptest damage as well as forests in the north-east and central United States.

1.2.1.9 Warfare and Military’s role

Forest eradication in El Salvador has been caused from warfare. Separately from military immersions in wars, the military’s role in deforestation has been recognized in Southeast Asia and South America (Mather, 1991; Sands, 2005).

1.2.1.10 Tourism

Sanctuaries and National parks are afar disbelief to preserve the forests, without realizing that by opening these areas to the public for tourism really unsuitable and can be damaging. Regrettably, the national governments of tropical and sub-tropical countries approve tourism for faster method to produce money by sacrificing the stringent management policies. Additionally, numerous companies and resorts who promote themselves as eco-tourist institutions are in reality been abusing the forests for

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

income. In Cape Tribulation, Australia, for instance, the rain forest is being exposed by extreme tourism (Colchester and Lohmann, 1993).

1.2.2 Effects of Deforestation

The effects of deforestation consists of five major points that can be explained as stated below:

1.2.2.1 Climate change

Global warming is the definition of an increased of an average temperature of the earth or changes in the earth system is the result from the effect of human beings toward nature that created climate and environmental problems for instance, current visible temperature changes of climate and rainfall pattern in some areas, the rising of sea level, depletion of stratospheric ozone, pollution within atmosphere and forest deterioration. Tropical forests are decrease at a frequency of around five per cent per years as forests are logged and dispersed to provide sources to the local, regional, national and global markets for wood produces, livestock, agricultural produce and biofuels (Anon., 2007; 2010).

1.2.2.2 Flooding, Loss of Water and Soil Resources

Deforestation also disturbs the cycle of global water (Bruijnzeel, 2004). By eradicating the forest part by part, this will prevent it from depositing as much water producing a wryer climate. Reserves of water kept by deforestation comprise fisheries, marine

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

habitats and drinking water, deluge or drought control, dams and watercourses influenced by less appealing water related recreation, siltation and loss of crops and irrigation systems from turbidity and erosion (Anon., 1994a; Bruijnzeel et al., 2005).

1.2.2.3 Decreased biodiversity and habitat losses

Forests especially those in the tropics serve as a depots for biodiversity and subsequently disintegration, deforestation and degradation extinguishes the biodiversity as a whole and habitation for itinerant species comprising the imperiled ones, some of which have still to be categorized. Tropical forests comprise about 65 per cent of the world's 10, 000 endangered species and support about two thirds of all known species (Myers and Mittermeier, 2000).

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

1.2.2.4 Economic losses

The destruction of tropical forests every year consume about US $ 45 billion valued of forest capital losses according to Hansen (1997). All possible future employ and future profits that could be derived from their sustainable organization for timber and non-timber products disappear after the eradication of the forests.

1.2.2.5 Social consequences

The greatest instantaneous social impact of deforestation befalls at the local level with the ecological services losses provided by the forests. Forests provide humans with

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

valuable facilities such as flood control, cross-fertilization, erosion prevention, fisheries protection and water treatment functions that are mostly vital to the world's unfortunate people who depend on natural resources for their daily survival. By eradicating the forests we risk not only our own life quality, staking with the stability of local weather and climate, we also intimidate the life of other species and deteriorate the valuable services providing by biological diversity.

1.3 Purpose of the study

Of late, numerous logging activities in these areas (Lojing and Royal Belum Forests) have been exposed, for instance, illegal logging, jungle clearing and hill cutting that made way for farming activity, as well as mixed development projects. Therefore, this study is vital in supporting the nation plan. This study experimented upon and developed an automated multifunctional remote monitoring model for a sustainable forest management, which could be used for protecting and monitoring purposes from afar and immediate response can be made if disturbance is detected in the rainforest.

This study depicts the dynamics and the phases of temperature, humidity, and contaminated gaseous, such as carbon secretions; as well as rain detection. It had been equipped with a long distance transmitter competent for transmitting the data over the mobile channel at encoded time periods.

Also, this study collected some crucial data that could be used by scientists in making our rainforests healthier and stronger from growing sick and deformed. In fact,

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

this research mainly utilized and evaluated an automated object-based change detection method for detecting changes within the ecosystem. Moreover, coalescing these multi-date raw parameters and analyzing them via First Order Structural Deforestation Modeling for the Effect of Environmental Data developed based on Technology Acceptance Model (TAM) could pinpoint the major characteristics that affected our rainforest system.

1.4 Research Objectives

This study had been embarked upon the following objectives:

1. To determine the effectiveness of the ACRSS system in measuring environment data, such as temperature, humidity, and gaseous, at the upper and lower parts of the Royal Belum forest.

2. To develop a new device for multifunctional remote monitoring, equipped with GPS and GPM/GPRS transmitter that is capable of monitoring temperature, humidity, contaminated gaseous, and rain detection for remote control sensor.

3. To configure an experimental system that can act as an indicator by using the developed device in selected test locations in the Royal Belum Forest.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4. To achieve and to evaluate the prediction of ACRSS as an accurate calibration on the remote monitoring via First Order Structural Deforestation Modeling for the Effect of Environmental Data for testing model to identify the causal relationship between the observed variables and the depleted forest from both the upper and lower parts of the forest.

1.5 Research Questions

The researcher had composed numerous questions that had to be resolved in this study in order to achieve its research objectives. The research questions for this study are listed in the following:

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

1. Does the ACRSS system influence the measurement reading of environment data, such as the mean values of temperature, humidity, and gaseous from both the upper and lower parts of the Royal Belum forest?

2. Are there any temperature differences towards environmental data at the upper part and lower part of Royal Belum forest?

3. Are there any humidity differences towards environmental data at the upper part and lower part of Royal Belum forest?

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4. Are there any hydrogen gaseous differences towards environmental data at the upper part and lower part of Royal Belum forest?

5. Can the ACRSS determine the significance of the causal relationship between the observed variables and the depleted forest from both the upper and lower parts of the forest via First Order Structural Deforestation Modeling for the Effect of Environmental Data?

1.6 Hypotheses

1.6.1 Research Hypotheses

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

H_1 There are significant differences mean vector in the reading measurement for the ACRSS system between temperature, humidity, and gaseous taken at the upper and the lower parts of the Royal Belum forest.

H_2 There are significant differences in the mean values of the reading measurement for the ACRSS system between the temperature taken at the upper part and the lower part of the Royal Belum forest.

H_3 There are significant differences in the mean values of the reading measurement for the ACRSS system between the humidity taken at the upper part and the lower part of the Royal Belum forest.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

H_4 There are significant differences in the mean values of the reading measurement for the ACRSS system between the hydrogen gaseous taken at the upper part and the lower part of the Royal Belum forest.

H_5 There are significant relationships between the observed variables and the depleted forest at the lower part of the forest by using First Order Structural Deforestation Modeling for the Effect of Environmental Data.

1.6.2 Null Hypotheses

$H_0$1 There are no significant difference mean vector in the reading measurement for the ACRSS system between temperature, humidity, and gaseous taken at the upper and lower parts of the Royal Belum forest.

$H_0$2 There are no significant difference in the mean values of the reading measurement for the ACRSS system between the temperature taken at the upper part and the lower part of the Royal Belum forest.

$H_0$3 There are no significant difference in the mean values of the reading measurement for the ACRSS system between the humidity taken at the upper part and the lower part of the Royal Belum forest.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

$H_0$4 There are no significant difference in the mean values of the reading measurement for the ACRSS system between the gaseous taken at the upper part and the lower part of the Royal Belum forest.

$H_0$5 There are no significant relationship between the observed variables and the depleted forest at the lower part of the forest by using First Order Structural Deforestation Modeling for the Effect of Environmental Data.

1.6.3 Alternative Hypotheses

H_A1 There are significant differences mean vector in the reading measurement for the ACRSS system between temperature, humidity, and gaseous taken at the upper part and the lower part of the Royal Belum forest.

H_A2 There are significant differences in the mean values of the reading measurement for the ACRSS system between the temperature taken at the upper part and the lower part of the Royal Belum forest.

H_A3 There are significant differences in the mean values of the reading measurement for the ACRSS system between the humidity taken at the upper part and the lower part of the Royal Belum forest.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

H_A4 There are significant differences in the mean values of the reading measurement for the ACRSS system between the gaseous taken at the upper part and the lower part of the Royal Belum forest.

H_A5 There are significant relationships between the observed variables and the depleted forest at the lower part of the forest by using First Order Structural Deforestation Modeling for the Effect of Environmental Data.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi
05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

1.7 Conceptual Framework

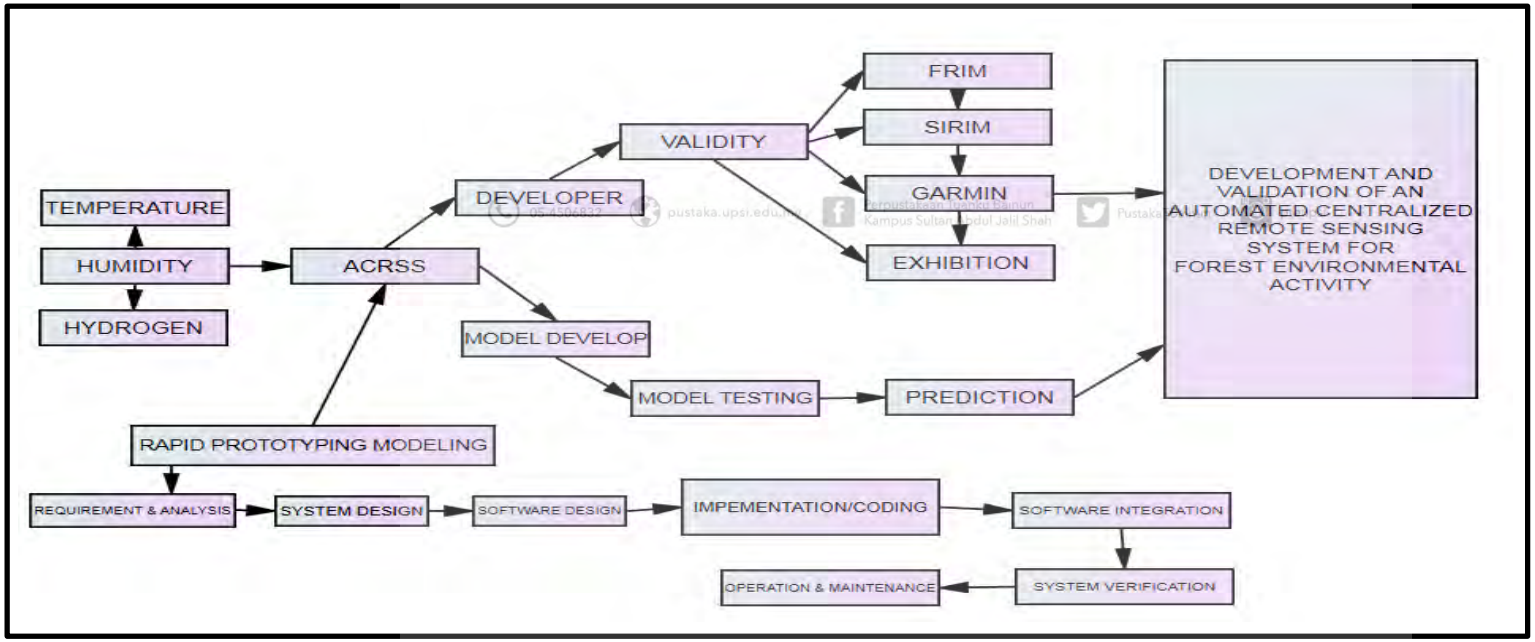


Figure 1.1. ACRSS Conceptual Framework

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

The figure above (**Figure 1.1**) illustrates the conceptual framework developed in this research. This conceptual framework is related to the hypotheses listed in the previous section. By looking at the attributes mentioned in the figure, which are temperature, humidity, and gaseous, researcher had been able to verify if there was a significant relationship between the variables stated with the causes of climate changes. Therefore, it had been necessary to analyze the data collected first before determining the significances among them. In addition, the figure also led to the identification of any significant relationship between temperature and humidity with illegal logging, as well as between gaseous and illegal logging. After that, temperature and humidity were tested to ascertain if they could function as indicators of climate changes. Finally, prediction for climate changes caused by illegal logging had been looked into. Besides the hypotheses, the objectives and the research questions must be in-sync in order to proof the validation of the data. The data gathered were analyzed by using AMOS and the findings determined the significance of the depicted relationships. Thus, in future, one should be able to predict the causes of climate changes.

1.8 Significance of the study

This research will be a significant endeavor in developing a remote monitoring device that could be further converted into a working prototype and thus, become marketable worldwide because it is the newest multifunction gadget. Moreover, this study can function as the centralized control system that can be beneficial when used by prospective regulatory bodies, researchers, and environmentalists to continue their studies and for further research in the area of rainforest management.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

In addition, this study can be enhanced by developing a series of games applications to advise the young generation about maintaining the environment. The development of a series of games as teaching aids can make aware our future generation about the depletion of rainforest and its impact upon the environment. Most importantly, this research generated numerous outcomes. In fact, the purpose of this research had been to study a database on the technical features of the existing system in measuring environment data and to configure an experimental system by using the inverted device in selected test locations within the Royal Belum Forest. Thus, it is hoped that the research could produce output that would benefit both government and private sectors through the interactions between end users and their end products.

1.9 Limitation of the study

The limitations of this research basically involved the locations of the research. The Royal Belum forest is vast in nature as the rainforest covers about 117, 500ha of land in Perak and it is the biggest in Malaysia according to the Malaysia Natural Heritage (2013). Moreover, this research was only limited at the upper and lower parts of the forest as the selected locations had limited coverage for the GSM to function. Furthermore, the more remote the locations, the fewer the signals gained. This somehow affected the aim of this research as the prototype must be centralized in real-time with the GSM and the server. On top of that, since the components of the developed prototype were mostly open sources and the sensors applied were not considered as high calibration sensors like those found in remote sensing, the reading might be, sometimes, off the chart and had to be re-calibrated a number of times until it worked.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Also, the program within the prototype had to be changed depending on the situation because those components employed voltage values. The GPS, on the other hand, did not pose any problem as it worked by using satellite signal only, but it consumed a lot of battery power at about 8 volt. Therefore, the LiPo battery had to be charged after being used, or else, the GSM and the GPS would not function and all the data cannot be sent to server. Hence, additional power supply was used as back-up when the field experiment was still on-going. Moreover, since the forest canvas was at large-scale, the solar did not work as it was covered mostly by trees and the sunlight did not reach the solar panel. Besides, the weather was considered first as it was unpredictable and could influence the power supply; in this case, the solar power.

1.10 Research Design

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

In this research, the causal type of research, which is developed to gather raw data construct and any related information that permit the choice made by researcher was used as the applied design to exhibit the cause and effect relationship between two or more variables. Causal research had been the most appropriate among other research designs because the research objectives included the need to understand the reason for deforestation to happen when certain variables changed. Furthermore, it was used to understand the functional relationship between the causal factors and the effects predicted on the deforestation variable under investigation.

In fact, this type of research design allows the decision maker to gain the highest level of understanding in the research process. In addition, understanding the cause-

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

effect relationship in deforestation allowed the researcher to make if-the statements about the variables. On top of that, among the different data collection techniques available, experimental designs had been found to hold the greatest potential for establishing cause-effect relationship because they allow researchers to investigate changes in one variable while manipulating one or two variables under controlled conditions.

1.11 Operational Definition

An operational definition can be described as something, term or material, or variable in a phase of a particular procedure or a set of tests used that has been validated to presence and quantity. Properties described in this manner must be publicly accessible so that the person, who is other than the definer, can independently measure or test them at will.

Automated – is the ease of use of countless control system for maintenance devices; for instance a robotic movement that is programmed by a programmer to do certain kinds of works that will only require minimal or reduced human involvement. Also, it allows an application such as factory processing machine do human works just by pressing a certain button to operate it.

Remote Monitoring – can be defined as a new era of controllable network operations center that has the capability to change the operation of these components from the central point. Many types of remote monitoring are

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

currently synchronized with the development of wireless sensing network, which is not only initially limited to SCADA technology.

Rainforest – Rainforest is the habitat for millions of flora and fauna which are very dense, wet and warm, which is extremely crucial for a stable ecosystem and ecology of the earth. The Earth's oxygen is mostly generated by the plants in the forest.

Ecosystem – An ecosystem is a community of wide variety of living organisms such as human, animals and plants in conjunction with the non-living components of their surrounding environment like air, water and mineral soil which interact as a system.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Open Source Hardware – The hardware consists of a board with input and output and the software support that can write standard programming language. The support can produce many types of newly devices that can be benefit to all and manufacture useful end products. The Arduino and Raspberry Pi is an example for open source hardware which requires C++ and Python programming language to make it operational.

Sensor – a components that acts as a transducer whose purpose is to sense several characteristics of its environments. It senses an event or change in the measurement and quantities which correspond and provide an output of an electrical or optical signal. An example is when phase particle converts dust particle to an output voltage.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Temperature – is a condition that measures hot and cold conditions using a thermometer. The thermometer contains a liquid based material known as mercury that can detect heat radiation through the behavior of bulk. Temperature can be measured in several types of readings such as Celsius, Kelvin as Fahrenheit.

Humidity – Humidity can be defined as a volume of liquid that vaporizes in the air, in which becomes in state of gaseous containing water and cannot be seen. Humidity can take any form of dew, fog or precipitation which indicates the rate of evaporation of moisture from the skin has depleted and the effectiveness of sweating is reduced due to the cooling condition of the body.

Illegal Logging – Illegal logging is an activity which involves harvesting, transporting, purchasing or sale of timber which violate the laws. This procedure may be illegal due to entering the forest without permission from a preserved or protected area, which involves the cutting of protected trees' species or bringing out the timber from the areas within agreed limits.

Deforestation – is a state of removing or clearing the forest or tress to convert the forest into a non-forest use, or example, clearing the forest to develop a farm or an urban community. This term also is sometimes being misused when applied to describe a tree clearing process, in which all the trees have been cut.

GPS – also known as Global Positioning System, is a navigation based on the satellite system that can locate any information in regards to location. The

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

location also covers everywhere near the Earth and even in harsh weather conditions, by pointing the areas to the map or devices through latitude and longitude. GPS usually involves 4 or more satellites to operate.

GSM – is a standard digital mobile phone, which is the current dominant 2G in the world. The term itself refers to the Global System for Mobile Communication. GSM can determine the communication of mobile network with towers of land based network.

Solar Energy – Solar energy is a renewable type of energy which converts sunlight into electrical energy. It is one way to reduce electrical energy that is currently used and can be approached with low cost and global scale use. Solar energy can be developed throughout biotechnology and nanotechnology, as well as the components and physical sciences (Nathan S. Lewis, 2007).

1.12 Conclusion

This research comprises of six major chapters; chapter 1 until chapter 6. Chapter 1 presents the introduction of the research, the background study of the research, the problem statements, the research questions, research objectives, significance of the study, the research hypotheses, scope and the limitations of the study; while chapter 2 depicts the discussion pertaining to literature topic, literature concept, the gap behind the research and also the debates about them. Not only that, knowledge and information regarding similar researches are also put into use to find and compare the results, as well as their advantages and disadvantages, thus, offering the opportunity to identify

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

the research gap between them. Meanwhile in chapter 3 will illustrate the develop model used for an automated centralized remote sensing system (ACRSS) involved when developing the system. Besides, it illustrates the flow and the Gantt charts of the system, including the hardware and software used to develop the system. Then, chapter 4 looks into the implementation of the instructional design to the system by phase of requirements. Chapter 5, on the other hand, presents the results that had been analyzed using selected method of data analysis with the specific software to determine if the system developed achieved the objectives provided. Lastly, chapter 6 depicts the overall summary of the research, the limitations of the system, and some suggestions that can be implemented to improve the system for a more accurate and precise operation.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

CHAPTER 2

LITERATURE REVIEW

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

2.1 Introduction

This chapter will deliberate the literature review on the information used to develop this prototype system. This chapter will discuss previous literature topic, the literature regarding GSM and GPS, the literature concept, the research gap found and the debate about previous work similar to the research that researcher aimed to conduct.

2.2 Previous Literature Topics

Remote Sensing has been utilized in assessing and giving early warnings of illegal logging (Mayer & Lopez, 2011). However, this technique, which implements the sequential of satellite image to preserve forest in coarse- grained patterns, is not suitable for early fine grained and real-time monitoring of deforestation (J.Mariel, 2009).

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

According to Nirvika Chouhan, P.D.Vyavahare, and Jain (2013) the main applications of wireless sensor network involve the volume of contaminated gaseous within the atmosphere as well as the detection of forest fire through the measurement of variables such as humidity, temperature and gaseous which are manufactured by flame in trees or foliage. In fact, even the slightest advancement of soil can be sensed. These applications can be concluded as an involvement of environmental sensing. Furthermore, there is a large number of small sized and power limited nodes contained within the wireless sensor network. This situation is such because its flexibility, processing within in-network, cost-effective deployment and wide range of fields can also be categorized as important characteristics. This research had been supported by Wang, Wang, Wang, and Liu (2012) who stated that wireless sensor network has been utilized widely in environmental sensing and forest fire detection although these subject matters are not discussed in any literature investigating the use of wireless sensor network to monitor illegal logging.

Moreover, an article by Lozano and Rodriguez (2013) presents the design of a system, which had been employed monitored both temperature and humidity, in preventing forest fires through the use of wireless sensor networks. Forest fires are a major problem due to the destruction of forests, and generally, wooded nature reserves. In Colombia, out of the 71% of the forests, only 46% were preserved, placing the country as the fifth most deforested country in the world. It is for these reasons that fire detection systems play a key role in fighting against forest fires. Hence, this project designed a service for early detection of forest fires. This solution had been sought through the deployment of a WSN in order to minimize environmental, human, and

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

material damages associated with fire, as well as to support the tasks of regular monitoring of the environment.

Moreover, several numerical experiments on deforestation in Amazonia revealed that temperature rose significantly and precipitation decreased as a result of deforestation according to Anastasiadou, Koulinas, Kiourtsis, and Athanasiadis (2014). The pilot implementation had been expected to yield significant results and insights on how Environmental Management Information Systems, together with low cost sensors, could assist in fighting illegal logging and timber certification, as well as how illegal logging is performed in the local cross border environments.

In a prototype developed by Ball (2010), their experiment involved using two sensors which are mercury and temperature sensor that operate well for sensing fire and tree theft, by using selected and mesh protocols for alert routing as well as disturbance detection. Meanwhile, latency estimation and network lifetime for the deployment scenario took place due to the display of implementation probability of such the monitoring system for deforestation application. However, there were issues in regard to power supply towards the sensor node as the battery replacement became the major problem for wireless sensor network applications, which required a prolonged duration for monitoring large-scale areas, especially remote areas. Therefore, it is essential to have a proper method to recharge the batteries in empowering the sensor node to improve the network lifespan.

In addition, WSN facilitates a number of activities in preserving the forest, specifically in the evaluation toward wild fire risk, inspection of illegal logging, climate

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

surveillance and evaluation of tree canopy (Ngabas & Abdullah, 2014). Besides that, a regular technique to implement the sensor by measuring the distance of the electronic was used. However, this attempt demanded a labor and spent too much time, mainly in terrains that is complex and have an uneven geographical structure.

Next, a paper proposed by Sidén (2007) depicted a new concept of scattered sensors that have been referred to as Action Activated TAGs (AAT). It is a new electronic system used to detect forest fire, which the system includes a sensor unit that is cost effective and can implement from air to ground. The AAT sensors were latent and would only activate to transmit the alarm signal only when it detected the rise of temperature of a forest fire but would not activate when there was an interference.

Other than that, according to Yatskiv and Sachenko (2014), monitoring of forest, based on WSN technology, provides operability, high accuracy of fire and determining its scale, as well as low cost installation and maintenance. Nonetheless, the proposed models reduced the amount of data transmitted to the base station, as well as extended the persistence of autonomous nodes and networks as a whole.

Meanwhile, Czúni, and Varga (2014) concluded that while the area of acoustic signal processing was very large, the detection of chainsaw, an important event in forest surveillance, is not analyzed deeply. Moreover, most papers did not consider the limited hardware resources and energy supply available in WSNs.

Furthermore, Babiš, Ďuríček, Harvanová, and Vojtko (2011) proposed an original approach to online forest monitoring in order to detect logging activities. They

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

designed a system that consisted of a heterogeneous sensor network and a web application that were capable of presenting the gathered data to the user in a convenient way. The implementation of the prototype of the proposed system had been conducted and several experiments had also been performed toward it.

Next, Mohanapriya (2014) proposed a system entitled "Wireless Sensor Network", which had been used for remote forest monitoring, as well as for preventing illegal logging of invaluable trees. Illegal logging activity can be prevented by using this system that is proper for monitoring widely range forests. Moreover, the cutting of trees can be monitored by using a group of sensor nodes. Occasionally, the data gathered were recorded and sent to the monitoring centre after being transmitted.

Additionally, the proposed method generated in a research by Kirubaharan, Sunder, Ramesh, and Dhinakar (2014) consisted of numerous sensors used for measuring temperature and humidity, having the sensors in each standalone case. The boxes then were distributed around the forest area to obtain a comprehensive coverage. Furthermore, it was necessary to detect fire as early as possible, especially when the temperature increased while the humidity of air decreased. Therefore, when the threshold value of temperature was higher and the threshold value of humidity of air was lower, the control centre received an alert signal from it.

Furthermore, the field of forest monitoring has advanced in many ways as a result of forest research after several decades, for example activities like invaluable tree theft, honey theft and flame detection. Moreover, forest fire monitoring and environmental monitoring can be observed via applying the wireless sensor network

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

(Mittal et al., 2012). They further asserted that the communication node is in a state of sleep mode due to the rareness of an event occurrence caused by the implementation of forest monitoring application.

Meanwhile, the system proposed by Subhas (2014) spread some of the wireless sensor monitoring nodes that had been included in their developed system on the hillside. They developed a Zigbee based wireless data connection network as the data had been gathered with a combination of wireless technology and GSM technology. All of the readings were transferred to Zigbee for transmission with the functionality of GPS technology that provided the location through latitude and longitude.

Furthermore, in a paper written by Lavanya (2014), a wireless sensor network was proposed for forest monitoring based on remote technique, whereby the Zigbee communication was used to receive information transmitted to remote stations through the sensors. A forest monitoring based on embedded system as mentioned by them as a novel system, was proposed to develop a robot to observe tree cutting, landslides, earth vibrations and temperature based on the event detection in the forest area. The main drawback of the current system as stated by the researcher was that only a certain part of the forest can be detected. In addition, the current system also consumed extra power as the control station received information even though there were no event occurrence.

Other than that, Sidek et al. (2014) built a low cost device to detect oxygen, carbon dioxide, humidity and temperature. As the forest absorbed C02 emission to keep the world cool, this situation had caused global warming. CO2 has been utilized among the preferred areas of Belum rainforest in Malaysia to monitor its assimilation level.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Nevertheless, the air device has been built from scratch as it cannot be purchased due to specific criteria to transmit the data throughout the remote area and also because of limited research fund.

2.3 Literature on Global Positioning System

Kamburov (2010) presented a test experiment of how GPS methods may be applied in a forestation process of an area; destroyed by illegal cutting and insects. In the past decades, the forests in Bulgaria suffered from various natural disasters – fires, wind throws, deceases, and insects. The reason for this had been poor forest management, as well as increased intensity of extreme climate events, like hurricanes, temperature variances, flood rains, which caused stress in the forest ecosystems. Based on a statement from the Bulgarian State Forestry Agency (STA), the forest territories that were destroyed in the past years accounted for over 60, 000 da. Illegal cutting also caused significant problems onto the forest ecosystems, where a huge part of it had been inside the "Natura 2000" protected areas. Thus, this research offers a field analysis of four modern GPS methods; tested individually and together for mapping of the forestation. The researcher concluded that the VRS type of GPS method, based on **Figure 2.1**, achieved accuracy at decimetre level, even in a relatively harsh terrain.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

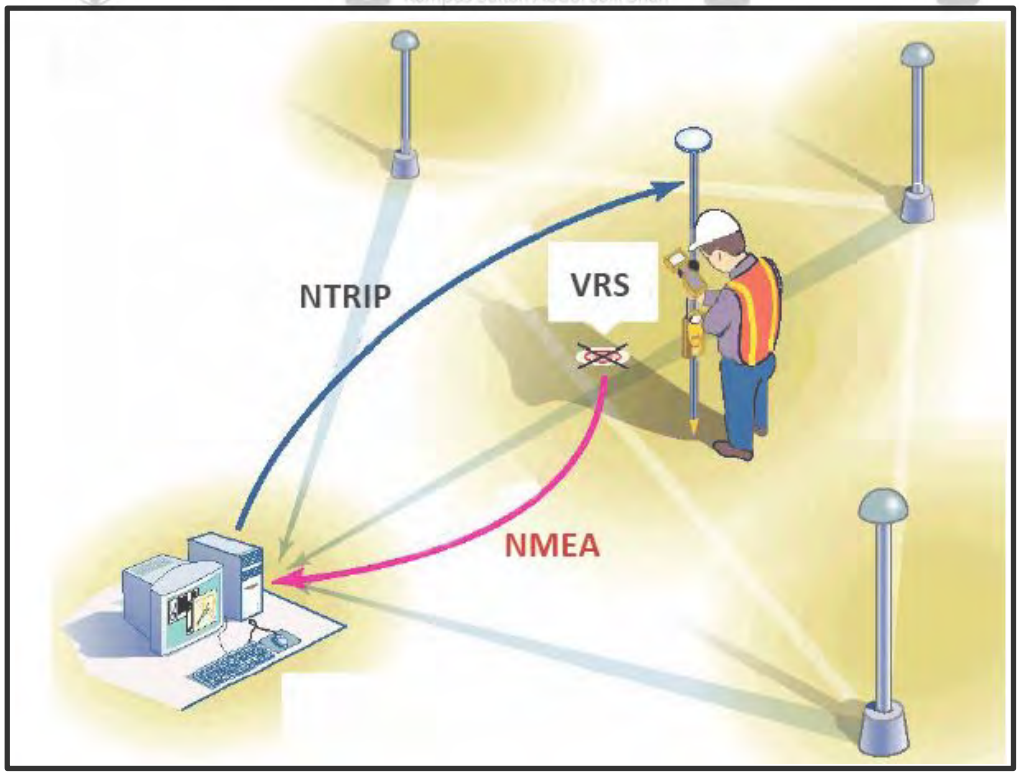


Figure 2.1. VRS Technology. (Source: Kamburov, 2010)

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Avalanches and landslides can be monitored automated continuously as the use of GPS increases. For instance, the geometric distribution and the number of satellites that are being tracked will heavily affect the reliability, the accuracy, the integrity of positioning solutions and the availability of GPS based deformation monitoring systems. Besides that, continuous data on the landslide activity can be provided due to the precise position upon the immediate surroundings or the landslide body, as a series of sensor has been composed with rapid and easy installation (Srinivas & Rao, 2014).

The nodes can be located using GPS when the number of the nodes is higher, leading having it easier for GPS to detect the location of the fire (Kirubaharan et al., 2014)

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

2.4 Literature on GSM

Currently, the use of the existing wireless network such as GSM/GPRS or through separate formation of dedicated network, including those upon TCP/IP can be considered as the most promising tool used in the concept of network sensor nodes.

In addition, GSM will send the compressed and digitized data to a channel with two other streams of user data which have their own time slot in each one of them. The frequency at either 900 Mhz or 1800Mhz can be used to operate GSM. Hence, GSM can inform any occurrence of fire in the forest (Kirubaharan et al., 2014).

It is crucial to obtain information on any early warning to prevent any unpredictable occurrence of common major natural disasters such as floods caused by rainfall, volcanic activities and earthquakes. In many cases, the increase in the incidence caused by landslide happened because of deforestation and modified slopes from human activities and development. In order to obtain information concerning the monitoring operations, a user can contact the system through the SMS technology (Subhas et al., 2014).

2.5 Literature Concept

Based on a comparison between receiver-generated replica signals and received signal, the satellite navigation's observables are determined by differences in phase and measuring time. According to Wang et al. (2012), different from the measurements of terrestrial electronic distance, the use of "one-way concept" of satellite navigation

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

involves two types of clock, with one in the receiver while the other in the satellite. WSN nodes mounted on the trunk of tress will influence the signal received and determine the signal strength indicator from one to another as illustrated in **Figure 2.2**. This is an important step to stop illegal logging. Moreover, while the nodes are mounted in a non-intrusive manner due to its small size, it cannot be easily found .Thus, the changes in the position of the small size nodes mounted on the trunk will indicate that the tree monitored is chopped down by intruders. Meanwhile, the monitoring system and the forest guard will correspond via ad hoc wireless sensor network with GPRS link after an alarm of illegal logging triggers. Besides that, the valuable forest resources can be guarded effectively and efficiently as the action would be taken to prevent these unhealthy activity.

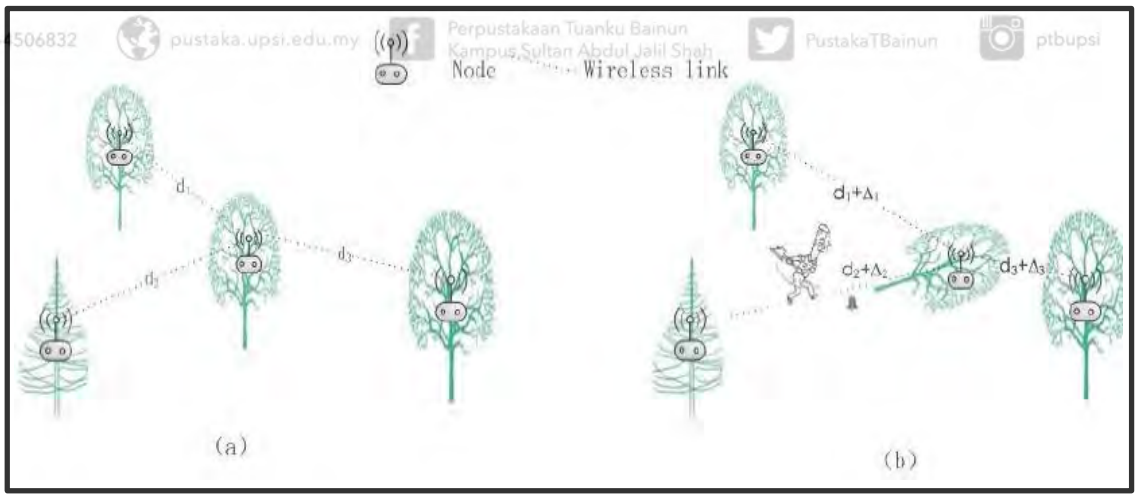


Figure 2.2. WSN detecting trunk. (Source: Wang, Wang, Wang, & Liu, 2012)

The design of the WSN system for forest monitoring according to Mittal et al. (2012) contains Middleware, Sensors, Simulation, Design of low power wireless communication module, implementation of energy efficient protocol and also strategies

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

for deployment. **Figure 2.3** portrays several wireless nodes (namely N1 to N10) that are in charge of communicating the information deployed in the forest and sensing the desired physical entities. The upstream routers will receive any information gathered by the nodes and the use of Base Station is to collect information from the routers. The Base Station will be connected to the main system through wireless connection that will finally process the obtained information and appropriate decision will be made.

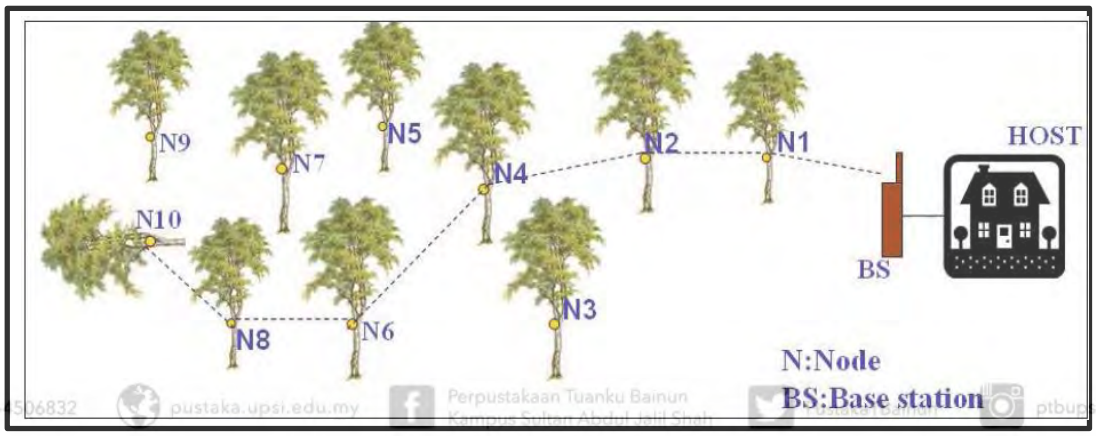


Figure 2.3. Demonstration Scenario using WSN. (Source: Mittal et al., 2012)

By adding a number of more powerful "Zone Nodes" to provide support for this system, the significant areas can be covered where each presented sensor node will have a number within reach **(Figure 2.4).** In addition, these Zone nodes could be referred to GSM/GPRS based on that would be able to form a separate network on their own, which linked to station responsible for monitoring the fire or providing direct links into the existing network. Moreover, in order for these sensors to be utilized continuously in the forest, certain preconditions must be achieved. Preferably, such system must meet the requirements stated below (Sidén, J., 2007):

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

- The system should be capable of covering the wide areas of the forest
- The system should be capable of identifying sensors that emit warning signal (localization)
- The sensor unit should be comparatively small and easy to be implemented
- The sensor unit should be in a state of maintenance free for a few years and should have a long period of lifespan
- The sensor unit should not contain components or materials that are potentially dangerous to the environment
- The sensor should not release any hazardous chemicals when devastated by fire.

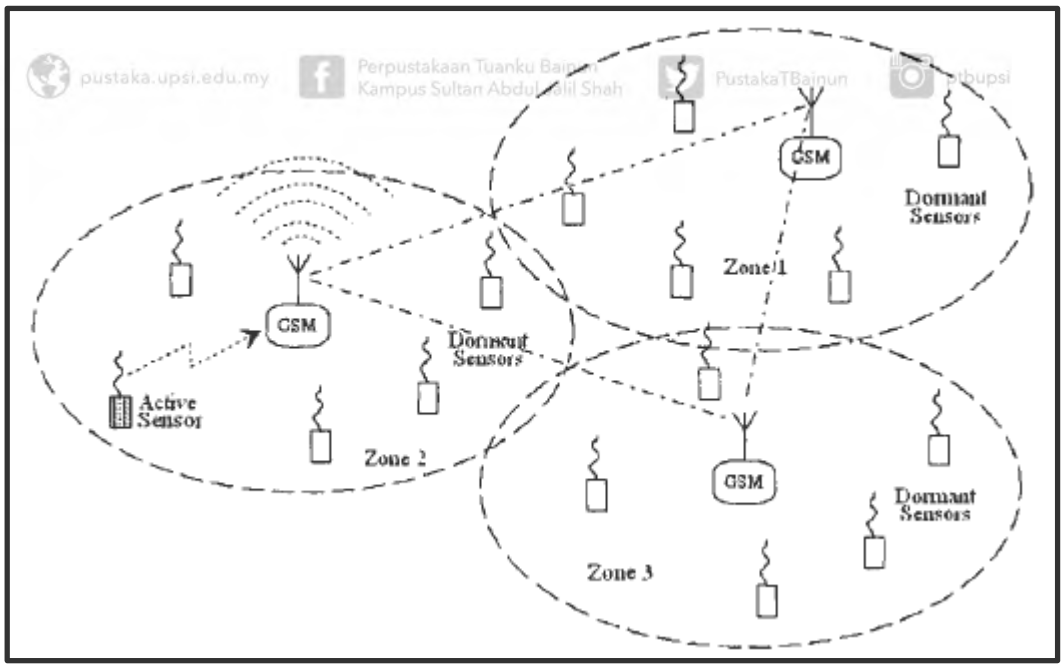


Figure 2.4. Simplified WSN hierarchical network structure. (Source: Sidén, 2007).

Furthermore, the authors of functionality of the monitoring forest system, Yatskiv and Sachenko (n.d), proposed to equip the wireless sensor node with Sound

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

sensor (**Figure. 2.5**). Besides, in order to reduce the load on WSN communication channels and to increase the efficiency of detection event processed in wireless sensor node, cluster analysis and modeling were used. The use of sound sensor had been found to increase the reliability of fire detection and extended the functionality of the monitoring system, including detection of unauthorized deforestation facts in real-time.

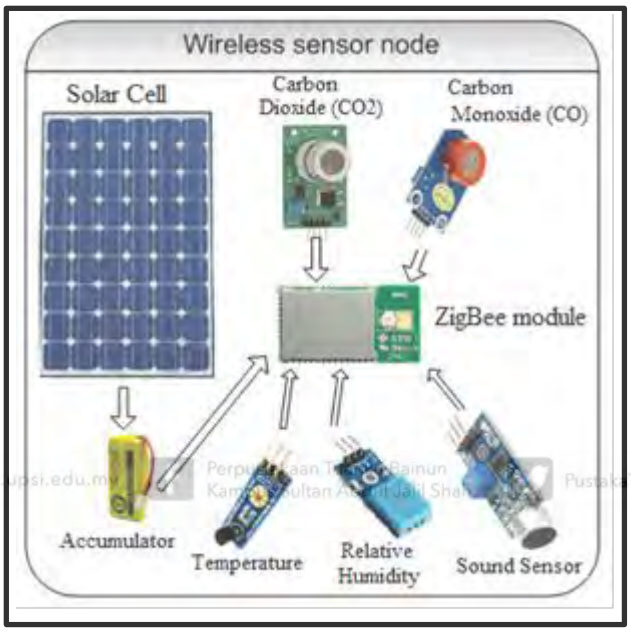


Figure 2.5. Wireless Node Structure. (Source: Yatskiv & Sachenko, 2014)

Based on the communication characteristics and energy consumption limitations of the system, WSN is designed to form a cluster-tree topology network (as shown in **Figure 2.6**) and to employ the ZigBee communication protocol (Babiš et al., 2011).

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

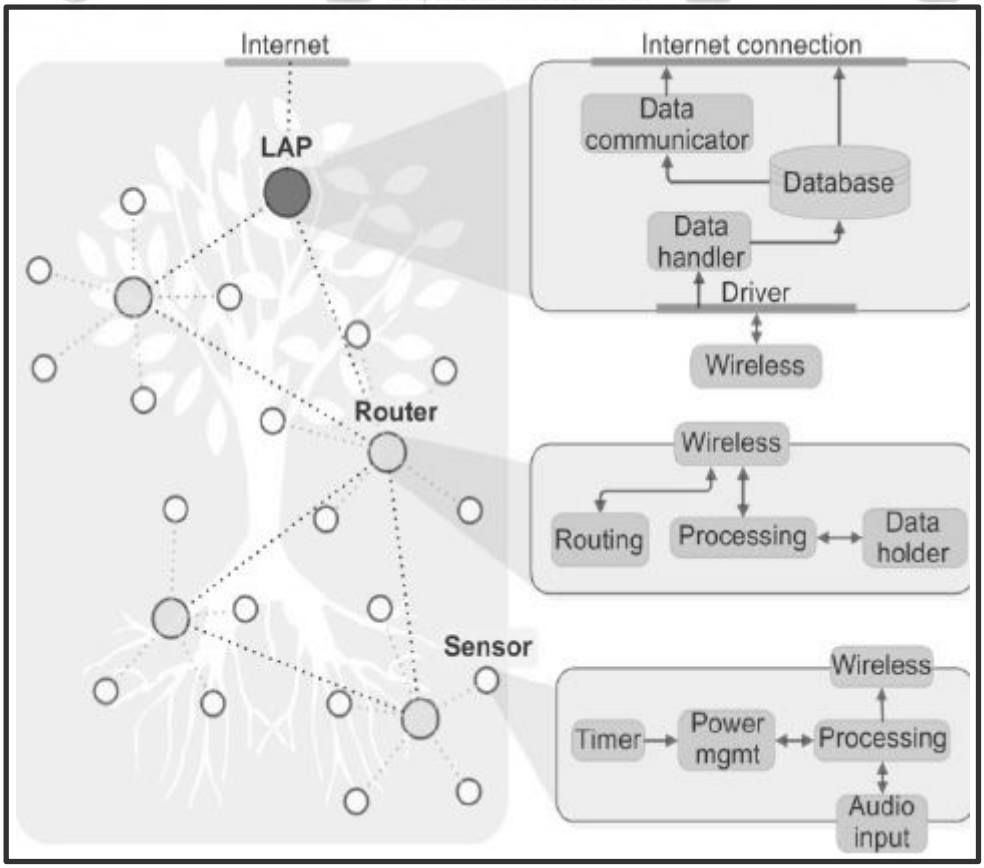


Figure 2.6. Wireless sensor structure of components. (Source: Babiš et al., 2011)

Figure 2.7 below illustrates the concept of the proposed prototype developed by Kirubaharan et al (2014)which consists of the following attributes:

- The initialization and synchronization of all the nodes must have the same clock
- All base stations must be connected to the control center when a cluster of nodes is connected to it
- The LM 35 sensor will sense the temperature and transmit the data to the base station every 30 minutes when the humidity of air is high

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

- There is a possibility for fire when the humidity of the air reduces, hence the measurement rate will rise every 15 minutes
- The node will enter the sleep mode when the temperature is less than the threshold value, while the sensor continuously senses the temperature and transmits the result to the base station
- When the node detects the fire, it will send a warning packet to its neighboring nodes and the timer will start and continue running until the fire alert is triggered. The rate of fire spread and the spread's direction will be calculated.
- The direction of fire spread as well as all of the values calculate the rate as the base station collects it.
- An alert message is sent through GSM to nearby villages to transfer the people to a safe zone.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

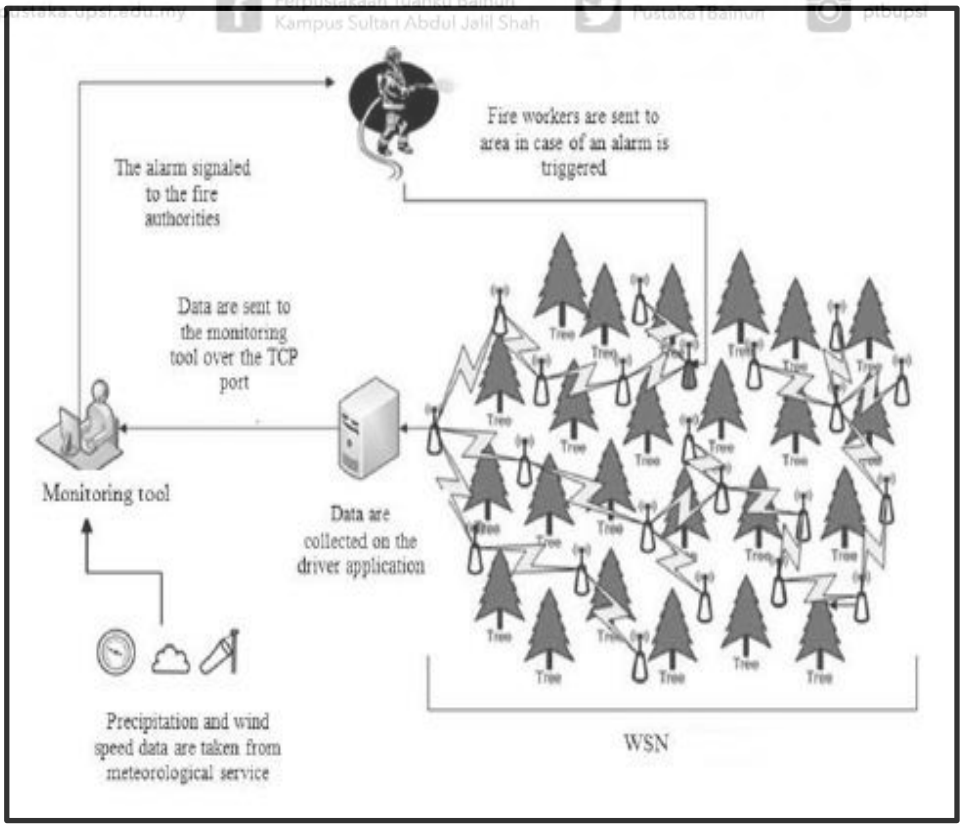


Figure 2.7. Deployment of sensor in the forest. (Source: Kirubaharan et al., 2014)

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

The final system within this research as depicted by Sidek et al. (2014), comprises of a microcontroller, a sensor which consists of humidity, temperature, oxygen and carbon dioxide, electronic components such as resistor, voltage regulator, crystal, pin header, capacitor and terminal, SD card module, RTC as well as data transfer wirelessly and Wireless Sensor Network application by using Xbee. **Figure 2.8** below portrays the final prototype that had been developed with its GUI, as presented in **Figure 2.9** that displays and records the data.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

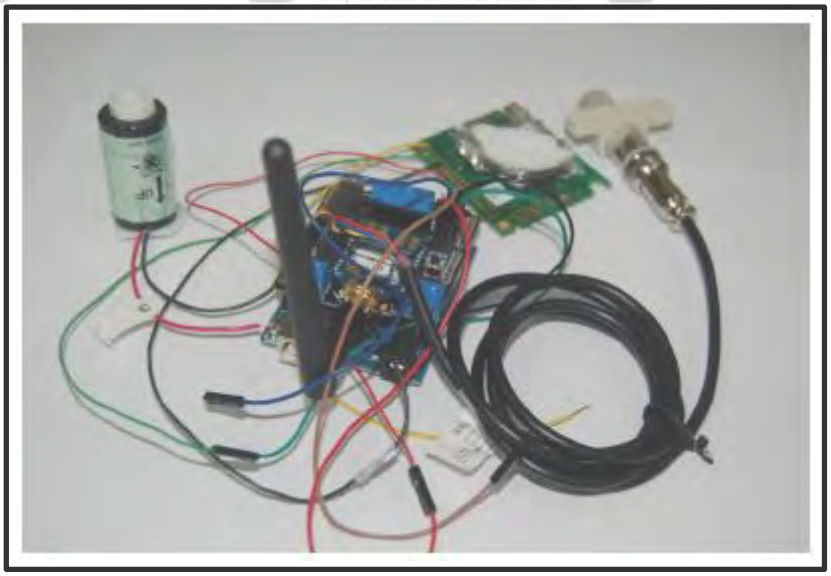


Figure 2.8. PCB Board of the System Hardware. (Source: Sidek et al., 2014)



Figure 2.9. The System GUI. (Source: Sidek et al., 2014)

The concept for the development of a system proposed by Yusoff, Shafiril, Abas, and Yusoff (2015) consists of four stage models known as data acquisition, data

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

communication, data presentation and alert notification. **Figure 2.10** below demonstrates the overall research system's models that were implemented.

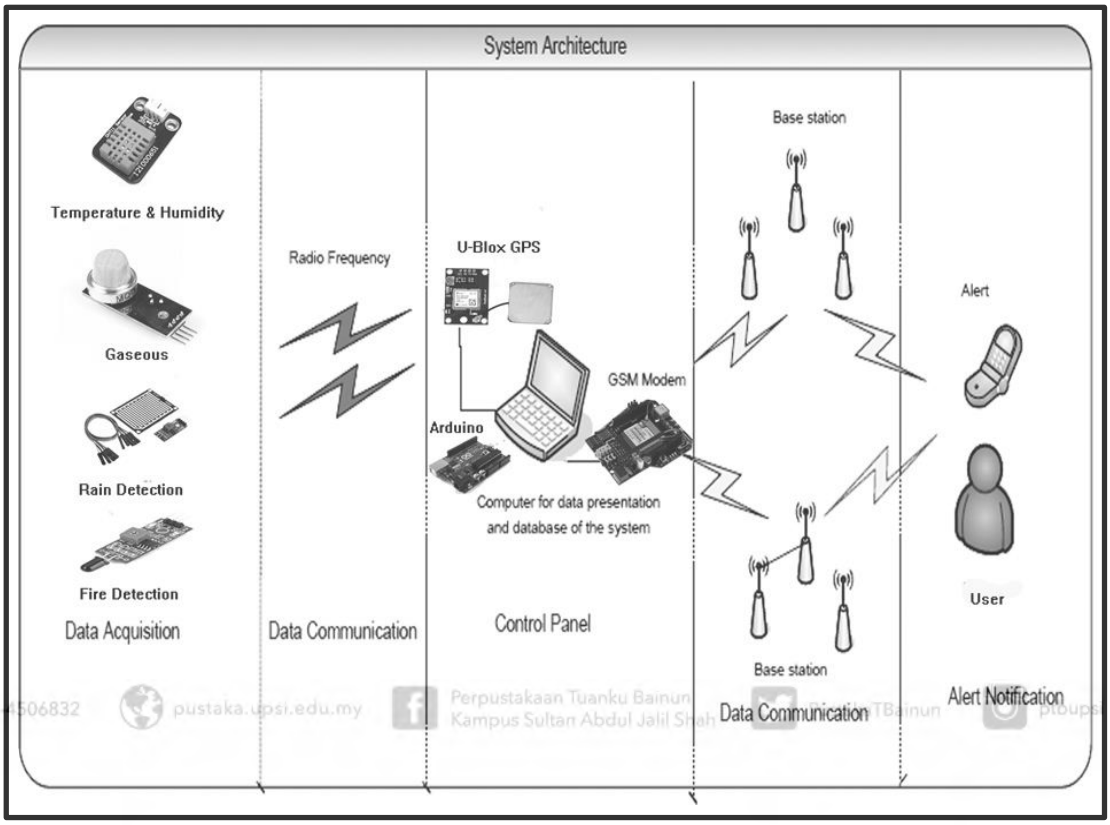


Figure 2.10. System Architecture (Source: Yusoff, Shafiril, Abas, & Yusoff, 2015)

2.6 Summarization from previous research

Based on the literature above, a certain gap had to be identified for the researcher to conduct this research in bridging the gap. First of all, since WSN is a new technology and most literature had been only based on theoretical, but not practical, limited studies had implemented this system (Subhas et al., 2014). This notion is also supported by Mayer and Lopez (2011), who explained the degree to which these technologies being

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

used fall far short of their potential, with a variety of technical, financial, and political reasons likely the cause of the shortfall. Thus, the main concern here, for another researcher who had previously worked on a similar research, is that such as energy consumption (Nirvika Chouhan et al., 2013). This is also supported by Mittal et al. (2012) as the Wireless Sensor Network application involved long term monitoring, especially on a wide area that consumes battery life and also the ease of battery replacement. Besides, other researchers like Czúni and Varga (2014) also claimed that the main constraints within the research had been the limited processing power and also communication bandwidth to undertake the tasks. The maintenance costs also played a major role within the research carried out by Babiš et al. (2011) as the implementation of the prototype within a large scale area in forest could consume a lot of money. In fact, one of the advantages of detecting fire is that it cannot be predicted by considering the signals due to environmental conditions. This had been further asserted by Kirubaharan et al. (2014). Moreover, some WSNs are contingent on data-loggers in order to operate and retrieve the measurement, thus a push button is required. In addition, the possibilities of the network can be destabilized and affected by the costs of sensors (De La Piedra, Benitez-capistros, Dominguez, & Touhafi, 2013). This was also supported by Sidek et al. (2014), who had been concerned about the temperature sensor, as the cheapest sensor applied was found unfit for environmental testing. For instance, the sensor was unstable and did not provide accurate results when compared with the present temperature obtained from the meteorological department, as the temperament of sensor was impractical for lasting monitoring of forest ecosystems and marine application due to aging and bio-fouling.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Moreover, drawbacks such as the low dependability of the GSM communication system and the cost per SMS posing financial problem also influenced the accurateness and efficiency of the data gathered. All the arguments depicted above had been based on a survey conducted by De La Piedra et al. (2013). Based on the limitations listed by other researchers, it had been summarized that in order to develop a prototype that could measure all the variables listed by the researcher, the aspects depicted above had to be taken into consideration from a number of perspectives. The gap that had been outlined had been used by the researcher to answer the research questions, to achieve the objectives, and to ascertain the hypotheses (see **Table 2.1 and Table 2.2**).

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 2.1

ACRSS Research Gap

			Temp	Humd	Gas	GSM	GPS	Fire	Rain
	ACRSS		Y	Y	Y	Y	Y	Y	Y
NO	Title	Author							
1	Wireless Sensor Network-A Survey	Nirvika Chouhan (2013)	Y	Y	N	Y	N	Y	N
2	A Novel Illegal Logging Monitoring System Based on WSN	SF Wang (2012)	Y	Y	N	N	Y	Y	N
3	Design of Forest Fire Early Detection System Using Wireless Sensor Networks	Lozano (2013)	Y	Y	N	Y	N	Y	N
4	GPS Methods In Support Of GIS Technologies For Management Of Forest Territories,	Kamburov (2010)	Y	Y	N	N	Y	N	N
5	Wireless Sensor Network Platform for Precision Agriculture	Mittal et al. (2012)	Y	Y	N	N	Y	N	N
6	wireless sensor node to increase the functionality of the monitoring system for unauthorized deforestation	Yatskiv (2014)	Y	Y	Y	Y	N	N	N
7	Sustainable Forest Management. Commonwealth Forests	Ball (2010)	Y	Y	N	Y	N	Y	N

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 2.2

ACRSS Research Gap (Continued from Table 2.1)

			Temp	Humd	Gas	GSM	GPS	Fire	Rain
	ACRSS		Y	Y	Y	Y	Y	Y	Y
NO	Title	Author							
8	A Review of Simulation Framework for Wireless Sensor Networks Localization	Ngabas (2014)	Y	Y	N	N	Y	Y	N
9	Wireless Sensor And Actor Networks	Bott (2014)	Y	N	N	Y	N	Y	N
10	Forest Guardian – Monitoring System for Detecting Logging Activities Based on Sound Recognition	Babiš (2011)	Y	Y	Y	Y	N	N	N
11	Wireless Sensor Network based Conservation of Illegal logging of Forest	Mohanapriya (2014)	Y	Y	N	Y	N	N	N
12	Intruder Detection and Forest Fire Alert System with Using Wireless Sensor Network	Kirubaharan et al.(2014)	Y	Y	N	Y	Y	Y	N
13	Landslide Warning System using Wireless Sensor Network	Subhas (2014)	Y	N	N	Y	Y	N	N
14	Mobile Embedded Wireless Sensor Network to Prevent Deforestation	Lavanya (2014)	Y	N	N	N	Y	N	N

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

2.7 Conclusion

This chapter discusses the involvement of the previous literature topic, the literature concept, the research gap, and also the debate concerning the topics. Hence, this chapter functions as a guide to the researcher in order to understand more about the research that had been carried out. Moreover, the information depicted in this chapter focuses on previous similar researches that involved the usages of sensors and microcontroller, as well as the functionality of GSM and GPS. In addition, comparison was made between previous researches by looking into the results and the weakness in order to gain more information in identifying the gap between them, which this research bridged. Moving on, the next chapter discusses more about the methodology used in developing the device, the flow chart that determined the processes in each stage, the milestones of the device procedure, as well as the hardware and the software used in order to develop the devices. Likewise, the researcher determined the validation of the standards of the developed prototype, including the procedure that had been employed to analyze the data.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

CHAPTER 3

METHODOLOGY

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

3.1 Introduction

In this chapter, the methods used will be described as the purpose of this study is experimented upon and developed an automated multifunctional remote monitoring model for a sustainable forest management, which could be used for protecting and monitoring purposes from afar and immediate response can be made if disturbance is detected in the rainforest so the research methodology is an essential component in conducting a system or project. Therefore, the most appropriate methodology must be chosen first. This phase is required to ensure that the system developed is implemented on track based on the schedule prepared. Furthermore, the methodology is necessary for a developer to make some enhancements if any error occurs. Besides, the research methodology section has been accepted by many researchers in the field of system design research (Vaishnavi & Kuechler, 2004).

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

The design's process model is often drawn in the flow diagram form with the design developed from one stage to the next, including the looping feedback that exhibits iterative returns to earlier stages which are made compulsory in the model. On top of that, this chapter also includes the explanation of the flowchart with the Gantt chart that describes when and how the system had been developed, the related milestones and dates, the procedure of data analysis, the validation of standard, the Technology Acceptance Model (TAM), and the conclusion of this chapter

3.2 Flow Chart of Research Activity

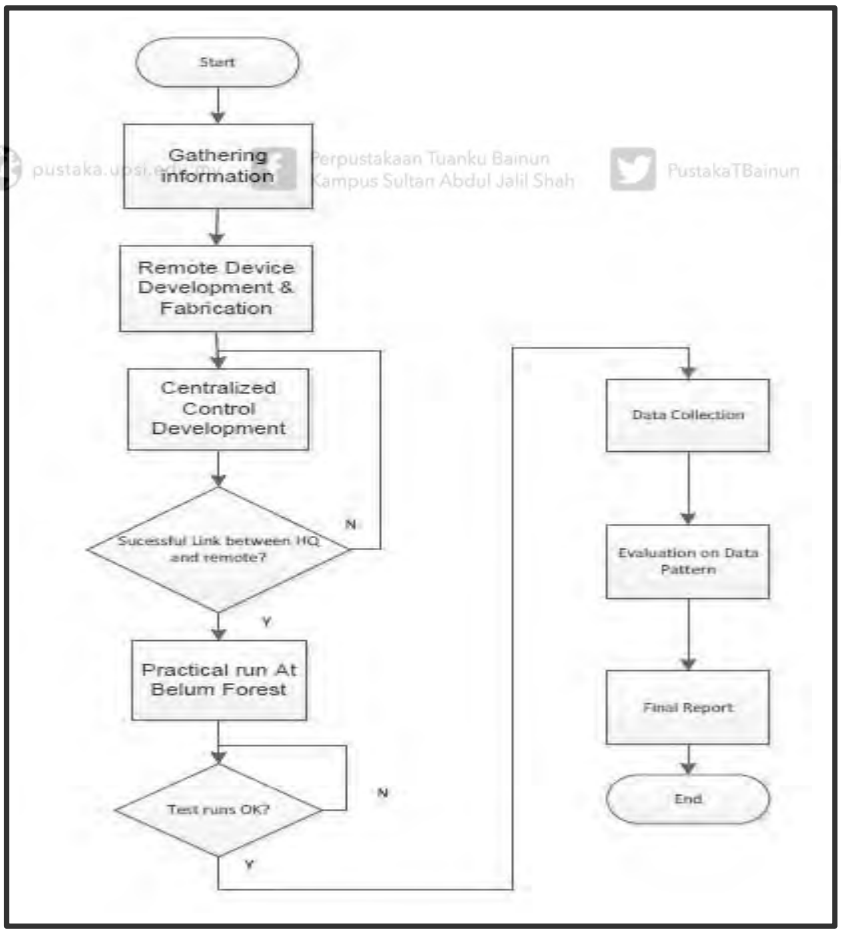


Figure 3.1. Research Flow Chart

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

3.2.1 Gathering Information

This is the first stage of the design process gathered all information about environmental pollution; focused on the Malaysian rainforest ecosystem. These data were obtained from the Forest Research Institute Malaysia, as well as Natural Resources and Environmental Ministry.

3.2.2 Remote Device Development and Fabrication

This is the phase where practical knowledge, engineering science, production methods and commercial aspects were gather, and the most important decision was taken. Hence, developing a new model for a multifunctional remote monitoring device that included the standard features on data measuring, along with new added features, had been assessable from the main control location. Moreover, this studies comprised of both hardware and software development.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

3.2.3 Centralized Control Development

The idea of centralized control location was to design a system that could be automatically updated to a dedicated web page, which did not only indicate the location of the remote monitoring device on the map, but also displayed a statistical line graph versus time (in days) for every incoming data, such as the gaseous levels, rain spells, humidity, and temperature readout. This system completely is written in HTML, PHP, and Javascript, besides being integrated with SQL to ease end users to view these data over a wide variety of different platforms such as a computer, Ipad, and mobile phones.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

3.2.4 Successful Link between HQ and Remote

The overall system consisted of a central server that functioned as a center hub for collecting the incoming environmental data from the remote sensing devices. If the data does not display within the developed website, then it will go through the centralized control development all over again until the process succeeded.

3.2.5 Practical Run at Royal Belum forest

The system will be applied at Royal Belum Forest, Perak which the system will monitor the surrounding environment at the selected location choose by the researcher. The pilot test will first conduct to see whether the system developed can achieve the objective of this research. The real experimental will improve any disadvantages from the previous pilot test to capture the data precisely as the researcher wanted.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

3.2.6 Test Run

The system not only captures all the data on a single device but also possesses the ability to upload instantaneous real and accurate data every minute to be fed into the control station. This would provide the essential and crucial data that should inform us on how to manage our forests better. If the process does not serve it, purpose to collect the data. It will do the test run that is by monitoring the environmental data all over again until the data will be collect.

3.2.7 Data Collection

The data will be collected to evaluate the data obtained for further analysis. All of the data captured by the system and sent it to the user and also save it to the database. There

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

is delay about one minute that is because the sensor needs to calibrate every time to get valid data especially for hydrogen gas and also for GPS module to search the location of the system because this system used satellite coverage to obtain the location.

3.2.8 Evaluation on Data Pattern

This is the phase where the central monitoring system analyzed a vast number of data. The data that were captured will be stored in the database and then it will be displayed through developed website. Within the site, the data were divided into five sections that are the current data obtained, a graph of the temperature, humidity, and hydrogen with the locations of the system via google earth that been embedded within the website to display by its latitude and longitude.

3.2.9 Final Report

After all of the process within the flow chart has been followed. The final report that is the thesis will record all of the following information regarding this research from the gathering information until the evaluation on data pattern to provide a reference for future research or any researcher that working on similar research in remote sensing and rainforest management.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

3.3 Gantt chart of Research Activity

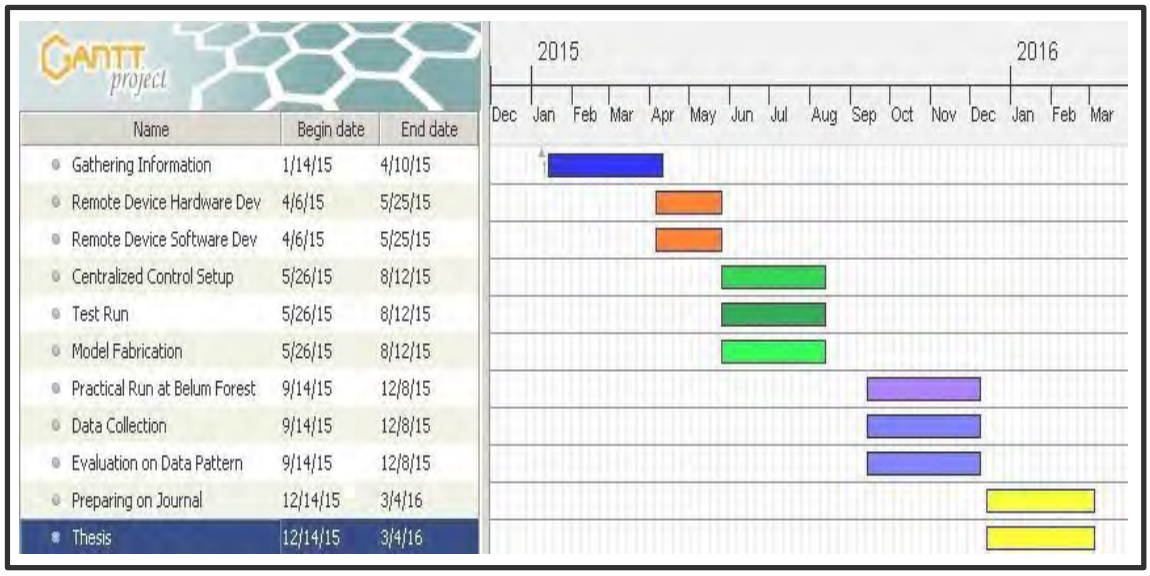


Figure 3.2. Research Gantt Chart

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

The Gantt chart as stated in **Figure 3.2** consists of the procedure to complete this research. The procedure must be followed appropriately so that the research will proceed smoothly without having trouble carrying it as stated from begin date to the end date.

3.4 Milestone and Date

- Gathering Information (2 months) February 2015
- Remote Device Development (2 and a 1/2 months) March 2015
- Centralized Control (6 months) June 2015
- Practical run (3 months) December 2015

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

- Thesis (March 2016)

3.5 Procedure of Data Analysis

All of the data gathered were analysed by using the combination of Statistical Package for Science Social version (SPSS 23) and AMOS program version 20 (AMOS 20). The SPSS was used to analyze Paired Sample T-Test to facilitate data clearing and checking for logical inconsistencies, while the AMOS software was used to calculate the First Order Structural Deforestation Modeling for the Effect of Environmental Data developed by researcher

3.6 Validation of Standard

This prototype had been validated to ensure that it can be used in the real world. Some actions were taken to verify its quality through the following procedure: -

1. The prototype will be tested by a staff at Forest Research Institute of Malaysia. The data of the prototype, in this case temperature and humidity, will be evaluated with existing devices at the department. After the testing had been made, the staff will validate the prototype. (This section will be answered in Chapter 6)

2. Next, the location of the prototype in terms of latitude and longitude via GPS was compared with the data obtained from Garmin Montana,

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

whereby the device could tell the location of the user handling it. The data were analyzed by looking into the precision offered by both the devices; which had been the prototype and Garmin Montana. If the data of the prototype failed to match the data from the Garmin Montana, then the prototype would be considered as a failure due to its lack of precision in terms of location. (This section will be answered in Chapter 6)

3. The prototype was displayed at exhibitions, such as ITEX or PeCIPTA, which had been organized by higher learning institutions, in order to introduce to the society what this prototype could do. This is one way to show everyone the usability of this prototype. (This section will be answered in Chapter 6)

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

3.7 Technology Acceptance Model

The effect of external variables is the theory of TAM; for example, development process, system characteristic and training as the objectives are mediated by the perceived ease of use and perceived usefulness (Venkatesh, Davis, & College, 2003). Based on TAM, the perceived ease of use will influence the perceived usefulness because when the system for use is easier, it is more useful as it is equal to each other. There are 424 journal citations in the two journal articles that introduced TAM by Institute for Scientific Information's Social Science Citation Index as of January 2000 (i.e., Saadé, R., 2005; King, W. R., 2006). In just 10 years, TAM has been widely recognized as a powerful, parsimonious and robust model for predicting user

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

acceptance. Perceived usefulness, across many TAM's empirical tests, has consistently become a strong determinant of usage intentions that has typically around 0.6 of its standardized regression coefficients. Thus, it is important to comprehend the determinants of this construct, as their effect could change over time with the increase of experience in using the system, since perceived usefulness is such a fundamental driver of usage intentions.

Meanwhile, the Technology Acceptance Model of other direct determinants of intention, known as the perceived ease of use has displayed a fewer consistent effect on intention across studies. Nevertheless, few researchers have modelled its factor (Venkatesh & Davis, 2003), where the factor of perceived usefulness has been relatively overlooked. Besides, for better understanding, the factor of perceived usefulness would enable researcher to develop organizational interventions that could improve the usage of systems and user acceptance. Therefore, TAM has become a goal of the current research through the inclusion of additional key determinants of Technology Acceptance Model, such as perceived usefulness and usage intention construct. TAM also aims to determine the effects of these factors, which could change with the increasing user experience over time with the target system.

Based on Technology Acceptance Model, the researcher tries to develop his own model that is related to the connection between variables of temperature and humidity and hydrogen gaseous, with the selected locations at the upper and lower parts of Royal Belum forest. This model aims to determine if there are significant values from both locations toward the depleted forest. If the significant is more toward the lower part of

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

the forest, then there are effects of illegal logging or tree cutting that will lead to the depleted forest.

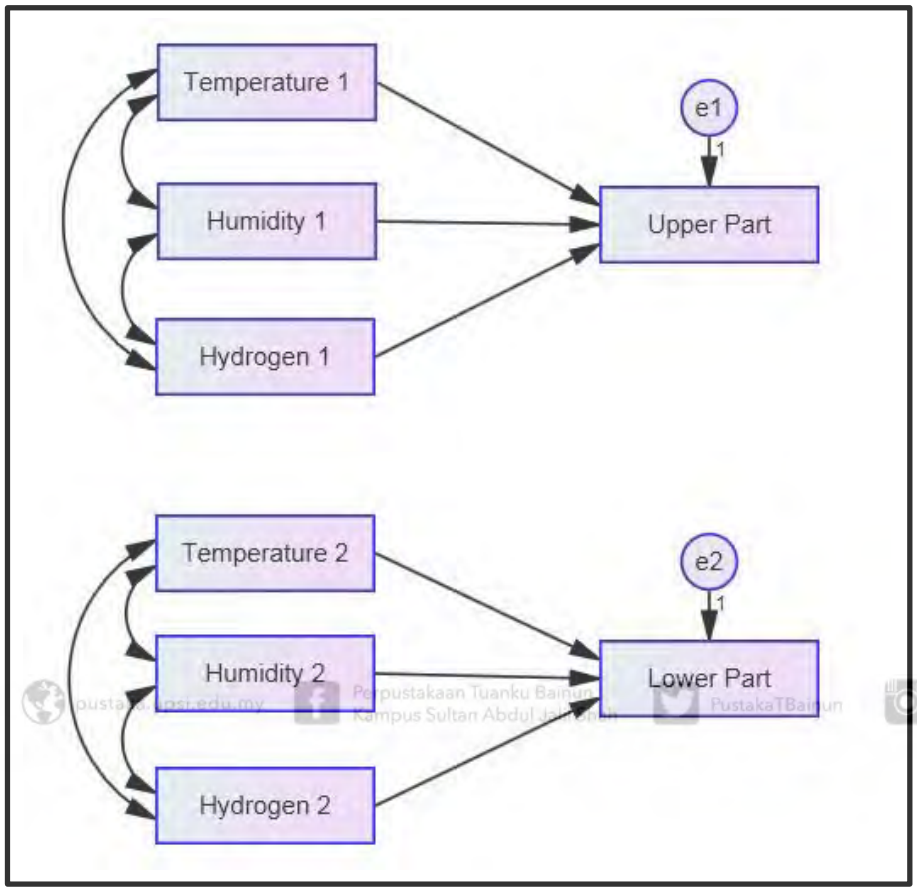


Figure 3.3. Model Developed

Figure 3.3 above shows the model that had been developed by the researcher that been refer from Technology Acceptance Model in order to get prediction of depleted forest at the upper part and lower part of the forest. Based on the figure, the main variables that were tested via AMOS software had been temperature, humidity, and hydrogen; which were analyzed to determine the variables that had a relationship with both the upper and the lower parts of the Royal Belum forest. If the analyzed data

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

displayed variables that favored the lower part of the forest more, then this showed that the lower part of the forest had a relationship with the depleted forest.

Phase 1 – In phase 1, data were gathered from the upper parts (**Figure 3.4**) of the Royal Belum forest. The system developed will be implemented at the lower part to capture the environmental data and transmitted it to the user via GSM module and also sent to the database in near-real time for further analysis

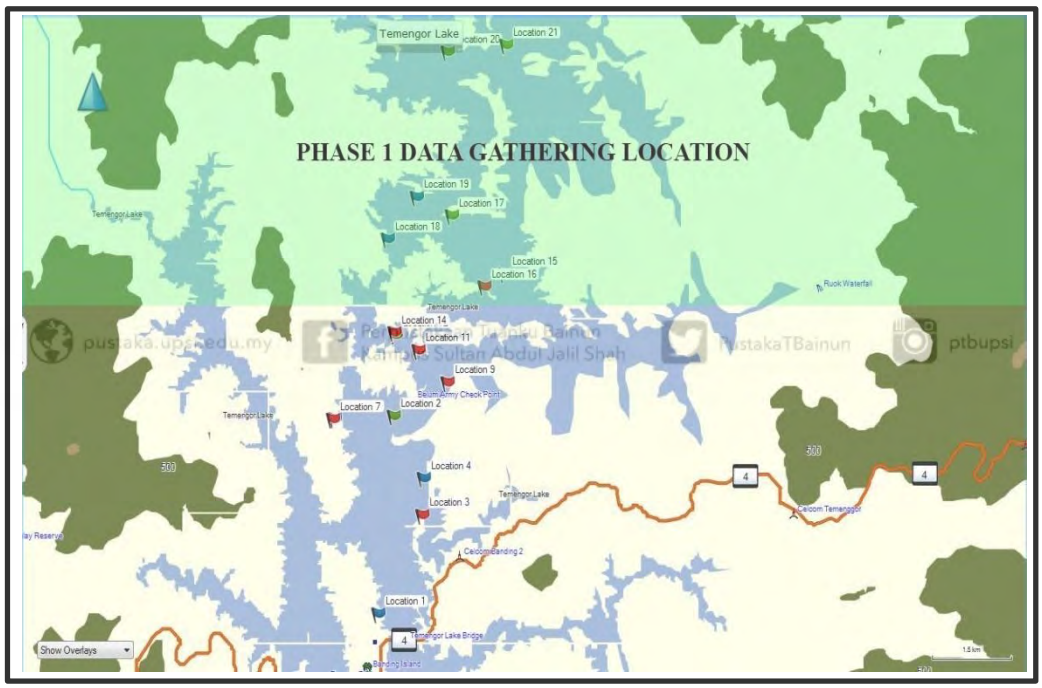


Figure 3.4. Upper Part Location of Royal Belum Forest

Phase 2 – In phase 2, the data were gathered from the lower parts (**Figure 3.5**) of the Royal Belum forest. The system developed will be implemented at the lower part to capture the environmental data and transmitted it to the user via GSM module and also sent to the database in near-real time for further analysis.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

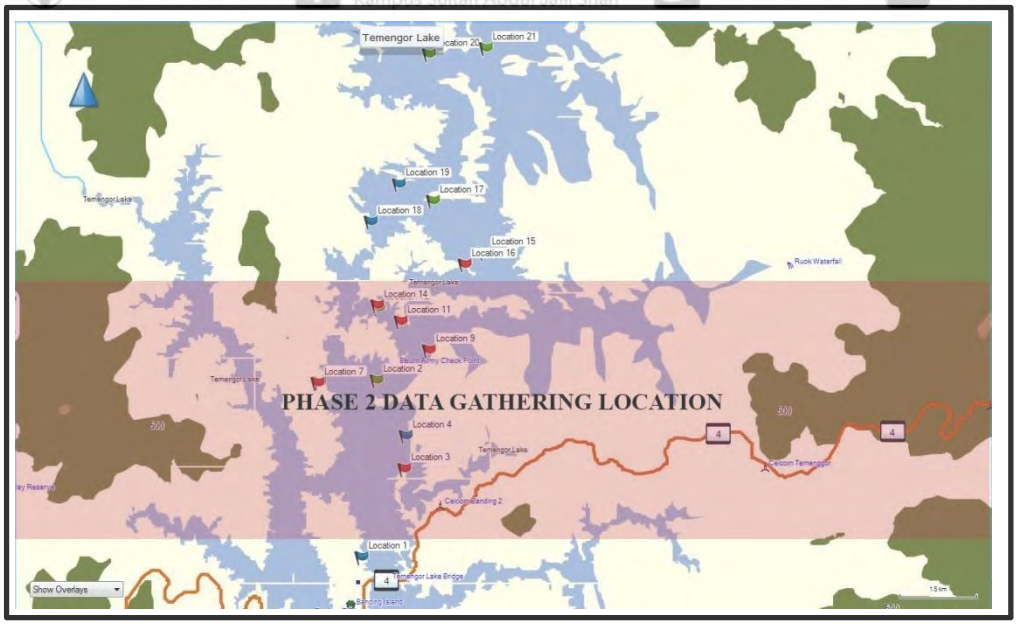


Figure 3.5. Lower Part Location of Royal Belum Forest

All the data that had been gathered, such as temperature, humidity, gaseous, fire, rain detection, and GPS, were compared from one phase to another to determine the differences between the data obtained. After that, the three phases were further analyzed in order to detect the one that possessed the potential to be involved in deforestation. The data, such as temperature, were further examined to identify the differences by comparing them with the values that had been gathered. The higher the values, the higher its probability towards illegal logging.

3.8 Conclusion

This chapter discusses the research methodology that had been used in this study. It includes the division of methods; flow chart of the research; the procedure for data analysis that had been carried out simply by using SPSS and AMOS; validation of

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

standard means as the prototype was tested first by an expert in the related field, in this case the researcher had sought the staff from the Forest Research Institute of Malaysia to get their validation, Garmin Montana been used to get the validation by comparing the device and the system developed which ensured that the data collected by the prototype reflected the data gathered from the device and also by attending any exhibitions related to product development in order to introduce to visitor about this prototype and what can it do, suggestions can be obtained in order to improve the prototype for further research in the future; employment of Technology Acceptance Model (TAM) to develop model to get prediction of the prototype by comparing the data obtained from upper part and lower part; hardware and software that were used to determine the quality of the prototype.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

CHAPTER 4

DEVELOPMENT

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4.1 Introduction

This chapter presents the development as an important element for building a system or prototype. Therefore, the appropriate modeling must be chosen first. This phase is required to ensure that the system had been developed by implementing it on track based on the proposed schedule. Furthermore, the instructional design is necessary to a developer to make some enhancements if any error is detected within the system.

The rapid prototyping model of the design process is described in this chapter, including the development of code that had been used, the hardware and software involved in the development of the device, as well as the conclusion of this chapter.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4.2 Rapid Prototyping Modeling

Rapid Prototyping is an alternate approach to the traditional instructional design. A prototype is an early phase of a system that shares similar key feature components of the "real" thing. Besides, the ID technology allows greater flexibility in defining the goals and in forming instruction at early stages (Wilson & Cole, 1993). Moreover, designers may opt to use Rapid Instructional Design (or Rapid Prototyping) when the following pose as factors

When an instructional design is incorporated with these requirements, the rapid prototyping modelling methodologies can be applied. It should reduce production time because: (a) using working models of the final product early in a project tends to eliminate time-consuming revisions later on, and (b) design tasks are completed concurrently, rather than sequentially throughout the project." (Jones & Richey, 2000). By implementing Rapid prototyping modelling, phases are combined altogether to reduce the amount of time required to develop an end product or a training. In addition, the drafts of the blueprint and development process are done concurrently, while the determinative evaluation is completed during the process.

Advantages of Prototyping

1. Users actively participate

2. Users will be allow to change their mind in specifying requirements

3. The system that been developed will make the user understand it better.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4. Earlier error or bug detection

5. User will be promotes to communicate

6. Final production can used the prototype

7. Developed application take less time needed compared to the Waterfall method

Disadvantages of Prototyping

1. Major system rewrites will be the cause of constantly redefining project requirements

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

2. As the scope of the system expands, the system will have a potential to increased complexity

3. The prototype will make the user believe as the working version

4. The complexity of implementation compromises will increased due to application fixes and updates been applied.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

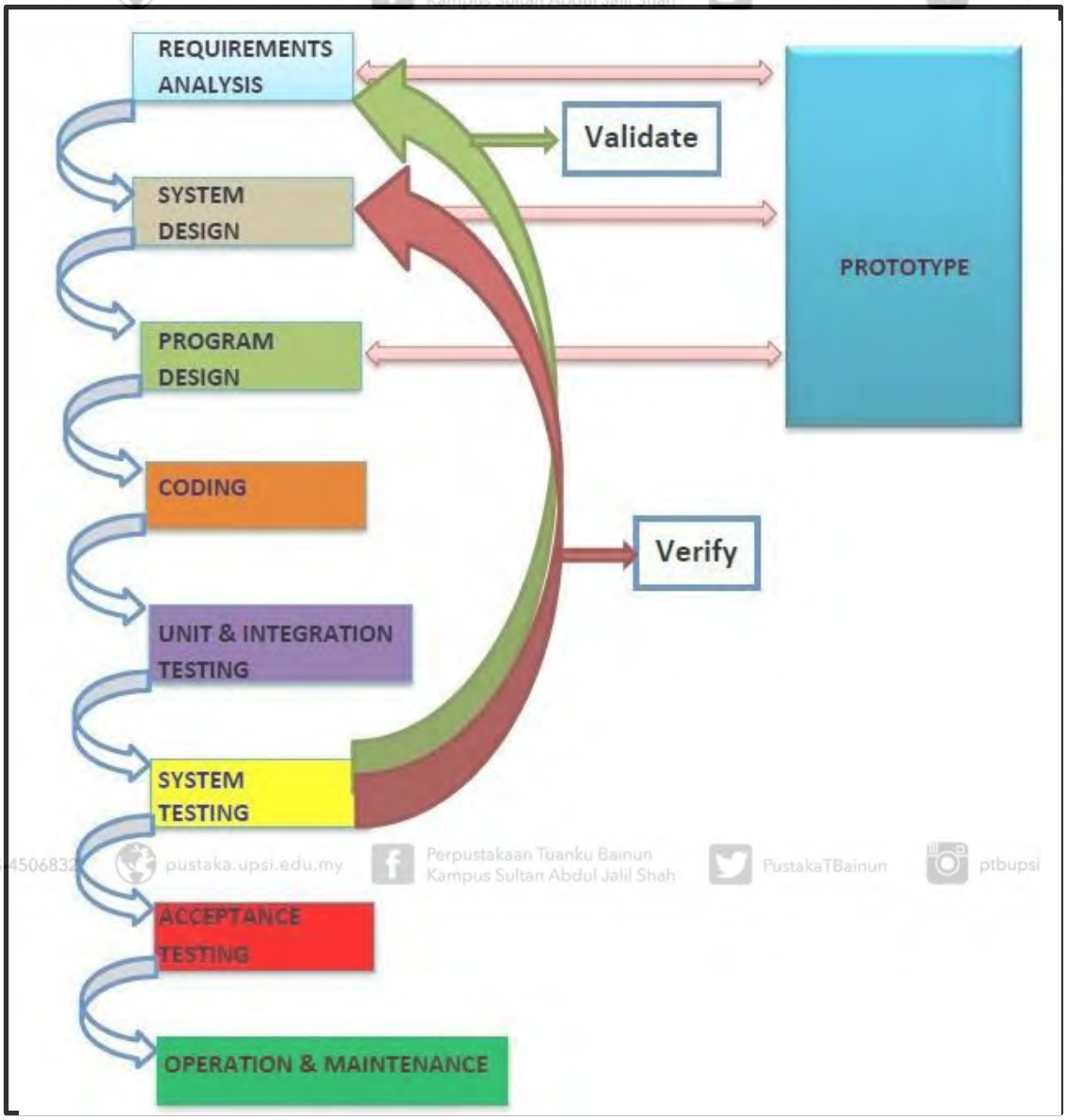


Figure 4.1. Rapid Prototyping Modeling

In the diagram (**Figure 4.1**), the square shapes represent stages in progress while the square with validation and verification represents stages reached or outputs. The first design activity is the requirement analysis of the problem and it ends with evaluation as the process begins with an initial statement of a need.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4.3 ACRSS Development Modeling

This study experimented and developed an automated multifunctional remote monitoring model for a sustainable forest management. Thus, a number of steps had been taken to achieve the objectives outlined in this study. Some of the identified methods that had been undertaken in this research are depicted in the next sections.

4.4 Requirement Analysis and Definition

To developed and determine if the project is even achievable will be the focuses of this phase to define the requirements for a project. The obligations are gathered by the current system and the functionality in correlation with the desires and the needs of the end users. This phase desire output is a set of specific requirements that are to be deployed and designed in the subsequent stages. This phase is used to clarify if any value by completed project will be gained.

4.5 System Design

The primary aims of this phase are on the system's actual architectural design and how it will communicate within itself and with other current applications. The level of this project should be at high level so that the decision made by the implementation phase will influence the actual implementation details. Nonetheless, decisions of major environments such as platform and hardware are decided in this phase. In addition, the aims of this phase are to design a system level of an application within those interfaces,

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

classes and interactions defined. Furthermore, decisions that are related to distributions, scalability and reliability should also be counted for all decisions. This phase's desired output will be a functional design document that clarifies all decisions of the architecture that has been made in regard to the project as well as class and sequence diagrams.

4.5.1 System Model

Figure 4.2 illustrates the overall system model that is implemented in this research. The system was developed in a four-stage model consisting of data acquisition, data communication, data presentation and alert notification. The hardware used in this research was Arduino Uno, Adafruit Ultimate GPS logger, and GSM/GPS/GPR Shield V3 to gather data concerning temperature, humidity, gaseous, fire and rain detection by monitoring their activities, which had been equipped with a SIM card to send SMS alerts, as well as a mobile phone to receive the SMS alert messagesIt is to fulfill the gap from another researcher like research previously been done by Sidek et al. (2014) which only have a temperature, humidity, and carbon dioxide as well as oxygen gas. The improvement that was added to this system is that the gaseous that the ACRSS system can detect are hydrogen, carbon monoxide, LPG, and smoke. It was also included with fire and rain detection. Furthermore, research conducted by both Kirubaharan et al. (2014) which implement temperature, humidity, fire detection with GSM and GPS system as well as research conducted by Lozano (2013) while Nirvika et al. (2014) only included temperature, humidity and gaseous but not GPS. As for software, Coolterm, Garmin Base Camp, and Arduino Software Serial via UART had been employed as they

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

possess the ability to alter the input data from volts to suitable reading in Celsius, humidity reading in percentage, and gaseous in part per million (PPM).

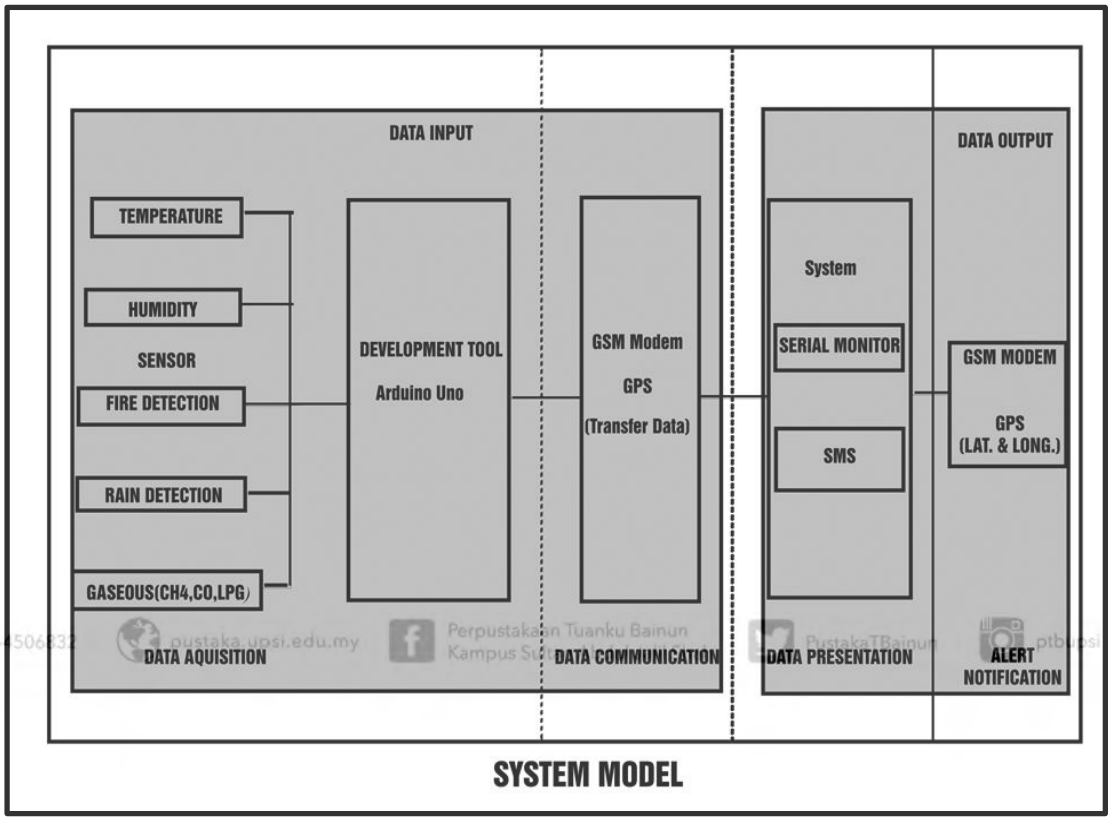


Figure 4.2. System Model

4.5.2 System Architecture

Figure 4.3 displays the proposed system architecture of the research. Temperature, humidity, gaseous, fire and rain data were obtained by the wireless sensor, in which all data were transmitted to the access point at the mobile phone. Thereafter, these data were propagated to the system control panel. The data were extracted, recorded into the database and scaled by value of threshold that had been set by user. When the data

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

topped the value of the threshold, an alert SMS would be triggered and sent from the cellular network via the GSM modem to the user's mobile phone.

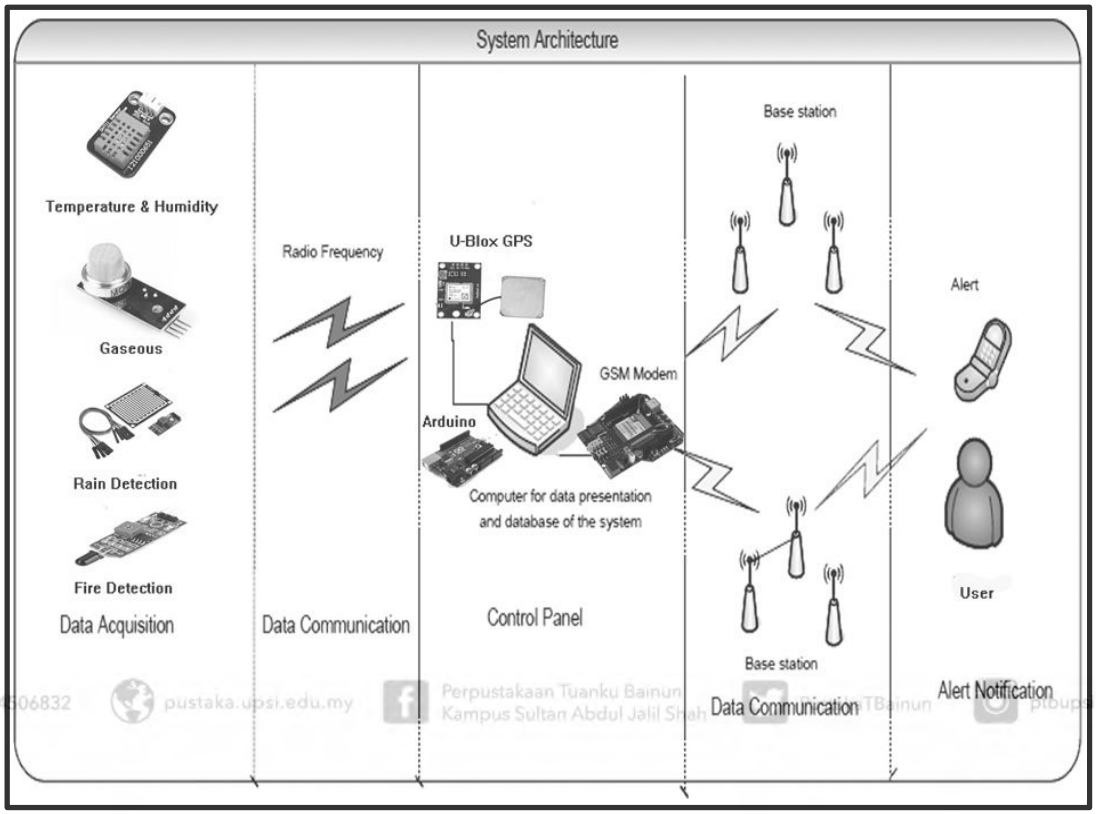


Figure 4.3. System Architecture

4.5.3 Hardware

1. Arduino

The Arduino Uno R3 is a microcontroller board based on the Atmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

or power it with an AC-to-DC adapter or battery to get started. The Arduino Uno can be powered via USB connection or with an external power supply. The power source is selected automatically. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Meanwhile, leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If more than 12V is used, the voltage regulator may overheat and damage the board. The recommended range, therefore, is 7 to 12 volts. This microcontroller has been selected after comparison been done especially an excellent compatibility with shield as stated in **Table 4.1** and **Table 4.2.**

05-4506832 Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi



Figure 4.4. Arduino Uno

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 4.1

Arduino Technical Comparison

	Processor	Processor Voltage	Supply Voltage	Flash	SRAM	Digital I/O Pin	PMW Pins	Analog Inputs	Hardware Serial Ports	Dimensions	Shield Compability
Uno	16MHz Atmega 328	5v	7-12v	32Kb	2Kb	14	6	6	1	2.1"x2.7" 53x75mm	Excellent (most will work)
Uno Ethernet	16MHz Atmega 328	5v	7-12v	32Kb	2Kb	14	6	6	1	2.1"x2.7" 53x75mm	Very Good (some pin conflicts)
Mega	16MHz Atmega 2560	5v	7-12v	256Kb	8Kb	54	14	16	4	2.1"x4" 53x102mm	Good (some pinout differences)
Mega ADK	16MHz Atmega 2560	5v	7-12v	256Kb	8Kb	54	14	16	4	2.1"x4" 53x102mm	Good (some pinout differences)
Leonardo	16MHz Atmega 32U4	5v	7-12v	32Kb	2.5Kb	20*	7	12*	1	2.1"x2.7" 53x75mm	Fair (many Pinout Differences)
Due	84MHz ARM SAM3X8E	3.3v	7-12v	512Kb	96Kb	54	12	12	4	2.1"x4" 53x102mm	Poor (voltage pinout differences)

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 4.2

Arduino Technical Comparison (Continued from Table 4.1)

	Processor	Processor Voltage	Supply Voltage	Flash	SRAM	Digital I/O Pin	PMW Pins	Analog Inputs	Hardware Serial Ports	Dimensions	Shield Compability
Micro	16MHz Atmega 32U4 5v	5v	5v	32Kb	2.5Kb	20*	7	12*	1	0.7"x1.9" 18x49mm	N/A
Flora	8MHz Atmega 32U4 3.3v	3.3v	3.5-16v	32Kb	2.5Kb	8*	4	4*	1	1.75" dia 44.5mm dia	N/A
DC Boarduino	16MHz Atmega 5v 328	5v	7-12v	32Kb	2Kb	14	6	6	1	0.8"x3" 20.5x76mm	N/A
USB Boarduino	16MHzAtmega 5v 328	5v	5v (USB)	32Kb	2Kb	14	6	6	1	0.8"x3" 20.5x76mm	N/A
Menta	16MHz Atmega 5v 328	5v	7-12v	32Kb	2Kb	14	6	6	1	0.8"x3" 20.5x76mm	Excellent (most will work)

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

2. DHT 11 Temperature and Humidity Sensor

The features a temperature & humidity sensor are rather complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, high reliability and excellent long-term stability are ensured. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability, and cost-effectiveness. Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programs in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes the system integration quick and easy. Its small size, low power consumption, and up-to-20 meter signal transmission makes it the best choice for various applications, including those most demanding ones. The component is a 4-pin single row pin package. Moreover, it is convenient to connect and special packages can be provided according to users' request. This sensor been choose because of its absolute accuracy and long term stability compare to other sensor as displayed in **Table 4.3** below.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi



Figure 4.5. DHT 11 Temperature and Humidity Sensor

Table 4.3

Temperature and Humidity Technical Comparison

	AM2302 / DHT22	DHT11	SHT71
Range	0-100%	20-90%	0-100%
Absolute accuracy	±2%	±5%	±3% (20<RH<80) ±5% (RH<20, RH>80)
Repeatability	±1%	±1%	±0.1%
Long term stability	±0.5% per year	±1% per year	<0.5% per year
Typical street price	RM60	RM20	RM200

3. Analog Gas Sensor

Generally, this sensor is used in gas leakage detecting equipment in consumer and industry markets, as this sensor is suitable for detecting LPG, i-butane, propane, methane, alcohol, hydrogen, and smoke. It has high sensitivity and fast response time and the sensitivity can be adjusted by using a

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

potentiometer. **Table 4.4** below showed why this sensor been apply compare to other gas sensor. It is important to measure the gaseous based on the range as the analog gas sensor has a constant measurement range of gas from 200ppm to 10000 ppm compare to others.



05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Figure 4.6. Analog Gas Sensor

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 4.4

Gas Sensor Technical Comparison

Gas	Measurable Gases	Range
Grove - Gas Sensor (MQ2)	CO	200 ~ 10000 ppm
	CH4	5000 ~ 20000 ppm
	Propane	200 ~ 5000 ppm
	LPG	200 ~ 5000 ppm
	Butane	3000 ~ 5000 ppm
	Smoke	200 ~ 10000 ppm
	H2	300 ~ 5000 ppm
Grove - Gas Sensor (MQ3)	CO	0.05 ~ 10 ppm
	Alcohol	0.05 ~ 10 ppm
	CH4	0.05 ~ 10 ppm
	Hexane	0.05 ~ 10 ppm
	LPG	0.05 ~ 10 ppm
	Benzine	0.05 ~ 10 ppm
Grove – Analog Gas Sensor (MQ5)	CO	200 ~ 10000 ppm
	CH4	200 ~ 10000 ppm
	LPG	200 ~ 10000 ppm
	H2	200 ~ 10000 ppm
Grove - Gas Sensor (MQ9)	CO	20 ~ 2000 ppm
	CH4	500 ~ 10000 ppm
	LPG	500 ~ 10000 ppm

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4. Rain Detection Sensor

The rain sensor module is an easy tool for rain detection. It can be used as a switch when raindrop falls through the raining board and also for measuring rainfall intensity. The module features a rain board and the control board that is separate for more convenience, power indicator LED, and adjustable sensitivity through a potentiometer. The analog output is used in detection of drops in the amount of rainfall. Connected to a 5V power supply, the LED will be turned on when the induction board has no rain drop, and DO output is high. However, when there is a little amount of water and the DO output is low, the switch indicator will be turned on. Moreover, when the water droplets are brushed off, and when restored to the initial state, high level of outputs can be obtained. This rain module choose based on the material used to develop it. It is crucial to make sure that the durability of the sensor can achieve long period usage. **Table 4.5** below display the comparison between this sensor module with others brand.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi
05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi



Figure 4.7. Rain Sensor Module

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi
05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 4.5

Rain Detection Technical Comparison

Loxone Rain Sensor 24 V	High Sensitivity water Sensor	Seed-studio Electronic Brick – Water Sensor	Rain Sensor Module
• Operating voltage 24V DC ± 20% • Current consumption about 16mA when the heater is off. • OC (PNP) output approx. 30mA at • 24V, short-circuit, active high. • Heating current about 29mA at 24V. • Ambient temperature -30°C...+70°C • Housing Plastic, polyamide. • 30% glass reinforced cable gland, quick locking screws, pure	• Working voltage: 5V • Working Current: <20ma • Interface: Analog • Width of detection: 40mm×16mm • Working Temperature: 10℃~30℃ • Weight: 3g • Size: 65mm×20mm×8mm • Arduino compatible interface • Low power consumption • High sensitivity • Output voltage signal: 0~4.2V	• Module size: 42.8mm × 20.4mm × 1.6mm • Power supply: 3.3V and 5V compatible • Connector: 3 pin Buckled Electronic Brick interface • IO: structure 2 power pins and 1 signal pin • Connectivity: Compatible with Arduino • ROHS: YES	• Adopts high quality of RF-04 double sided material. • Area: 5cm x 4cm nickel plate on side, • Anti-oxidation, anti-conductivity, with long use time; • Comparator output signal clean waveform is good, driving ability, over 15mA; • Potentiometer adjust the sensitivity; • Working voltage 5V; • Output format: Digital switching output (0 and 1) and analog voltage output AO

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

5. Fire Detection Sensor

This module is sensitive to flame and radiation. It also can detect ordinary light source in the range of a wavelength at 760nm-1100 nm. Meanwhile, the detection distance is up to 100 cm. The Flame sensor can provide output in the form of digital or analog signal. **Table 4.6** below illustrate the advantages of this sensor compare to other type of fire sensors.



Figure 4.8. Future electronic flame sensor

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 4.6

Fire Detection Sensor Technical Comparison

Future electronic flame sensor	Fire Sensor	Flame sensor SKU: DFR0076
• Detects a flame or a light source of a wavelength in the range of 760nm-1100 nm • Detection distance: 20cm (4.8V) ~ 100cm (1V) • Detection angle about 60 degrees, it is sensitive to the flame spectrum. • Comparator chip LM393 makes module readings stable. • Adjustable detection range. • Operating voltage 3.3V-5V • Digital and Analog Output • " DO digital switch outputs (0 and 1) • " AO analog voltage output • • Power indicator and digital switch output indicator	• On-board LM393 voltage comparator chip and infrared sensing probe. • Support 5V/3.3V voltage input. • On-board signal output indication, output effective signal is high level, and the same time the indicator light up, output signal can directly connect with microcontroller IO. • Signal detection sensitivity can be adjusted. • Reserved a line voltage compare circuit (P3 is leaded out). • PCB size: 30(mm) x15(mm).	• Supply Voltage: 3.3V to 5V • Detection range: 20cm (4.8V) ~ 100cm (1V) • Rang of Spectral Bandwidth : 760nm to 1100nm • Responsive time : 15us • Interface: Analog • Size:22x30mm

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

6. GPS/GPRS/GSM Module

This shield with a Quad-band GSM/GPRS engine works on frequencies EGSM 900MHz/DCS 1800MHz and GSM850 MHz/PCS 1900MHz. It also supports GPS technology for satellite navigation. Moreover, it is possible for a robot and a control system to send messages and use the GSM network. It is controlled via AT commands (GSM07.07, 07.05; and SIMCOM enhanced AT Commands). Besides, the design of this shield allows one to drive the GSM & GPS function directly with the computer and the Arduino Board. It includes a high-gain SMD antenna for GPS & GSM. This GPS/GPRS/GSM shield uses an embedded SIM908 chip from SIMCom. Featuring an industry-standard interface and GPS function, the combination of both technologies allows goods, vehicles, and people to be tracked seamlessly at any location and at anytime with signal coverage. This GSM module has been implement within the system developed because of its low power consumption compare to other modules. **Table 4.7** and **Table 4.8** show the technical specification between all of the modules.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi



Figure 4.9. GSM Module

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi
05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 4.7

GSM module Technical Comparison

GSM/GPS/GPRS SHIELD V3	SainSmart Sim900 GSM Shield for Arduino UNO, Mega	Geeetech SIMCOM SIM900 Arduino GSM / GPRS Shield Development Board	Arduino Wireless GSM – GPRS Shield from Arduino	1Sheeld GSM Shield For Arduino and Android
• Power supply: 6-12V@2A • Low power consumption (100mA@7V - GSM mode) • Quad-Band 850/900/1800/1900 MHz • GPRS multi-slot class 10	• It is completely compatible with Arduino UNO, and Arduino Mega boards • A high-quality electronics product from SainSmart which works on 2G networks • It works on all the GSM networks	• It is based on the Sim900 module from SIMCOM • It is perfectly compatible with the Arduino	• It is based on the Quad-band Sim900 module from SIMCOM • It is fully compatible with the Arduino Mega2560 development board series	• Compatible with most of the Arduino boards, including the Arduino UNO and Arduino Mega • Working on the tablets V2.3 and above and on Android Smartphones

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 4.8

GSM module Technical Comparison (Continued from Table 4.7)

GSM/GPS/GPRS SHIELD V3	SainSmart Sim900 GSM Shield for Arduino UNO, Mega	Geeetech SIMCOM SIM900 Arduino GSM / GPRS Shield Development Board	Arduino Wireless GSM – GPRS Shield from Arduino	1Sheeld GSM Shield For Arduino and Android
• Embeded high-gain SMD antennas for GPS & GSM • Directly support 4*4 button pad • USB/Arduino control switch • Board Surface:Immersion Gold • Size: 81x70mm	• The Embedded TCP/UDP stack allows uploading your data to a web server • The shield also has 12 GPIOs, an ADC, and 2 PWMs • It consumes low power – nearly to 1.5mA	• The Quad-band 1900/ 1800/ 900/ 850 MHz works on all the GSM networks across the world • It allows to achieve GPRS, SMS	• It is an SIM application toolkit • It has a supply voltage range of 3.1V to 4.8V	• shields, input/output shields and social media shields • Allowing you to experience over 40 Arduino shields on your Android smartphone • Using a standard HC-06 2.1 Bluetooth Adapter

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

7. Adafruit Ultimate GPS Logger Shield

This GPS shield works great with either UNO or Leonardo Arduinos and it is designed to log data onto an SD card. On the other hand, one can leave the SD card out and use the GPS for a geo-caching project, or maybe a music player that changes tunes, depending on where one is in the city. **Table 4.9** display the comparison between technical specification between this GPS module and other modules. The following point describe the advantages of this module compare to others.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

- -165 dBs sensitivity, 10 Hz updates, 66 channels
- Low power module – only 20Ma current draw, half of most GPS'
- Micro SD card slot for data logging onto a removable card
- RTC battery included, for up to 7 years of backup
- Built-in data logging to flash
- PPS output on fix
- >25Km altitude
- Internal patch antenna + u.FL connector for external active antenna
- Power, Pin #13 and Fix status LED

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

- Big prototyping area



Figure 4.10. GPS Module

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi
05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 4.9

GPS Modul Technical Comparison

GPS Receiver	Accuracy	Antenna	Baud Rate	Channels	Chipset	Maximum Update Rate
PAM-7Q GPS Module	< 2.0 meters	YES	9600bps	56	u-blox MAX-7	10Hz
GPR,GPS Quadband Module	< 2.5 meters	YES	115200bps	42	SIM908	10 Hz
GPS/GPRS/GSM ShleId V3.0	< 2.5 meters	YES	115200bps	42	SIM908	10Hz
Libelium GPS	< 2.5 meters	NO	115200bps	20	Vincotech A1080-8	10 Hz
Copernicus II DIP	< 2.5 meters	YES	115200bps	12	Trimble Trim Core	1 Hz
NavSpark-GL	2.5 meters	YES	115200bps	167	Venus 8	10 Hz
LS20031	meters 2.5	YES	57600bps	66	MT3339 MTK	10Hz
Arduino GPS Shield	2.5 rneters	NO	9600bps	65	Venus	10 Hz
Venus GPS	2.5 rneters	YES	115200bps	65	Venus638FLPx	10Hz
EM-506	2.5 rneters	YES	4800bps	48	SIRF Star IV	20 Hz
Adafruit Ultimate GPS Logger ShleId	< 3.0 meters	YES	9600bps	66	MT3339	10 Hz

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

8. Solar Panel

Solar panels harness the energy from sun in the form of light and convert the energy into electricity. Although the average consumer might associate solar panels with residential rooftop assemblies, solar panels are available for a wide range of applications, including powering individual gadgets, electronic devices, and vehicle batteries.

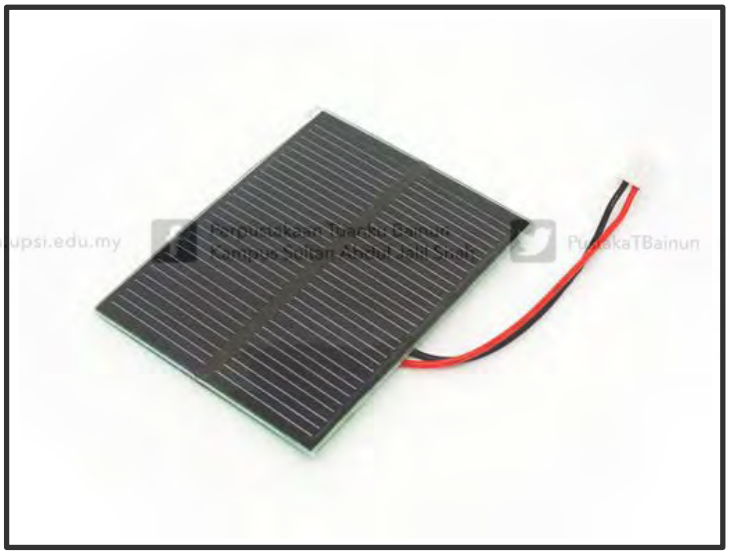


Figure 4.11. Solar Panel with JST pin

9. Lithium Polymer Battery

This is a light weight, high energy density Lithium Ion polymer battery. It outputs a nominal 3.7v at 2000mAh, comes terminated with a standard 2-pin JST connector and 2.0 mm spacing between the pins.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi



Figure 4.12. Lithium Polymer Battery

4.6 Software Design

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

The primary focus of this phase is to refine the decisions that had been discovered in the functional design document. Interface and interactions were obtained from previous indicated classes and interfaces that separated them into two parts of logical module. This phase's output is a formal design document.

4.6.1 Arduino SoftwareSerial

The Arduino development environment contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. It connects to the Arduino hardware to upload programs and to communicate with them. Software written by using Arduino is called sketches (**Figure 4.13**). These sketches are written in the text editor. The sketches are saved in the file extension .ino.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

It has features for cutting/pasting and for searching/replacing texts. The message area provides feedback while saving and exporting and also displays errors. The console displays text generated by the Arduino environment, including complete error messages and other information. The bottom right-hand corner of the window displays the current board and the serial port. Meanwhile, the toolbar buttons allow one to verify and upload programs, besides creating, opening, and saving sketches, as well as opening the serial monitor.

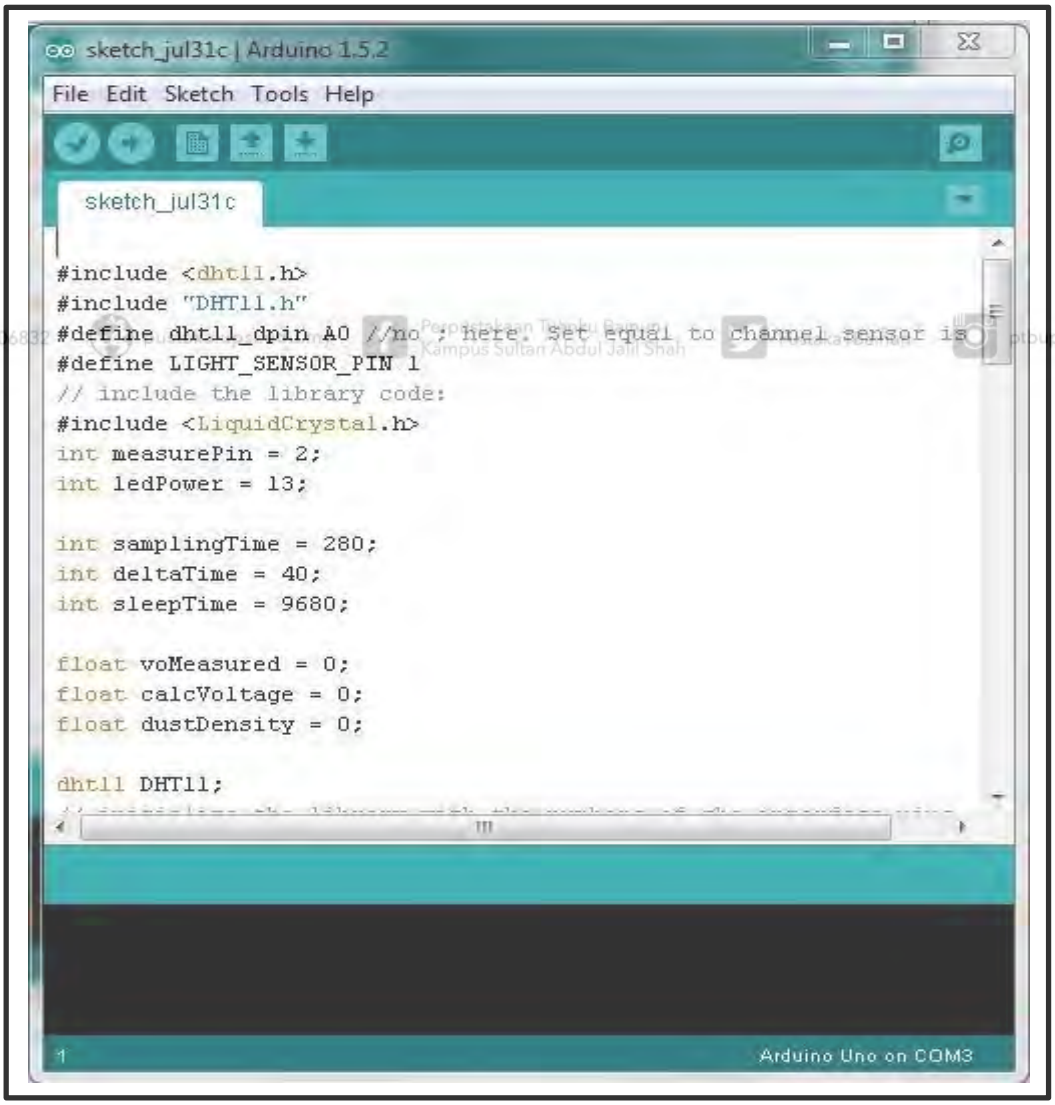


Figure 4.13. Arduino Software-Serial

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4.6.2 Garmin Base-Camp

Base Camp is a 3D (**Figure 4.14**) mapping application that allows one to transfer Garmin Custom Maps, BirdsEye Imagery, waypoints, tracks, and routes between Mac and Garmin device. It also allows one to manage the data on practically all Garmin map products, but topographic maps require 3-D rendering

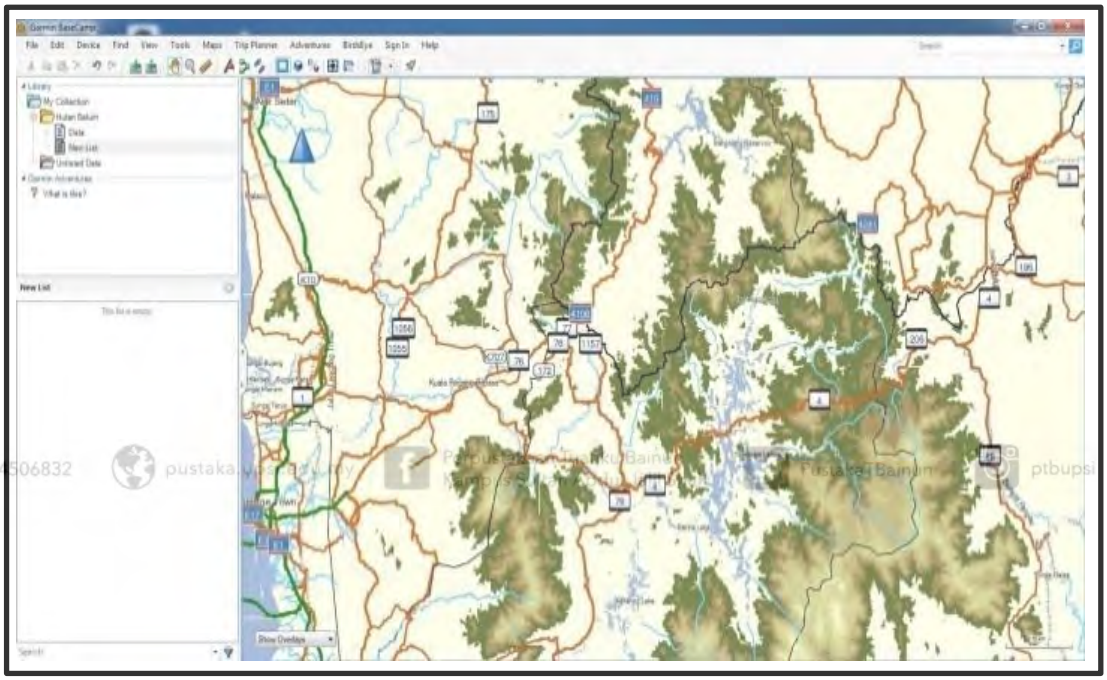


Figure 4.14. Garmin Base-Camp

4.7 Implementation/Coding

A flowchart is a type of diagram that exemplifies a workflow, an algorithm, process, present the idea by showing it within various kinds of boxes and linking them with arrows in order. It represents clarification model illustration to the problem that was given as demonstrated in the diagram. **Figure 4.15** below illustrate the codes that been developed by the researcher; the input consists all of the environmental data that need to observe such as temperature and humidity. The input then will be assign to the

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

controller that is the Arduino. The Arduino will process all of the input data before sending it to the GSM module. If the data does not obtain by the microcontroller, the procedure will repeat until the microcontroller can process the data. While the Arduino sends the data to the GSM, the GPS will pinpoint the location of the system and link it with the data that currently on the way to the GSM. If there are no GPS location displayed through the SMS, then the process will go all over again until the site of the system will synchronize with the input data. The final process consists of all of the data been stored in the database which finally display it through the developed website. The data will be analyzed separately to evaluate the pattern of the environmental data.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

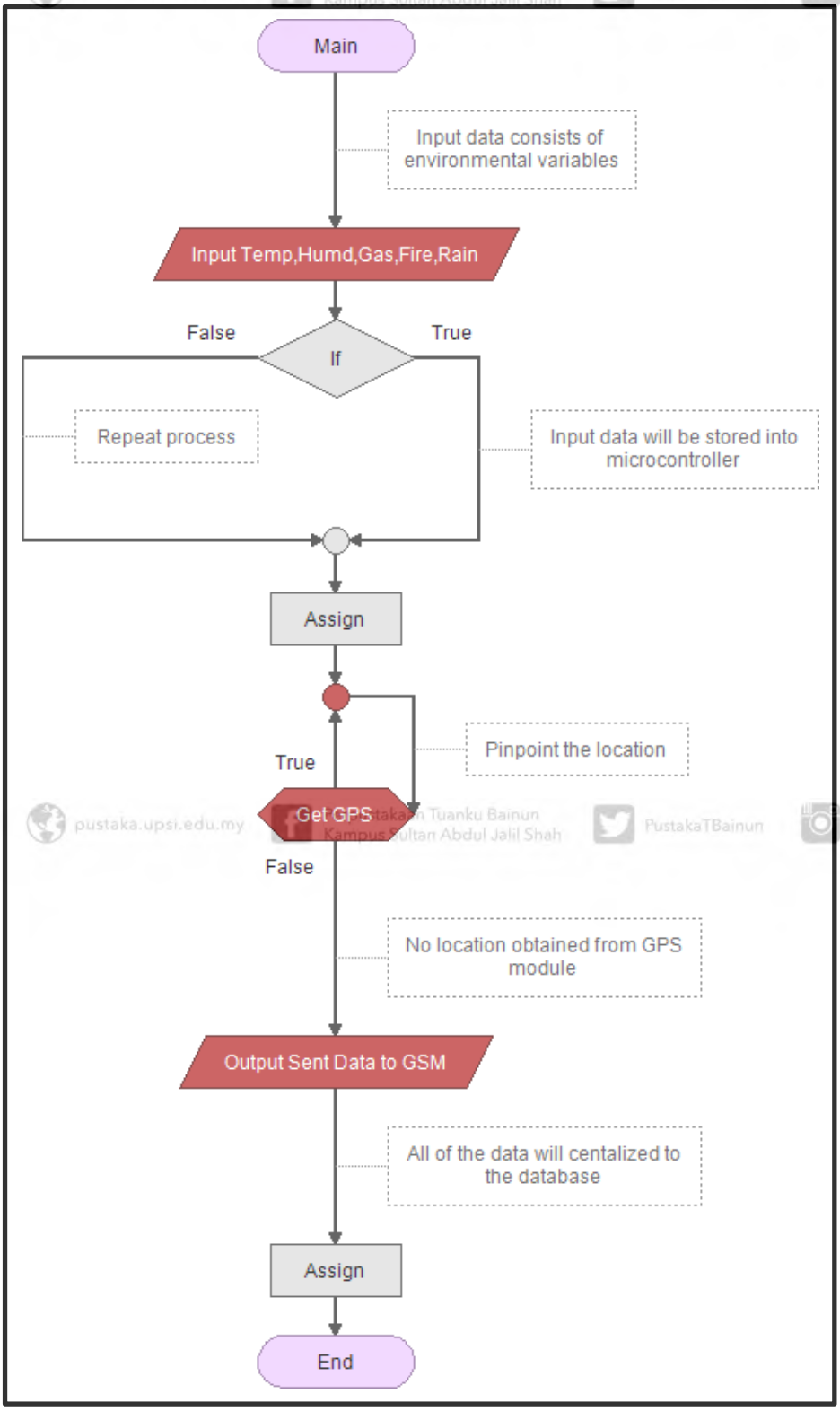


Figure 4.15. Flow Chart of the Coding

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4.8 Software Integration and Verification

The main focus of this phase is to test each unit of previously developed codes as well as to test the overall system. Besides, this phase is the basic type of testing that includes unit test and integration test. Testing the functionality of the code unit is the reason Unit Test was developed, where it aims to make sure that it performs its required task. On the other hand, the system will be tested as an overall for Integration testing since it only focuses on the results of specific unit combinations of code and therefore, expected results will be validated

4.8.1 Unit Test

The code for the prototype will be tested first before it can be implemented toward the end-prototype. The reason is to make sure that the code can be fully functional any error or debug can be corrected first and made sure that the code for sensor such as MQ-5 can achieve calibration that the researcher needed. **Figure 4.16** shows the results from code testing for DHT11 sensor using Arduino Serial Monitor. **Figure 4.17** portrays the schematic for the sensor before it will be connected to each other, while **Figure 4.18** illustrates the implementation of the coding to the sensor that has been connected to LCD for measurement readings of temperature and humidity.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

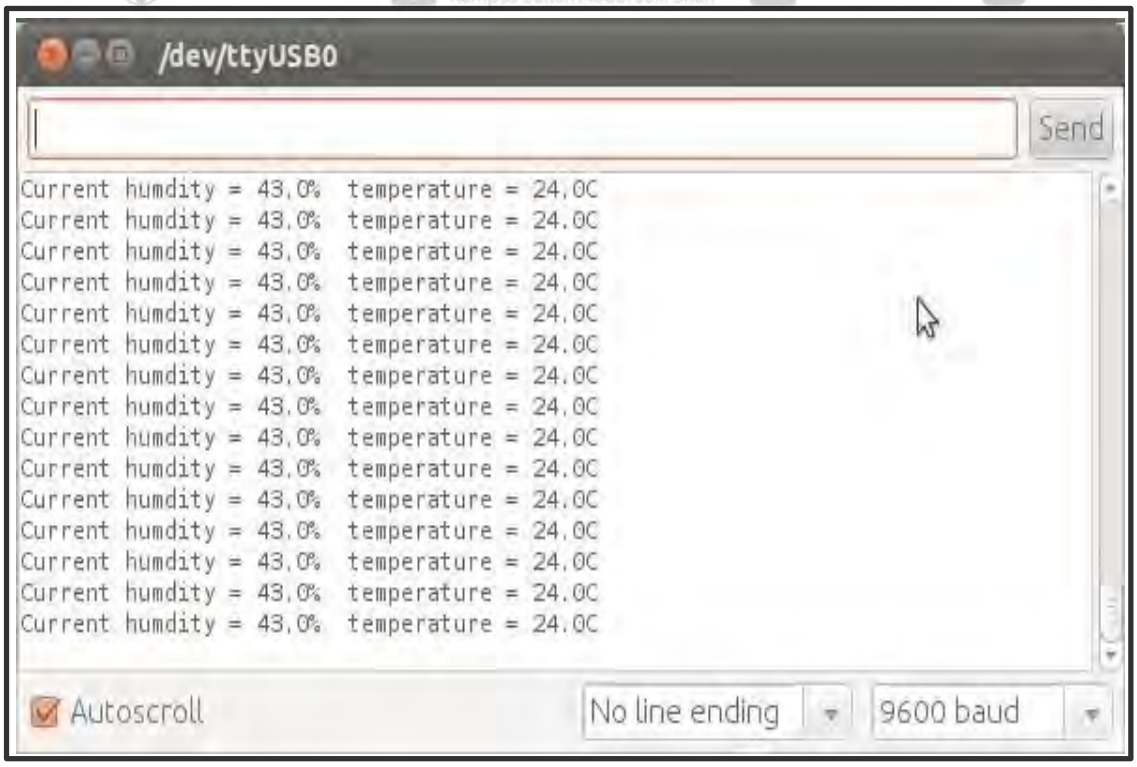


Figure 4.16. Temperature and Humidity code testing

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

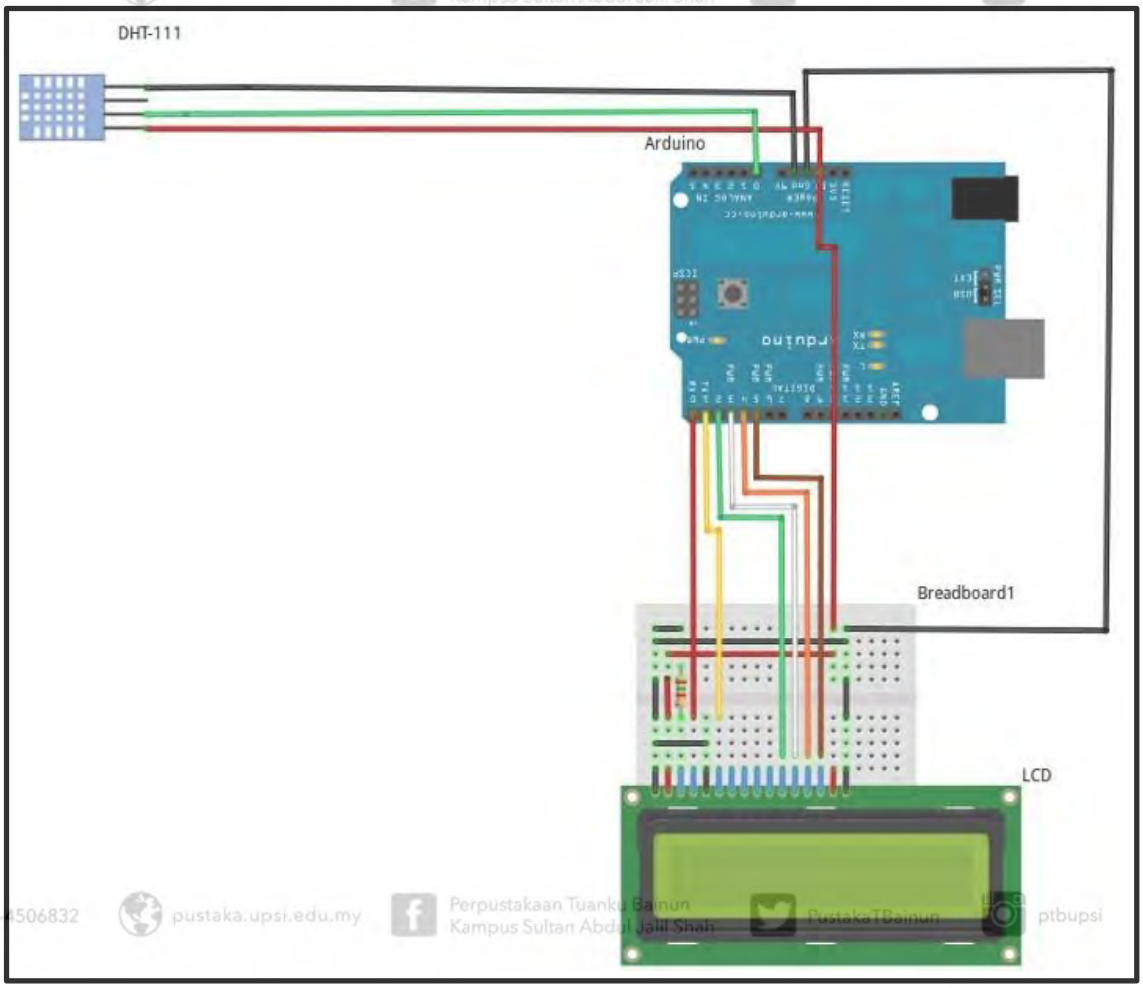


Figure 4.17. Schematic for DHT11 sensor and LCD

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

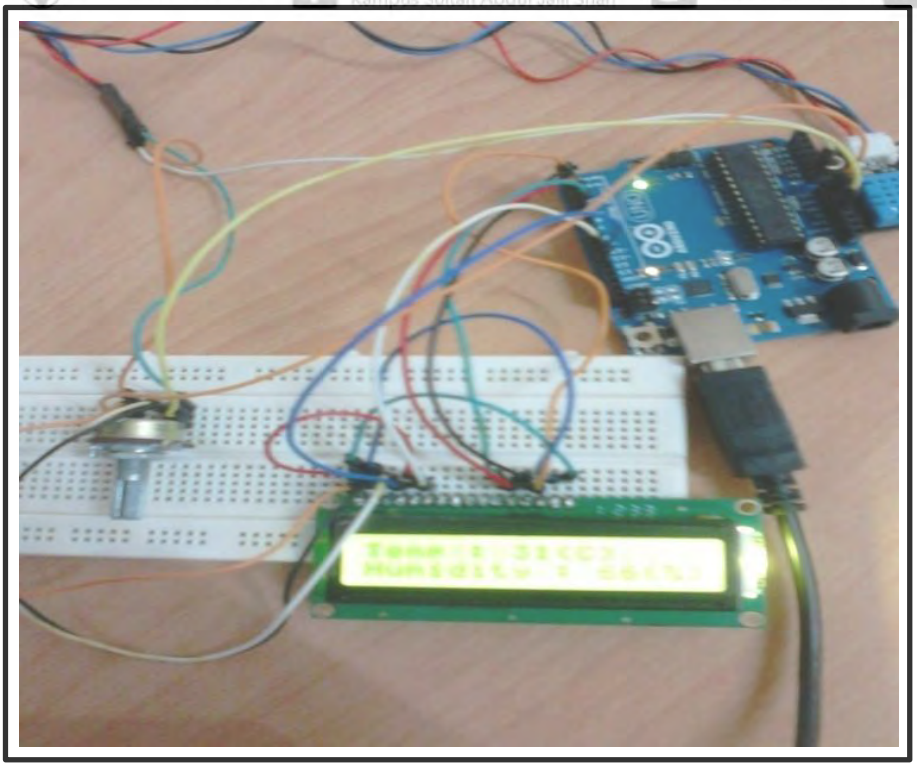


Figure 4.18. Unit Test for DHT11 sensor readings

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4.8.2 Unit Integration

Figure 4.19 shows the main interface of the prototype website, in which the data that has been collected will be sent here for display. This website uses HTML, CSS and most importantly a database developed using PHP and synchronized with SMS enabler and Arduino Ethernet.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

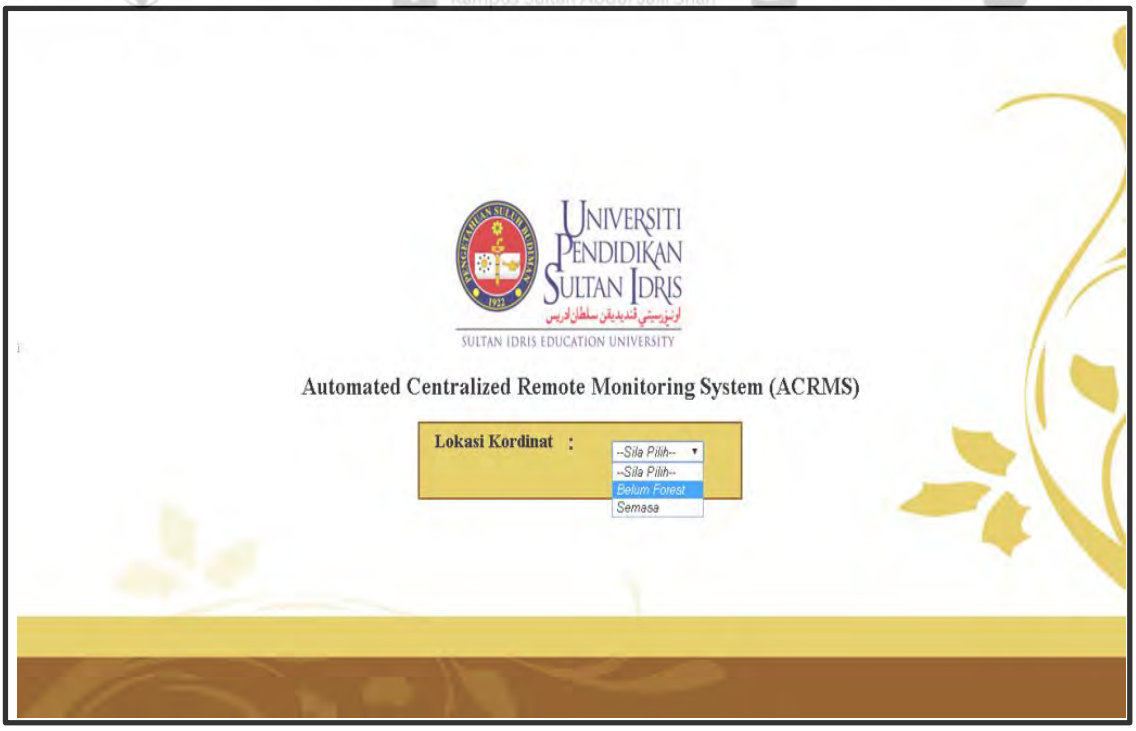


Figure 4.19. Main Page of ACRSS

4.9 System Verification

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

This phase mainly focuses on testing the overall system in relation to the list of desired operating environments and project requirements. **Figures 4.20, 4.21** and **4.22** are the final prototypes developed, which was presented at the exhibition for validation on December 2015.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi



Figure 4.20. Side View of ACRSS



Figure 4.21. Front View of ACRSS

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi



Figure 4.22. Top View of ACRSS

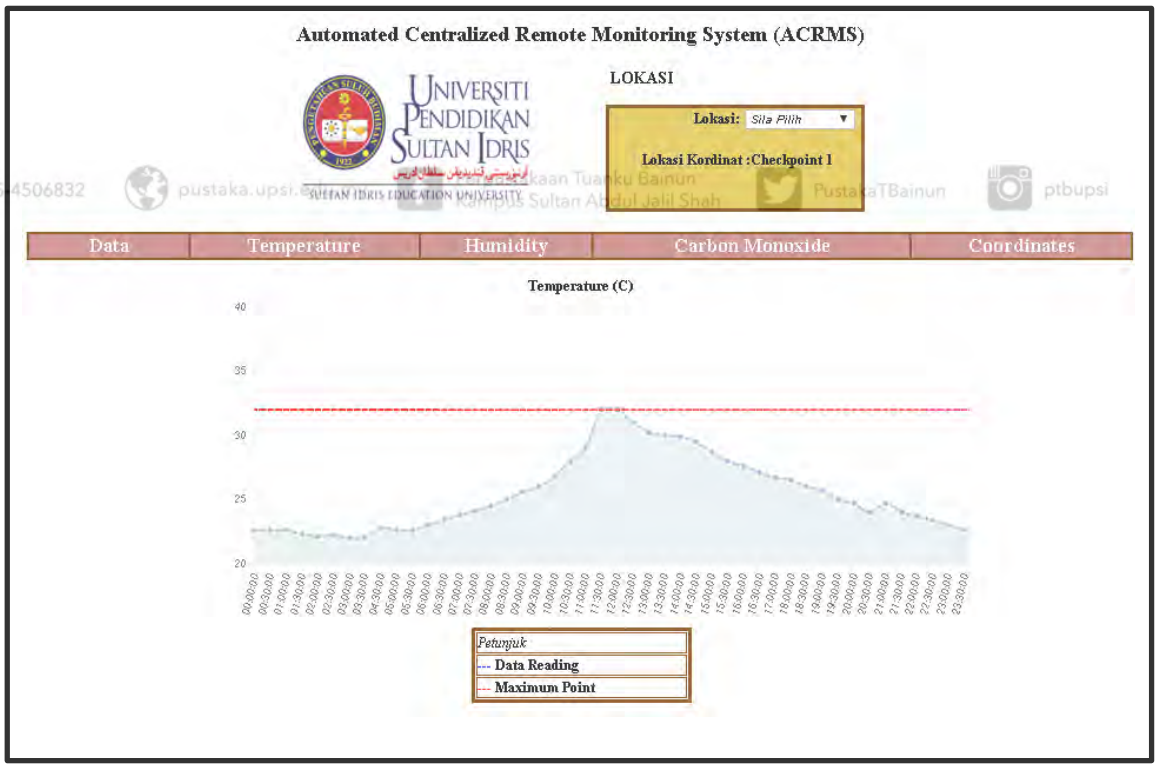


Figure 4.23. Temperature Data Interface

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Figure 4.23 shows the main interface of the ACRSS temperature graph. The data is converted into a graph to see the comparison of the measurement reading in 24 hours.

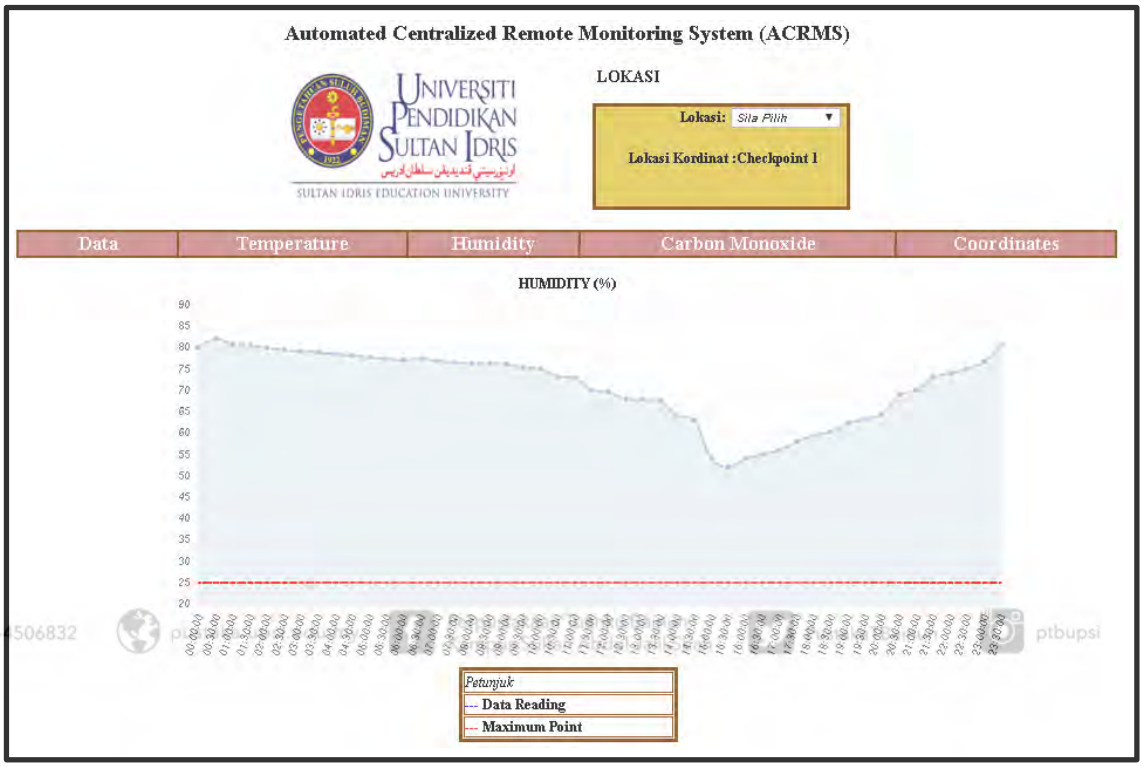


Figure 4.24. Humidity Data Interface

Figure 4.24 shows the main interface of the ACRSS humidity graph. The data is converted into a graph to see the comparison of the measurement reading in 24 hours.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

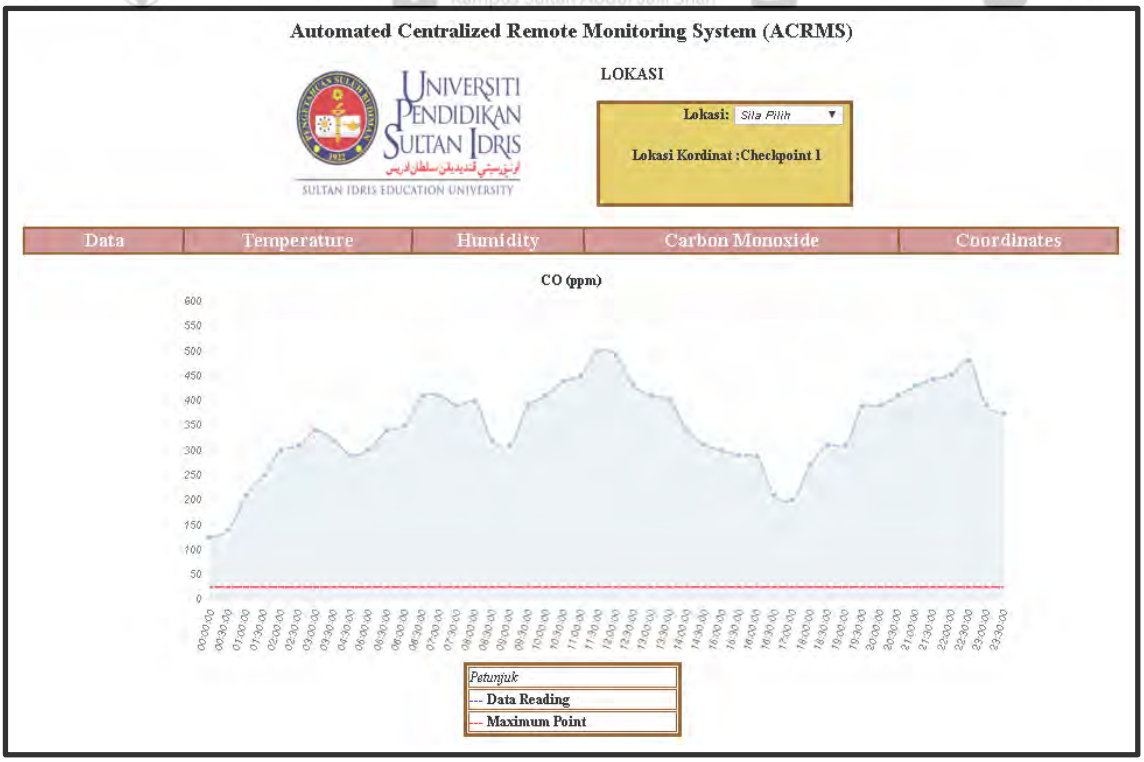


Figure 4.25. Gaseous Data Interface

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Figure 4.25 shows the main interface of the ACRSS gaseous graph. The data is converted into a graph to see the comparison of the measurement reading in 24 hours.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi



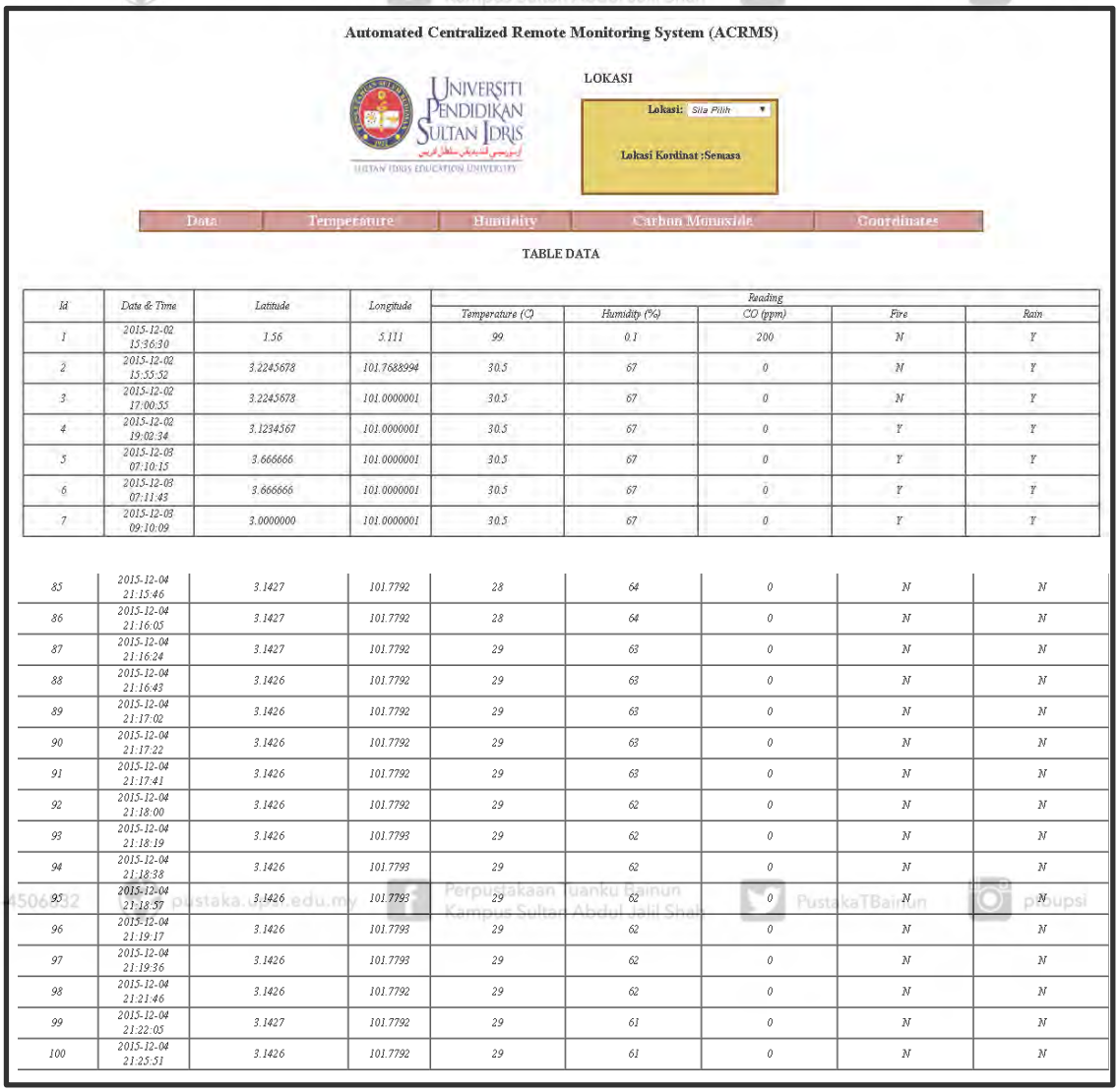
Figure 4.26. GPS Coordination Data

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Figure 4.26 shows the main interface of ACRSS-GPS latitude and longitude coordination. The coordination is displayed according to the locations captured by the prototype via satellite. This is followed by **Figure 4.27** showing the main interface of ACRSS data collections. The data will be displayed in real-time into the table that been design. All of the data captured will be displayed in an instant after the SMS sent to the database using SMS enabler.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi



Automated Centralized Remote Monitoring System (ACRMS)

UNIVERSITI PENDIDIKAN SULTAN IDRIS

LOKASI

Lokasi: Sila Pilih

Lokasi Kordinat :Semasa

Data | Temperature | Humidity | Carbon Monoxide | Coordinates

TABLE DATA

Id	Date & Time	Latitude	Longitude	Reading				
				Temperature (C)	Humidity (%)	CO (ppm)	Fire	Rain
1	2015-12-02 15:36:30	1.56	5.111	99	0.1	200	N	Y
2	2015-12-02 15:55:52	3.2245678	101.7688994	30.5	67	0	N	Y
3	2015-12-02 17:00:55	3.2245678	101.0000001	30.5	67	0	N	Y
4	2015-12-02 19:02:34	3.1234567	101.0000001	30.5	67	0	Y	Y
5	2015-12-03 07:10:15	3.666666	101.0000001	30.5	67	0	Y	Y
6	2015-12-03 07:11:43	3.666666	101.0000001	30.5	67	0	Y	Y
7	2015-12-03 09:10:09	3.0000000	101.0000001	30.5	67	0	Y	Y
85	2015-12-04 21:15:46	3.1427	101.7792	28	64	0	N	N
86	2015-12-04 21:16:05	3.1427	101.7792	28	64	0	N	N
87	2015-12-04 21:16:24	3.1427	101.7792	29	63	0	N	N
88	2015-12-04 21:16:43	3.1426	101.7792	29	63	0	N	N
89	2015-12-04 21:17:02	3.1426	101.7792	29	63	0	N	N
90	2015-12-04 21:17:22	3.1426	101.7792	29	63	0	N	N
91	2015-12-04 21:17:41	3.1426	101.7792	29	63	0	N	N
92	2015-12-04 21:18:00	3.1426	101.7792	29	62	0	N	N
93	2015-12-04 21:18:19	3.1426	101.7793	29	62	0	N	N
94	2015-12-04 21:18:38	3.1426	101.7793	29	62	0	N	N
95	2015-12-04 21:18:57	3.1426	101.7793	29	62	0	N	N
96	2015-12-04 21:19:17	3.1426	101.7793	29	62	0	N	N
97	2015-12-04 21:19:36	3.1426	101.7793	29	62	0	N	N
98	2015-12-04 21:21:46	3.1426	101.7792	29	62	0	N	N
99	2015-12-04 21:22:05	3.1427	101.7792	29	61	0	N	N
100	2015-12-04 21:25:51	3.1426	101.7792	29	61	0	N	N

Figure 4.27. Real Time Data Capture Interface

4.10 Operation and Maintenance

The aim of this phase is to focus on testing the project that has been completed over the user so that one can prove if their specifications are met according to their original requirements. This phase is also in need of changes to be made and to validate the correctness of the requirements. Furthermore, any problems that were unresolved in the

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

previous phase are managed in this stage. Finally, **Figure 4.28** portrays the implementation of the prototype at Royal Belum forest on April 2015.



Figure 4.28. The implementation of the prototype at Royal Belum

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

4.11 Conclusion

This chapter discusses the development of the prototype based on the model that had been chosen, which is the rapid prototyping modeling. This model is crucial when developing a new technology as they can affect the user's opinion when the prototype is used. In addition, the researcher had already developed the system model and the model clearly displayed how the prototype worked. Besides, the hardware that had been used to develop the model is also introduced in this chapter. In fact, most of the hardware employed had been based on open source that is currently popular in the world of technology and thus, the researcher took this opportunity to use this technology to create new things by exploring the hardware mentioned. Furthermore, the researcher

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

generated the flow chart of the codes for the developed prototype in this chapter as a reference and to prove that the codes were not taken from another source in the websites or other works. The only element that the researcher had used was the sample code provided by other people and thus, the researcher just manipulated and created new codes to suit the hardware used. The field experiment for the prototype and method of data analysis are discussed in chapter 5.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

CHAPTER 5

DATA ANALYSIS

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

5.1 Introduction

This chapter will discuss the outcome and analysis obtained from the data gathered. A total number of 60 samples for all of the variables were received from the locations of the research. The data gathered were analyzed by using SPSS and AMOS embedded tool. This chapter mainly focuses on presenting the gathered data to facilitate the discussion in a meaningful way, which will be continued in Chapter 6. The outset from this chapter provides the background of the samples by analyzing their demographic details followed by findings and analysis of data as well as the summary. The finding and the analysis will be analyzed using Paired Sampled T-Test and Two Group MANOVA by comparing data from the upper and lower parts of Royal Belum forest in view of temperature, humidity and gaseous. Moreover, tables and diagrams are used to simplify a simplistic reader-friendly writing. Lastly, the summary ends this chapter.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

5.2 Sampling Result

The data and corresponding numeric values used in the statistical analysis can be referred in the sampling results attached in the appendix

5.3 Paired Sample T-Test Analysis

Table 5.1 below display the result for Paired Sample T-test that been analysed from SPSS using Compare Means function to see the whether the data have a significant differences between upper part and lower part of the selected locations within the forest.

Table 5.1

Paired Sample T-Test

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

	Mean(SD)			
Variables	Upper Part	Lower Part	T Statistic(df)	p value
Temperature	29.9(1.647)	32.7(1.873)	9.226(29)	0.000
Humidity	56.9(1.489)	46.6(1.652)	23.434(29)	0.000
Hydrogen	23(3.66)	22.5(3.648)	6.530(29)	0.660

The information in Paired Sample Test from **Table 5.1** refers to the differences between both temperatures 1 and 2. This means that the table column is been labelled "Mean", Std.Deviation", "Std.Error Mean", with "95% Confidence Interval of Difference". The last 3 columns explains the results of T-test paired sample namely t-value, degree of freedom and significance level.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

The result from non-parametric analysis for one sample test stated that the distribution of Upper Part Temperature is normal with mean 29.9°c and standard deviation 1.647 while the distribution of Lower Part Temperature is normal with mean 32.7°c and standard deviation 1.873. In this case, the t-value (29) = -4.462 and *p* value (0.000) < 0.05. The results of this paired sample t-test show that the null hypothesis is rejected as there are no significant differences between mean of temperature. However, researcher can accept the research/alternative hypothesis that there is a significant difference for mean of temperature 1 (upper part of Royal Belum forest) and temperature 2 (lower part of Royal Belum forest). This simply indicates that the temperature at the lower part (32.7°c) is higher than the temperature at the upper part (29.9°c), probably because it has been exposed to the sun more than the upper part of the forest and there is no tree canopy to reduce the sunlight from it. **Figure 5.1** is the graph comparison between temperature at upper and lower part of the forest.

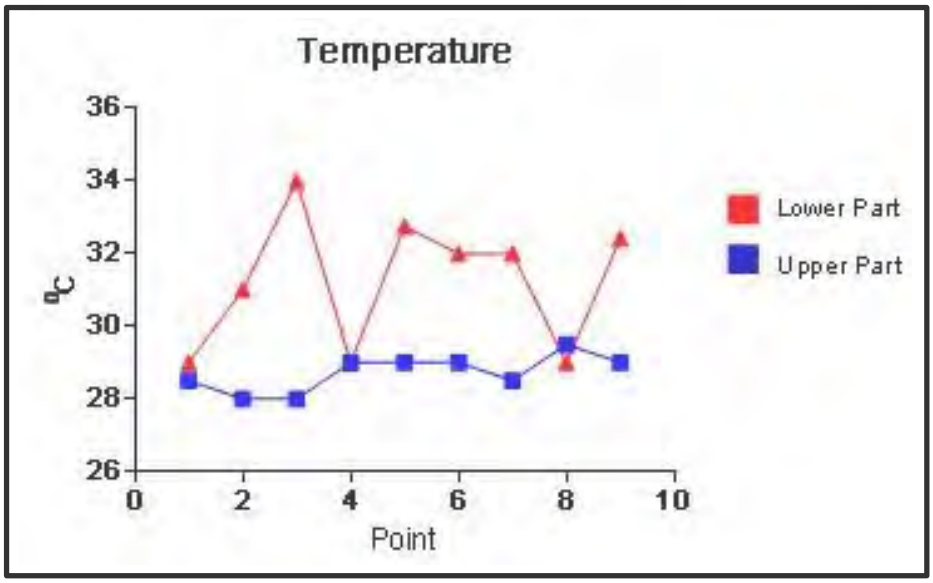


Figure 5.1. Graph of Temperature Statistic

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

The result from non-parametric analysis for one-sample test state that the distribution of Upper Part Humidity is normal with mean 56.9% and standard deviation 1.489 while the distribution of Lower Part Humidity is normal with mean 46.6% and standard deviation 1.652. In this case, the t-value (29) = 7.259 and *p* value (0.000) < 0.05. The results of this paired sample t-test show that the null hypothesis is rejected as there are no significant differences between mean of humidity. However, researcher can accept the research/alternative hypothesis that there is significant difference for mean of humidity 1 (upper part of Royal Belum forest) and humidity 2 (lower part of Royal Belum forest). This indicates that the humidity at the lower part (46.6%) is lower than the humidity at the upper part (56.9%). **Figure 5.2** is the graph comparison between humidity at upper and lower part of the forest.

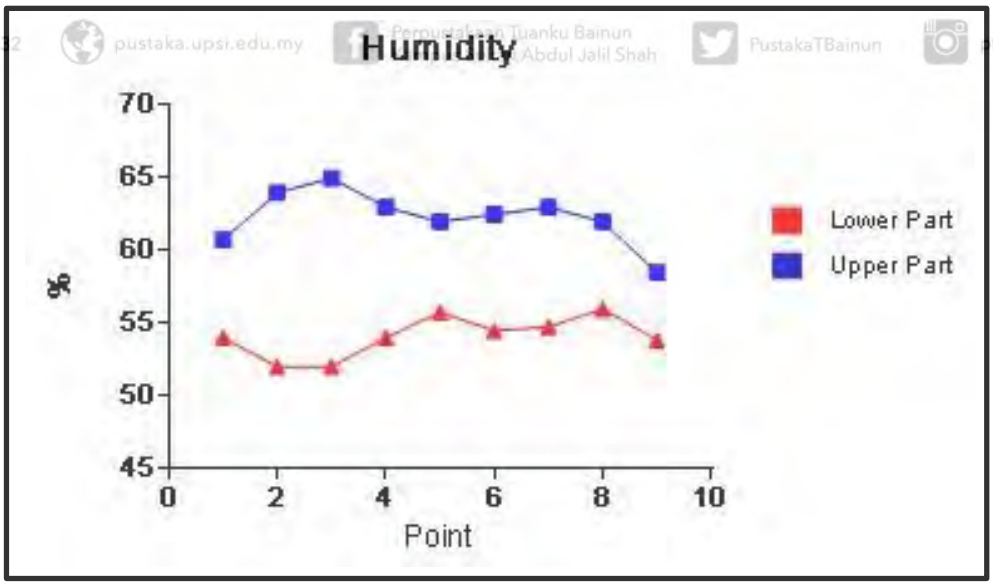


Figure 5.2. Graph of Humidity Statistic

The result from parametric analysis for one sample test stated that the distribution of Upper Part Hydrogen is normal with mean 23 ppm and standard

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

deviation 3.660 while the distribution of Lower Part Temperature is normal with mean 22.5 ppm and standard deviation 3.648. In this case, the t-value (29) = 1.678 and *p* value (0.104) > 0.05. The results of this paired sample t-test show that the null hypothesis is accepted as there are no significant differences between mean of hydrogen gaseous. However, researcher can reject the research/alternative hypothesis that there is a significant difference for mean of hydrogen gaseous 1(upper part of Royal Belum forest) and hydrogen gaseous 2 (lower part of Royal Belum forest). This indicates that the hydrogen gaseous at the upper part (23ppm) is almost the same with hydrogen gaseous at the lower part (22ppm). **Figure 5.3** is the graph comparison between hydrogen gaseous at upper and lower part of the forest.

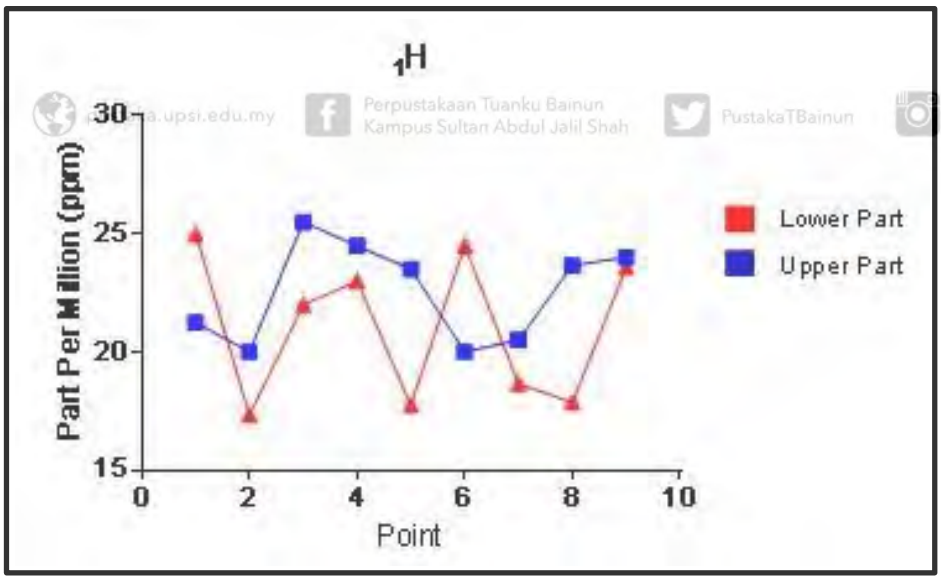


Figure 5.3. Graph of Hydrogen Statistic

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

5.4 Two-Group MANOVA Analysis

5.4.1 Correlation

Correlation was used to see whether the data can be used for two group MANOVA. There were linear correlation ($0.1 < r < 9.0$) among the dependent variables.

Table 5.2

Correlations

		Temperature	Humidity	Hydrogen
Temperature	Pearson Correlation	1	-.705**	.363**
	Sig. (2-tailed)		.000	.004
	N	60	60	60
Humidity	Pearson Correlation	-.705**	1	-.010
	Sig. (2-tailed)	.000		.941
	N	60	60	60
Hydrogen	Pearson Correlation	.363**	-.010	1
	Sig. (2-tailed)	.004	.941	
	N	60	60	60

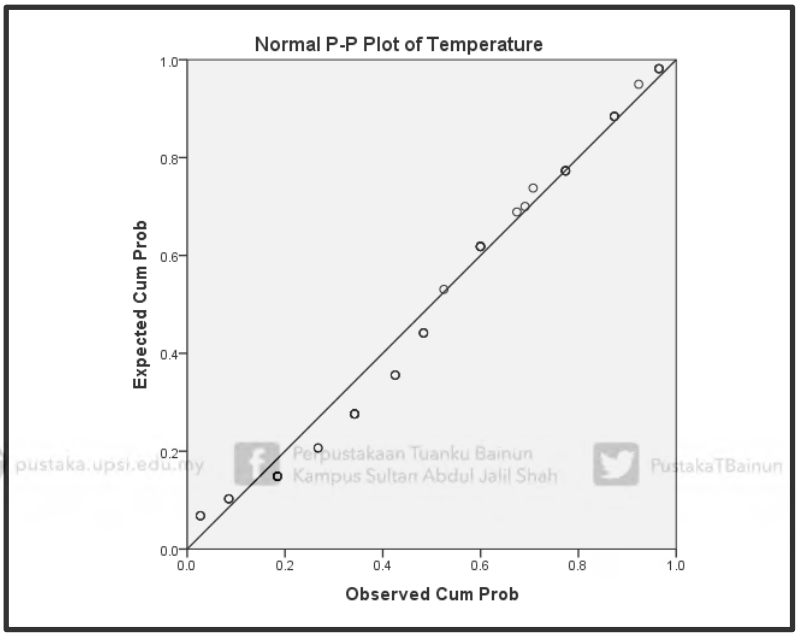
Result from correlation analysis (**Table 5.2**) depicts that all three variables had a linear correlation (Pearson Correlation) $0.1 < r < 9.0$. That means that this data suitable to be used using MANOVA analysis.

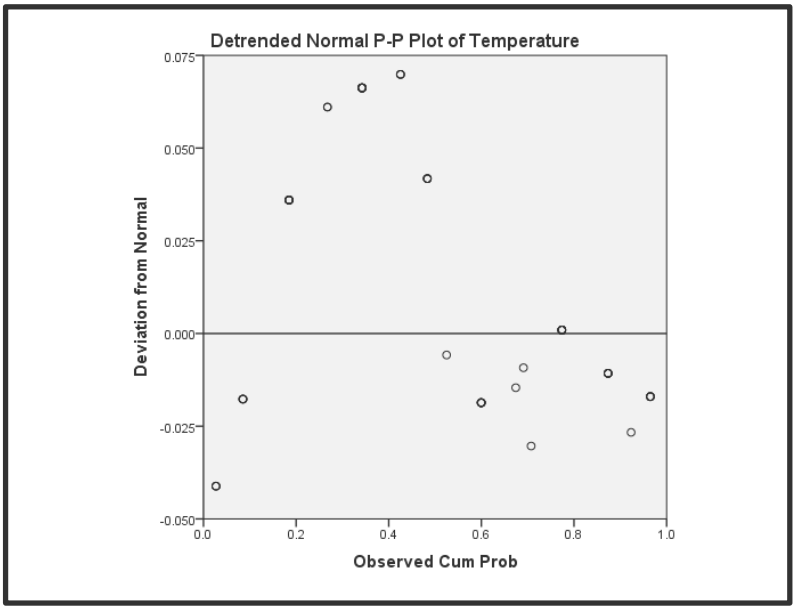
05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

5.4.2 P-Plot Normality Test

Result from Normal P-P Plot as displayed in **Figure 5.4**, **Figure 5.5** and **Figure 5.6** showed that all of the dependent variables had data with Normal Distribution – The coordinate point placed along the straight line or half of it at the upper and the other half located at below the straight line within Detrended Normal P-P Plot.

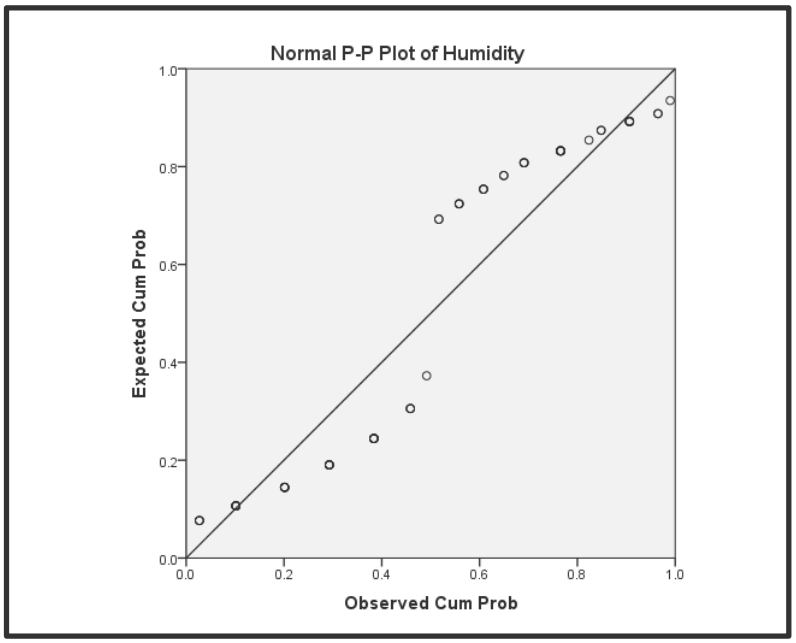




05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Figure 5.4 Temperature Normal P-P Plot



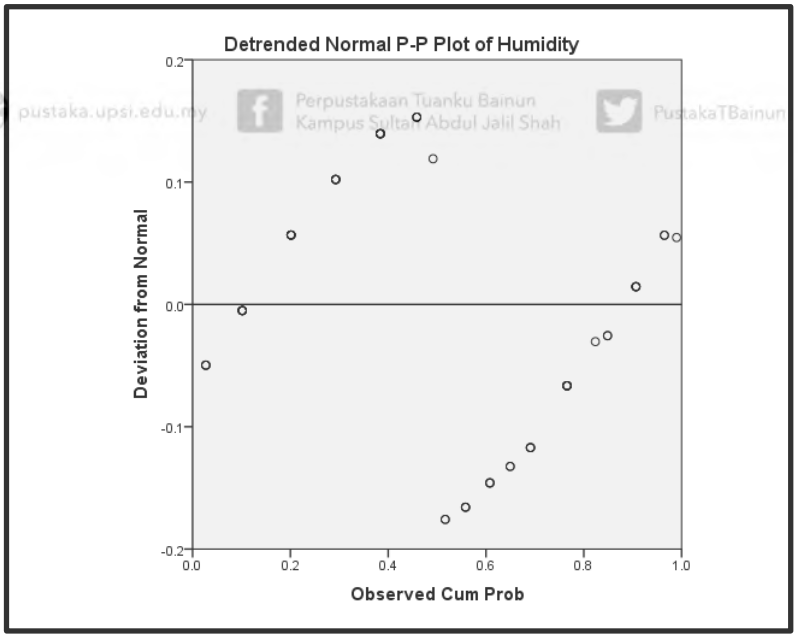


Figure 5.5 Humidity Normal P-P Plot

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

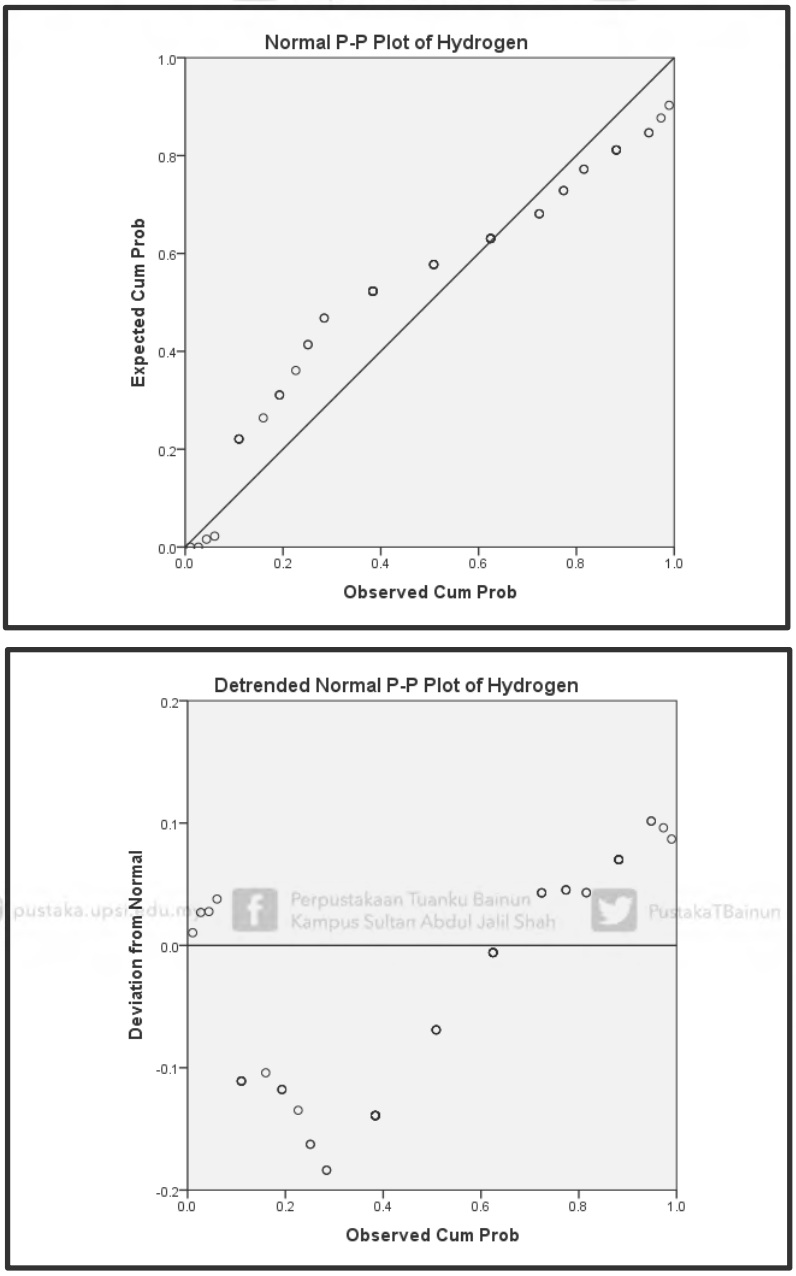


Figure 5.6 Hydrogen Normal P-P Plot

5.4.3 Descriptive Statistic

Table 5.3 showed the mean differences between the upper part and lower part for each dependent variables from Descriptive Statistics.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 5.3

Between-Subjects Factors

		Value Label	N
Location of the forest	1	Upper Part	30
	2	Lower Part	30

Table 5.4 Descriptive Statistics below showed that there are differences between mean between upper and lower part of the forest for each of the dependent variables. Standard Deviation showed that there are only a small dispersion between upper and lower part of the forest for each of the dependent variables.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 5.4

Descriptive Statistic

	Location of the forest	Mean	Std. Deviation	N
Temperature	Upper Part	29.9500	1.64710	30
	Lower Part	32.7060	1.87355	30
	Total	31.3280	2.23379	60
Humidity	Upper Part	56.9333	1.48981	30
	Lower Part	46.6000	1.65258	30
	Total	51.7667	5.43877	60
Hydrogen	Upper Part	23.0000	3.66013	30
	Lower Part	22.5833	3.64853	30
	Total	22.7917	3.62932	60

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

5.4.4 Box's Test of Equality of Covariance

Table 5.5 Box's Test depicts that those two groups of the location had same or equality of matric covariance for the dependent variables ($p > .05$).

Table 5.5

Box's Test Equality of Covariance

Box's M	31.078
F	4.888
df1	6
df2	24373.132
Sig.	.550

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

5.4.5 Multivariate Tests

Table 5.6 present six line of data, each of which represent a calculation for multivariate significance. On this occasion, the researcher will choose Pillai's Trace as the researcher to have two groups. We have a significant multivariate effect for the combined dependent variables of the upper part and lower part of the respect type of dependent variables, $F(3, 56) = .925$, $p < .05$.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 5.6

Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
RBP	Pillai's Trace	.925	228.762	3.00	56.0	0.00	.925

5.4.6 Levene's Test of Equality

Table 5.7

Levene's Test of Equality

	F	df1	df2	Sig.
Temperature	.504	1	58	.481
Humidity	.776	1	58	.382
Hydrogen	.005	1	58	.945

Levene's Test (**Table 5.7**) shows that there is equal variance assumed among all of the variables ($p > .05$) for upper and lower part of the forest.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

5.4.7 Test of Between-Subject Effect

Table 5.8

Test of Between-Subject Effect

Source	Dependent Variable	df	Mean Square	F	Sig.	Significant Path
RBP	Temperature	1	113.929	36.615	0.000	√
	Humidity	1	1601.667	647.063	0.000	√
	Hydrogen	1	2.604	.195	0.660	

Table 5.8 indicates that there are only differences between mean for Temperature, $F(1, 113.9) = 36.6$, $p < .05$) and Humidity, $F(1, 1601.6) = 647.06$, $p < .05$) that is significant at $p < .05$.

5.5 Amos Statistic Analysis

This section discusses the model developed based on Technology Acceptance Model. The model will be analyzed using AMOS software to see the main aim of this model that is to predict which part of the forest that has more significant relationship toward the depleted forest. **Figure 5.7** shows the generated output from AMOS according to the data of 60 samples. Estimation of the parameters in **Table 5.9** were generated by using Maximum Likehood with Estimates means and intercepts. The output settings are Minimization History, Standard estimates, Correlations of estimates and Tests for normality and outliers. The term form labels for the variables are the abbreviation from

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

the actual variables's labels used with model developed. The T1 is for Temperature 1, H1 is for Humidity 1, HY is for Hydrogen 1, T2 is for Temperature 2, H2 is for Humidity 2, HY2 is for Hydrogen 2, UP is for Upper Part of the forest and LP is for Lower Part of the forest.

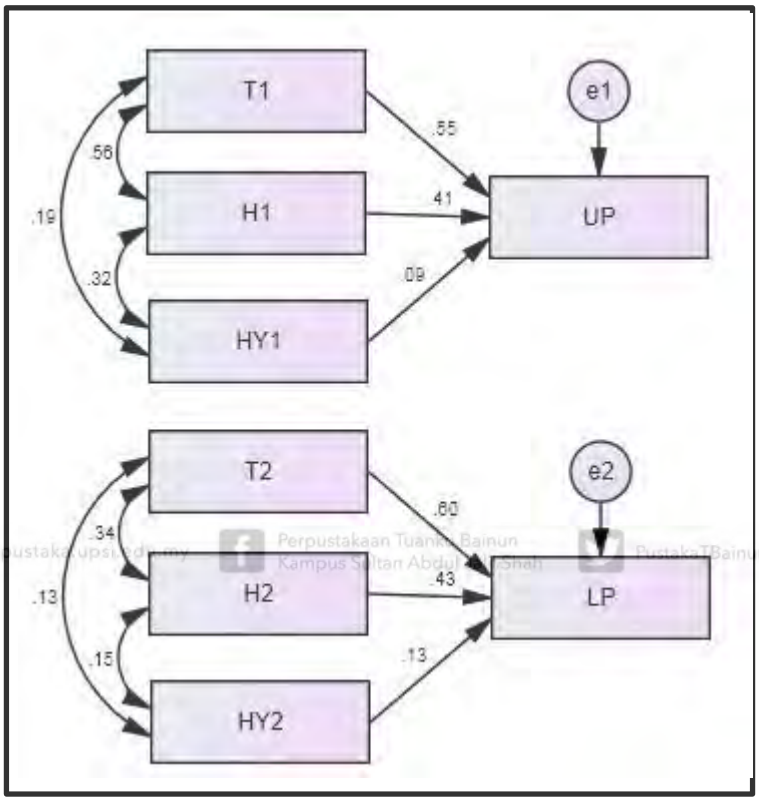


Figure 5.7. The standard output estimates

The results in **Figure 5.7** will be elaborated from right to left. In this figure, UP is the dependent variables while T1, H1 and HY1 are the independent variables connected to UP. The LP is the dependent variables while T2, H2 and HY2 are the independent variables connected to LP.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Table 5.9

The significant paths for the regression data (identified by √)

Regression	**Estimate**	**SE**	**CR**	**p**	**Significant Path**
T1 → UP	.668	.128	5.213	<0.001	√
H1 → UP	.358	.096	3.727	<0.001	√
HY1 → UP	.054	.054	1.006	.314	
T2 → LP	.568	.089	6.361	<0.001	√
H2 → LP	.308	.068	4.507	<0.001	√
HY2 → LP	.111	.076	1.455	.146	
Covariance	**Estimate**	**SE**	**CR**	**p**	
H1HY1	1.072	.640	1.674	.094	
T1H1	.884	.333	2.659	.008	√
T1HY1	.462	.449	1.028	.304	
H2HY2	.139	.171	.818	.413	
T2H2	.287	.161	1.786	.054	√
T2HY2	.088	.130	.683	.495	

Table 5.9 shows the significant path based on the critical ration (CR) (significant at 0.05 level). SE is standard error and p is for the probability

The relationship between all of the variables in **Figure 5.7** can be expressed in equations as stated

UP= (.55) T1 + (.41) H1 + (.32) HY1 + (.392) e1

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

LP = (.60) T2 + (.43) H2 + (.13) HY2 + (.133) e2

Based on the analysis generated by means and intercept, a number of significant paths within the model can be shown as below.

- Temperature 1 and Upper Part is significant
- Humidity 1 and Upper Part is significant
- Hydrogen 1 and Upper Part is not significant
- Temperature 1 and Humidity 1 are strongly correlated
- Temperature 2 and Lower Part is significant
- Humidity 2 and Lower Part is significant
- Hydrogen 2 and Lower Part is not significant
- Temperature2 and Humidity 2 are strongly correlated

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

5.6 Conclusion

In summary, this chapter has reported several statistics and related analysis. All the variables stated in Chapter 1 had been analyzed so that the researcher could determine the precision of the prototype developed. Moreover, through the use of SPSS and AMOS software, the researcher had successfully obtained the answers for this research. If the data collected had been valid, the results of the analysis revealed to the researcher about the natural phenomenon, and in this case, illegal logging. In particular, based on the analysis depicted in this chapter, the researcher concluded that all the variables stated in the previous chapter influenced each other. On top of that, by going through the statistical analysis for both the upper and lower parts of the Royal Belum forest,

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

comparisons were made between both areas, especially at the lower part of the forest. This shows that an occurrence happened at the mentioned sites, where action need to be taken by the authority. Next, chapter 6 looks into the results and the discussion from the findings to determine if the hypotheses could be supported or not. The researcher also answers all the research questions, as well as to ascertain if the objectives outlined has been achieved. Lastly, the researcher discusses the limitations faced throughout the research and provides recommendation for future researches.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

CHAPTER 6

RESULT AND CONCLUSION

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

6.1 Introduction

This chapter simplifies the argument on the testing that has been carried out and the results obtained in the previous chapter in corresponds to the hypothesis that has been predefined. The justification for selecting the specific test methods and the findings are discussed based on the facts and figures. This chapter also elaborates the relevant literature based on the cross-references of it followed by summarizing the outcome of the entire research. This involves the research conclusion, the level of success of the verification in achieving the attribute of the defined proposal by the aim, research objectives and research questions, limitations, recommendations and future research. At the beginning, this chapter provides an account on whether the aims, research objectives and research questions of the research have already been achieved and how. The second section follows that offers suggestions in the light of the research findings. Meanwhile,

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

a note on the limitations encountered in the research will be outlined within the third section. Finally, the chapter contributes recommendations to accomplish further research according to the research that had already been carried out. Finally, the summary of the study is outlined.

6.2 Hypotheses Testing

There had been one main hypothesis, and it further incorporated several sub divisions of hypotheses. The following lists the individual discussions on those hypotheses.

$H_0$1 There are no significant difference mean vector in the reading measurement for the ACRSS system between temperature, humidity, and gaseous taken at the upper and lower parts of the Royal Belum forest.

We have a significant multivariate effect for the combined dependent variables of the upper part and lower part of the respect type of dependent variables, $F(3, 56) = .925$, $p < .05$. This shows that "There are significant difference mean vector in the reading measurement for the ACRSS system between temperature, humidity, and gaseous taken at the upper and lower parts of the Royal Belum forest". (First hypotheses has been supported)

$H_0$2 There are no significant difference in the mean values of the reading measurement for the ACRSS system between the temperature taken at the upper part and the lower part of the Royal Belum forest.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

There are only differences between mean for Temperature, $F(1, 113.9) = 36.6$, $p < .05$) and Humidity, $F(1, 1601.6) = 647.06$, $p < .05$) that is significant at $p < .05$. This means that research hypotheses number two has been supported which stated that "There are significant difference in the mean values of the reading measurement for the ACRSS system between the temperature taken at the upper part and the lower part of the Royal Belum forest".

$H_0$3 There are no significant difference in the mean values of the reading measurement for the ACRSS system between the humidity taken at the upper part and the lower part of the Royal Belum forest.

There are only differences between mean for Temperature, $F(1, 113.9) = 36.6$, $p < .05$) and Humidity, $F(1, 1601.6) = 647.06$, $p < .05$) that is significant at $p < .05$. This stated that the third research hypotheses are also supported which means that "There are significant difference in the mean values of the reading measurement for the ACRSS system between the humidity taken at the upper part and the lower part of the Royal Belum forest".

$H_0$4 There is no significant difference in the mean values of the reading measurement for the ACRSS system between the gaseous taken at the upper part and the lower part of the Royal Belum forest.

There are only differences between mean for Temperature, $F(1, 113.9) = 36.6$, $p < .05$) and Humidity, $F(1, 1601.6) = 647.06$, $p < .05$) that is significant at $p <$

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

.05. This research hypotheses are not supported because the significant $p > .05$ thus accepted the null hypotheses.

H_05 There are no significant relationship between the observed variables and the depleted forest at the lower part of the forest by using First Order Structural Deforestation Modeling for the Effect of Environmental Data.

The regression and covariance predicting that the variables at lower part has a strongly significant values over the variables at the upper part of the forest.

6.3 Revisiting the Original Research Proposal

6.3.1 Research Questions

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

1. Does the ACRSS system influence the measurement reading of environment data, such as the mean values of temperature, humidity, and gaseous from the upper and the lower parts of the Royal Belum forest?

Based on the analysis depicted in chapter 4, it had been concluded that the mean value for temperature at lower part was 32.7°c compared to the mean value at the upper part, which was 29.9°c and has a significant value over it. Next, from the analysis of humidity, the mean value at the upper part was found higher than the lower part, which was 56.9% with a difference of 46.6% and also has a significant value over it. On the other hand, there are no significant differences of hydrogen gaseous toward mean values of upper part and lower part. The analysis revealed occurrences at the lower part of the forest because the literature that supported this analysis proved that it is necessary to detect fire as early as

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

possible when the humidity of the air is lower and the temperature is higher (Kirubaharan et al., 2014). Thus, if the humidity of the air is below a threshold value and the temperature is higher than the threshold value, then an alert signal should be activated. Therefore, the results retrieved from the analysis answered the research question stated above.

2. Can the ACRSS determine the significance of the causal relationship between the observed variables and the depleted forest from both the upper and lower parts of the forest via First Order Structural Deforestation Modeling for the Effect of Environmental Data?

Based on the analysis from AMOS, the ACRSS can determine the significance of the relationship between the observed variables and depleted forest according to the analysis, using First Order Structural Deforestation Modeling for the Effect of Environmental Data. This shows that the lower part of the forest is more significant toward depleted forest than the upper part of the forest as stated in the regression and covariance analysis.

6.3.2 Aims

The aim of this research had been concerned with the development of an automated centralized remote monitoring system for detecting rainforest activities. In fact, the main focus for developing this device had been to measure temperature, humidity, as well as hazardous gaseous, such as carbon monoxide, butane, propane, methane, and

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

smoke. In addition, the device must be able to detect fire and rain, whereby all the data gathered from device were transmitted to GSM by sending message in near real-time. The device was also equipped with GPS functionality to track the location of the device by its latitude and longitude.

6.3.3 Research Objective

The objectives set towards the aim had directed the research to achieve its goals as defined. The roles of the objectives are reviewed in this section:

1. To determine the effectiveness of the ACRSS system in measuring environment data, such as temperature, humidity, and gaseous, at the upper and the lower parts of the Royal Belum forest.

   This objective had been achieved through the results of the analysis depicted in chapter 5. Significant differences had been discovered between the mean values for temperature, humidity, and gaseous. This, therefore, had proven the effectiveness of the ACRSS system, which captured the related information and facilitated in conducting the research findings.

2. To develop a new device for multifunctional remote monitoring, equipped with GPS and GSM transmitter that are capable of monitoring temperature, humidity, contaminated gaseous, and rain detection for remote control sensor.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

The prototype, which had been developed based on chapter 4, is in fact capable of monitoring temperature, humidity, contaminated gaseous, rain, and fire detection; equipped with GPS and GSM that are capable of sending information needed in near real-time.

3. To configure an experimental system that can act as an indicator using the device that had been developed in selected test locations within the Royal Belum Forest.

   The experiment has been conducted at Royal Belum forest at two phases. The first phase that is the pilot test was conducted in December 2014, while the second phase was carried out in April 2015. The field experiment was successfully configured and the device was found to function as the researcher had intended with minor calibration.

4. To achieve and to evaluate the prediction of ACRSS as an accurate calibration on remote monitoring via First Order Structural Deforestation Modeling for the Effect of Environmental Data developed based on Technology Acceptance Model (TAM) for testing model in identifying the causal relationship between the observed variables and the depleted forest at the lower part of the forest.

   From the analysis using AMOS in predicting which part of the forest has influence toward depleted forest, the results from regression and covariance showed that the lower part has a strong significant level of

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

than the upper part. It is can be conclude that the lower part has a greater influence towards depleted forest.

6.3.4 Validation of Standard

1. The prototype will be tested by an officer or staff at Forest Research Institute of Malaysia. The data of the prototype, in this case temperature and humidity, were evaluated with existing devices at the department.

   Researcher refer to the experts in the field of remote sensing and GPS from the Forest Research Institute of Malaysia (FRIM) that is Dr. Hamdan Omar, a researcher from FRIM (an expert in the field of remote sensing, GIS and GPS) had validated the prototype developed and taken interest to work together in this research and joined another future research proposed by researcher. The research aims to develop a more advanced product using PCB for collecting data such as temperature, humidity, carbon dioxide, sound, GPS and GSM.

2. Next, the location of the prototype in terms of latitude and longitude via GPS was compared with the data obtained from Garmin Montana, whereby the device could tell the location of the user handling it. The data were analyzed by looking into the precision offered by both the devices; which had been the prototype and Garmin Montana. If the data of the prototype failed to match the data from the Garmin Montana, then

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

the prototype would be considered as a failure due to its lack of precision in terms of location.

The measurement readings for temperature and GPS had been initialized using Garmin Montana 600. The results showed that the readings from both prototype and Garmin Montana were similar. All of the locations' latitude and longitude with temperature had been taken and compared, however the results were still the same using both devices.

3. Display the system developed at exhibitions, such as ITEX or PeCIPTA, which organized by higher learning institutions, in order to introduce to the society what this system could do. This is one way to show everyone the usability of this prototype.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

The prototype was displayed at the PeCIPTA exhibition on December 2015 and received many suggestions to improve it for the future research. One of the commentators was the Remote Sensing Director of UKM (National University of Malaysia), who was also one of the judges at the exhibition.

6.4 Limitations

The limitations of this project that probably happened when the research was carried out at the Royal Belum forest had been related to the sensitivity of the sensor, which

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

might display error in its reading due to the quality of the sensor itself. Therefore, the quality of the sensors could also become a major issue as the more costly the sensor is, the better the performance would be, and vice versa. Moreover, the programming language that was used to calibrate the sensor and other hardware within the microcontroller had been somewhat complicated to write as the program must include all the data concerning temperature, humidity, gaseous, fire, and rain detection, as well as to display the location of the device accurately by its latitude and longitude. Furthermore, all the data had to be sent in real-time analysis through message via the function of GSM. Hence, this further complicated matters as the environment at the Royal Belum forest offered very limited coverage, and thus, the location to place the device too had been limited, especially in terms of its distance. This is because; if the device is planted at a location that is out of range for coverage, the GSM shield would probably fail to send the message, thus could have affected the objectives of this research. Moreover, it had been time consuming to comprehend the command used to send the message as it must be programmed correctly, or otherwise, one would not get the message in his/her mobile phone.

Additionally, as the Royal Belum forest is wide, the satellite for analyzing the location of the prototype might affect the system of the GPS, thus the data would be void 0, which means that the data for the latitude and longitude would become invalid as the validity of the GPS must be at void 1. On top of that, the other concerns might be probably due to the limited power supply as the batteries were installed inside the prototype. The power greatly reduced after one hour and one might need to change the batteries often, which is definitely a glaring disadvantage. In fact, the power dropped

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

greatly because all the devices in the prototype, especially the GPS device, needed 12 volts to operate optimally.

6.5 Further Research

As for future research, one can include another sensor, which is the sound sensor, to detect any illegal activity within the forest ecosystem by analyzing the data based on frequency of the sound made by intruder(s). Moreover, based on the other researches that had looked into similar research, the sound could indicate if there is any abnormal occurrence, such as the sound of the chainsaw made by the loggers, whereby the frequency will become higher than the threshold values. Other than that, by adding a few repeaters through the use of ARM within the remote areas that are inaccessible due to limited bandwidth, the information within the forest can be obtained and can be analyzed to obtain more accurate data. Besides, due to limited bandwidth, the GSM cannot send data from a remote location.

Therefore, in future, the researcher can combine the repeater by using ARM directly to the GSM, which could send all the data without being concern about the coverage. In fact, the most important aspect is indeed the life consumption of the battery, which needs to be taken seriously. Many previous researchers faced troubles with batteries. By using an appropriate solar panel and synchronizing it with a suitable battery, probably the life span of the battery can be extend beyond the current usage. Hence, those are some future enhancements that researchers can look into and add. In fact, there are more and potential researchers would try to gain them by reading other

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

research works in order to develop a prototype that could be more useful to the society and also the forest ecosystem; the sanctuary where flora and fauna live.

Moreover, in the future, the researcher suggested that to implement a high-quality calibration sensors that can give accurate data for monitoring environmental activities. The data obtained from the system need to send in real time not near real-time as it is necessary for the authorities to take precaution and immediately took actions to apprehend those whose commit any illegal activities within the forest. Also, the researcher thinks that is wiser to reduce the power of GPS module and any others function within the system by adding a "sleep mode" within the programs developed to reduce the battery lifespan for longer usage. This is necessary because the system must operate 24 hours a day to monitor the surrounding of the forest. To achieve that, the "sleep mode" function will be only useful as it will only activate if the values of the system surpassing the threshold value that been set by the researcher thus will send an alert signal to authority. That mean there are an occurrence within the forest else if will enter the "sleep mode" to reduce the power used while keep on monitoring the forest.

6.6 Conclusion

In this chapter, the researcher discusses the results obtained from the analysis in chapter 5; looks into the hypotheses based on the analysis; and depicts if the ACRSS really influenced the measurement of the reading for variables, such as temperature, humidity, and gaseous. Moreover, the research hypotheses have been accepted. Next, the temperature at the lower part displayed the highest mean value than the upper part,

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

which answered the second hypothesis and accepted the research hypothesis. Besides, the mean value of humidity at the lower part had been found to be lower than that at the upper part, thus accepting the research hypothesis. Last but not least, the mean value at the lower part was been recorded lower than the upper part and this accepts the research hypothesis. Also in this chapter, the researcher revisited a previous research proposal to answer the research questions stated in the previous chapter, the aims of this research, and also to determine if the objectives had been achieved. The researcher also elaborated the limitations of this research and finally, the future research that will be conducted by improving the current research.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

REFERENCES

Abdullah, J. B. (2014, December). A review of simulation framework for wireless sensor networks localization. In *Research and Development (SCOReD), 2014 IEEE Student Conference on* (pp. 1-6). IEEE.

Amor, D. (2008). *Road impact on deforestation and jaguar habitat loss in the Selva Maya*. Ph. D. dissertation. Ecology Department, Nicholas School of the Environment, Duke University.

Amor, D. & Pfaff, A. (2008). *Early history of the impact of road investments on deforestation in the Mayan forest*. Working Paper, Nicholas School of the Environment and Sanford School of Public Policy, Duke University, Durham, NC, USA.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Angelsen, A., Shitindi, E. F. K., & Aarrestad, J. (1999). Why do farmers expand their land into forests? Theories and evidence from Tanzania. *Environment and Development Economics*, *4*(03), 313-331.

Anastasiadou, D., Koulinas, K., Kiourtsis, F & Athanasiadis, I. N. (2014, September). Complementary software solutions for efficient timber logging and trade management. In *EnviroInfo* (pp. 783-788).

Anonymous. (1991). *The Forest Sector*. The World Bank, Washington DC.

Anonymous. (1994a). Deforestation Technical Support Package. Third International Conference on Environment Enforcement, Oaxaca Mexico April 25-28, 1994. World Wildlife Fund; U. S. Environmental Protection Agency and U. S. Agency for International Development.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Anonymous. (1994b). Breaking the logjam: obstacles to forestry policy reform in Indonesia and the United States. World Resource Institute, Washington.

Anonymous. (2002). *Forest certification and biodiversity: opposites or complements?* Discussion paper prepared for the GEF, International Tropical Timber Organization, Yokohama Japan.

Anonymous. (2005). *Ecosystems and Human well-being: synthesis*. Millennium ecosystem Assessment. Island Press, Washington DC.

Anonymous. (2007). Three Essential Strategies for Reducing Deforestation. Alianca da Terra, Amigos da Terra, Instituto Centro de Vida, IMAZON, Instituto de Pesquisa da Amazonia, Instituto Socio Ambiental, Nucleo de Estudos e Pratica Juridica Ambiental, Faculdade de Direito- Universidade Federal de Mato Grosso, Woods Hole Research Center and David and Lucile Packard Foundation.

Anonymous, (2010). *Global Forest Resources Assessment, 2010-Main Report*. FAO Forestry Paper 163. Rome, Italy. 340p.

Babiš, M., Ďuríček, M., Harvanová, V & Vojtko, M. (2011). Forest Guardian – Monitoring System for Detecting Logging Activities Based on Sound Recognition. *Artificial Intelligence, Computer Graphics and Multimedia*, *IIT.SRC 20*, 1–6.

Ball, J. (2010). Sustainable forest management. *Commonwealth forests*, 13.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Barbier, E. B., Burgess, J. C., Folke, C., Trzyna, T. C., Osborn, J. K., Pinter, L., et al (1995). *Paradise Lost?: the ecological economics of biodiversity* (No. GTZ-1575). Beijer International Institute of Ecological Economics (Suiza).

Barraclough, S. L., & Ghimire, K. B. (2013). *Agricultural expansion and tropical deforestation: International trade, poverty and land use*. Routledge.

Bhatnagar, P. (1991). *The Problem of Afforestation in India*. International Book Distributors, Dehra Dun.

Bonell, M., & Bruijnzeel, L. A. (Eds.). (2005). *Forests, water and people in the humid tropics: past, present and future hydrological research for integrated land and water management*. Cambridge University Press.

Caviglia, J. (1999). *Sustainable Agriculture in Brazil. Economic Development and Deforestation*. Edward Elgar.

Buys, P. (2007). *At loggerheads?: agricultural expansion, poverty reduction, and environment in the tropical forests*. World Bank Publications.

Chouhan, N., Vyavahare, P. D & Jain, R. (2013). Wireless Sensor Network-A Survey. *International Journal on Computer Science and Engineering*, *5*(7), 633.

Colchester, M. & Lohmann, L. (1993). *The Struggle for land and the fate of forest*. Zed books, London.

Cossalter, C., & Pye-Smith, C. (2003). *Fast-wood forestry: myths and realities* (Vol. 1). CIFOR.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Czúni, L. & Varga, P. Z. (2014, January). Lightweight Acoustic Detection of Logging in Wireless Sensor Networks. In *The International Conference on Digital Information, Networking, and Wireless Communications (DINWC)* (p. 120). Society of Digital Information and Wireless Communication.

Daily, G. (Ed.). (2007). *Nature's Services, Societal Dependence on Natural Ecosystems*. Washington DC: Island Press.

Yusoff, A., Shafiril, S., Abas, A., & Yusoff, N. C. (2015). A Real Time Development Study for Automated Centralized Remote Monitoring System at Royal Belum Forest. *World Academy of Science, Engineering and Technology, International Journal of Environmental, Chemical, Ecological, Geological and Geophysical Engineering*, *9*(9), 1099-1104.

Hammer, A., Heinemann, D., Hoyer, C., Kuhlemann, R., Lorenz, E., Müller, R., et al (2003). Solar energy assessment using remote sensing technologies. *Remote Sensing of Environment*, *86*(3), 423-432.

Hansen, C. P (1997). *Making available information on the conservation and utilization of forest genetic resources*. The FAO Worldwide Information System on Forest genetic resources.

Harvanová, V., Vojtko, M., Babis, M., Duríek, M., & Pohronská, M. (2011, November). Detection of wood logging based on sound recognition using zigbee sensor network. In *Proceedings of the International Conference on Design and Architectures for Signal and Image Processing, Tampere, Finland* (Vol. 24).

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Hema, L. K., Murugan, D & Priya, R. M. (2014, December). Wireless sensor network based conservation of illegal logging of forest trees. In *Emerging Trends In New & Renewable Energy Sources And Energy Management (NCET NRES EM), 2014 IEEE National Conference On* (pp. 130-134). IEEE.

Humphreys, D (2006). *Forest Politics*. Earthscan Publications Ltd., London.

J Harvanová, V., Vojtko, M., Babis, M., Duríek, M & Pohronská, M. (2011, November). Detection of wood logging based on sound recognition using zigbee sensor network. In *Proceedings of the International Conference on Design and Architectures for Signal and Image Processing, Tampere, Finland* (Vol. 24).

Kaimowitz, D., & Angelsen, A. (1998). *Economic models of tropical deforestation: a review*. Cifor.

Kamburov, A. GPS METHODS IN SUPPORT OF GIS TECHNOLOGIES FOR MANAGEMENT OF FOREST TERRITORIES.

Kartodihardjo, H., & Supriono, A. (2000). *The impact of sectoral development on natural forest conversion and degradation: The case of timber and tree crop plantations in Indonesia* (No. CIFOR Occasional Paper no. 26 (E), p. 14p). CIFOR, Bogor, Indonesia.

Kirubaharan, D. V., Sunder, A. J. C., Ramesh, S. M & Dhinakar, P. (2014). Intruder Detection and Forest Fire Alert System with Using Wireless Sensor Network. *International Advanced Research Journal in Science, Engineering and Technology*.

Lavanya, A., Thranya, J. S & Jagadeesan, A. Mobile Embedded Wireless Sensor Network to Prevent Deforestation.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Lean, G (1990). *World Wildlife Fund Atlas of the Environment*. Prentice Hall, New York.

Lozano, C. & Rodriguez, O. (2010). Design of forest fire early detection system using wireless sensor networks. *The Online Journal on Electronics and Electrical Engineering (OJEEE)*, *3*(2).

MalaysiaNaturalHeritage.(2013). Belum-Temenggor Rainforest Complex. Retrieved 29 January, 2013, from http://learningandteaching.info/learning/assimacc.htm

Mather, A. S (1991). *Global Forest Resources*. International Book Distributors, Dehra Dun.

Mayer, A. L. & Lopez, R. D. (2011). Use of remote sensing to support forest and wetlands policies in the USA. *Remote Sensing*, *3*(6), 1211-1233.

Mittal, A., Chetan, K. P., Jayaraman, S., Jagyasi, B. G., Pande, A & Balamuralidhar, P. (2012, December). mKRISHI wireless sensor network platform for precision agriculture. In *Sensing Technology (ICST), 2012 Sixth International Conference on* (pp. 623-629). IEEE.

Moghaddam, M., Entekhabi, D., Goykhman, Y., Li, K., Liu, M., Mahajan, A., et al (2010). A wireless soil moisture smart sensor web using physics-based optimal control: Concept and initial demonstrations. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, *3*(4), 522-535.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Myers, N. (1992). Tropical forests: the policy challenge. *Environmentalist*, *12*(1), 15-27.

Myers, N (1994). Tropical deforestation: rates and patterns. In: *The Causes of Tropical of Tropical Deforestation. The economic and statistical analysis of factors giving rise to the loss of the tropical forest*, eds. Brown, K. and Pearce, D. pp 27-40. UCL Press.

Myers, N., Mittermeier, R. A., Mittermeier, C. G., Da Fonseca, G. A., & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, *403*(6772), 853-858.

Ong, D. J. (2012). Rethink RM60 mil for wildlife -friendly viaducts. Retrieved 29 January, 2013, from http://www.learningandteaching.info/learning/assimacc.htm

Orozco-Barbosa, L., Olivares, T., Casado, R., & Bermúdez, A. (Eds.). (2007). *Wireless Sensor and Actor Networks: IFIP WG 6.8 First International Conference on Wireless Sensor and Actor Networks, WSAN'07, Albacete, Spain, September 24-26, 2007* (Vol. 248). Springer.

Panayotou, T (1990). *The economics of environmental degradation: problems, causes and responses*, HIID Development discussion papers 335. Harvard University.

Putz, F. E., Blate, G. M., Redford, K. H., Fimbel, R., & Robinson, J. (2001). Tropical forest management and conservation of biodiversity: an overview. *Conservation Biology*, *15*(1), 7-20.

Raloff, J (1989). Where Acids Reign. *Science News* July 22. Pp 56-58.

Repetto, R. (1988). The forest for the trees. *Government Policies and the Misuse of Forest Resources*, 43-51.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Rocchini, D., Foody, G. M., Nagendra, H., Ricotta, C., Anand, M., He, K. S., et al (2013). Uncertainty in ecosystem mapping by remote sensing. *Computers & Geosciences*, *50*, 128-135.

Rowe, R., Sharma, N. P & Bowder, J. (1992). Deforestation: problems, causes and concern. In: *Managing the world's forest: looking for balance between conservation and development*, ed. Sharma, N. P. Pp 33-46. Kendall/Hunt Publishing Company, Iowa.

Sands, R. (Ed.). (2013). *Forestry in a global context*. CABI.

Sidek, O., Mansor, M., Jafar, H., Nurulhaiza, U., Amran, N. A., Abdullah, A., et al (2014, May). A low cost approach of multisensor device for global warming studies. In *Technology Management and Emerging Technologies (ISTMET), 2014 International Symposium on* (pp. 355-358). IEEE.

Sidén, J., Koptyug, A., Gulliksson, M., & Nilsson, H. E. (2007). An action activated and self powered wireless forest fire detector. In *Wireless Sensor and Actor Networks* (pp. 47-58). Springer US.

Singh, S., & Abdullah, S. M. (2013). There's no illegal logging in Lojing. *New Straits Times*, p. 4.

Srinivas, Y. & Rao, K. R. Landslide Warning System Using ZigbeeAnd GPS. *IOSR Journal of Engineering (IOSRJEN)*.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Subhas, D. M., C, P. M. P. ., & N, P. K. S. (2014). Landslide Warning System using Wireless Sensor Network. *International Journal of Electronics & Communication Technology*, *2*(10), 1–5.

Van Kooten, G. C., & Bulte, E. H. (2001). *The economics of nature: managing biological assets*. Oxford.: Blackwell.

Wang, S. F., Wang, K. Y., Wang, X. J & Liu, Z. Q. (2012). A Novel Illegal Logging Monitoring System Based on WSN. In *Advanced Materials Research* (Vol. 518, pp. 1417-1421). Trans Tech Publications.

Wilkie, D., Shaw, E., Rotberg, F., Morelli, G., & Auzel, P. (2000). Roads, development, and conservation in the Congo Basin. *Conservation Biology*, *14*(6), 1614-1622.

Yatskiv, V., & Sachenko, A. Wireless Sensor Networks for Forest Fires Monitoring.

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

APPENDIX

Appendix A Permission Letter to Conduct Research

Pengurus besar
Perbadanan Taman Negeri Perak(Taman Negeri Royal Belum)
Tingkat 1, Kompleks Pejabat Kerajaan Negeri,
Daerah Hulu Perak,
33300 Geik, Perak.

Tarikh:

Tuan,

MEMOHON KEBENARAN MENGUMPUL DAN MEMBAWA KELUAR SPESIMEN

Saya dengan segala hormatnya merujuk kepada perkara tersebut di atas.

2. Adalah dimaklumkan bahawa, pihak kami memohon kebenaran untuk membawa keluar sampel kajian seperti senarai yang dilampirkan. Pengumpulan spesimen ini adalah bersemperna dengan ..... yang berlangsung dari ..... Hingga .....

3. Setiap spesimen yang dipohon untuk dibawa keluar telah memenuhi syarat-syarat berikut:-

   i. Spesimen tersebut tidak diperlindungi atau tidak diperlidungi sepenuhnya di bawah Akta Perlindungan Hidupan Liar 2010 Bilangan 716

   ii. Maksimum tiga individu sahaja bagi setiap spesies yang disampel dibawa keluar, kecuali spesies serangga yang disampel secara pasif (perangkap malaise,perangkap *pitfall*, perangkap cahaya)

4. Bagi setiap kajian yang dibuat di kawasan Taman Negeri Royal Belum, satu salinan laporan kajian akan disediakan dan akan diserahkan kepada Perbadanan Taman Negeri Perak sebagai rujukan.

5. Segalan perhatian dan pertimbangan pihak tuan amatlah dihargai.

Sekian, Terima Kasih

.....
Nama:
Jawatan:
Jabatan

Untuk kegunaan pejabat

Kelulusan: Permohonan diluluskan / tidak diluluskan*

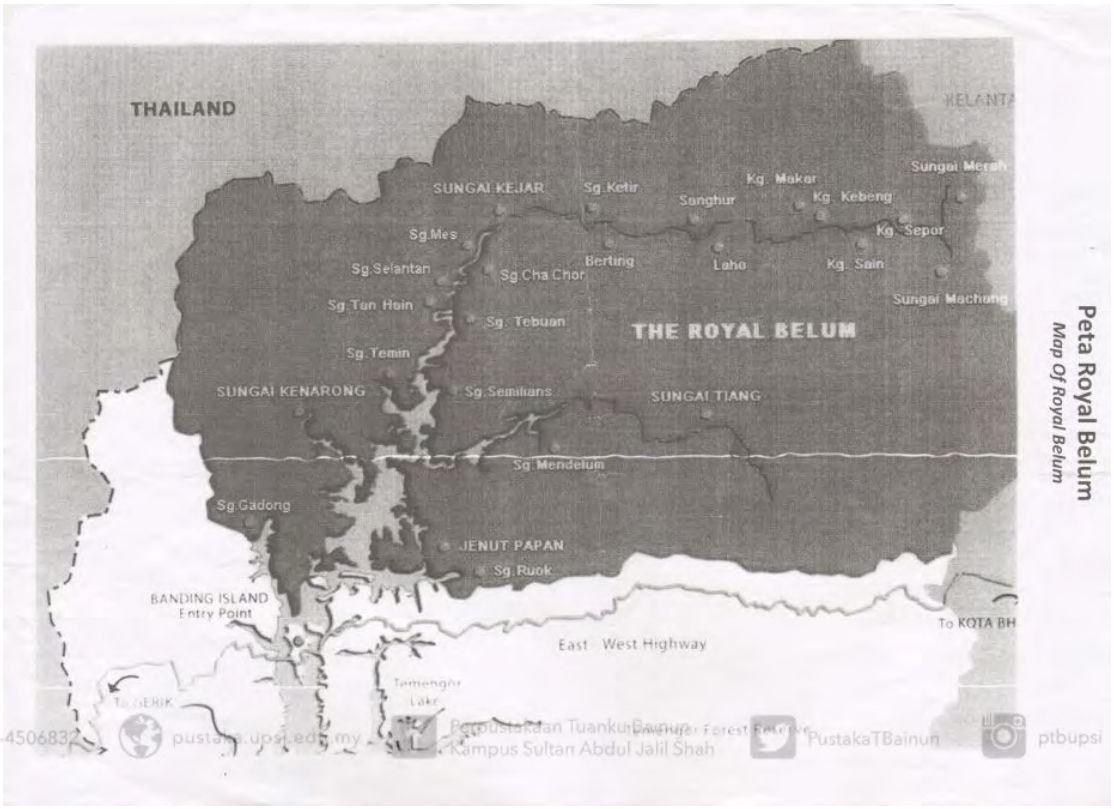
*Ulasan

.....
Tandatangan dan Cop
Nama:
Jawatan:
Tarikh:

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Appendix B Royal Belum Map



05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Appendix C EduInERI participant certificate



2013 Edu-InERI

Certificate of Participation

Universiti Pendidikan Sultan Idris

Sultan Idris Education University

This Certificate is presented to

Dr. Amri Yusoff

Shahrizuan b. Shafiril Sivaguru

For the participation of invention/innovation titled

Solar Powered Environmental Sensing for Rainforest

INTERNATIONAL Exposition Research & Innovation in Education 2013

Main Hall, Sultan Idris Education University
Sultan Azlan Shah Campus, Proton City, Perak Darul Ridzuan
20 - 22 September 2013

Professor Dato' Dr. Zakaria b. Kasa
Vice Chancellor
Sultan Idris Education University

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Appendix D EduInERI Bronze Medal Certificate



2013 Edu-InERI

BRONZE MEDAL

Universiti Pendidikan Sultan Idris

Sultan Idris Education University

This Certificate of Award is presented to

Dr. Amri Yusuf
Shahrizuan bin Shafiril Sivaguru

For the invention/innovation of

Solar Powered Environment Sensing For Rainforest

INTERNATIONAL Exposition Research & Innovation in Education 2013

Main Hall, Sultan Idris Education University
Sultan Azlan Shah Campus, Proton City, Perak Darul Ridzuan
20 - 22 September 2013

Professor Dato' Dr. Zakaria b. Kasa
Vice Chancellor
Sultan Idris Education University

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Appendix E ICESR Letter of Acceptance



CBEES
www.cbees.org

Unit B on 15th Floor Eu Yan Sang Tower Nos.11/15, Chatham Road South Kowloon, Hong Kong, Email: admin@cbees.org
Tel: +852-3500-0137(HK), +86-28-86528465(CN Branch), +1-206-456-6022 (USA)

Notification of Acceptance of the ICESR 2014

13-14 December, 2014, Kuala Lumpur, Malaysia

http://www.icesr.org/

Paper ID : 50022

Paper Title : The development of an automated system in collecting environmental data for monitoring forest activity

Dear Amri Yusoff, Shahrizuan Shahrir and Norma Che Yusoff,

First of all, thank you for your concern. 2014 International Conference on Environmental Systems Research (ICESR 2014) review procedure has been finished. We are delighted to inform you that your manuscript has been accepted for presentation at International Conference on Environmental Systems Research ICESR 2014, Kuala Lumpur, Malaysia. Your paper was blinded and **reviewed and, based on the evaluations. The reviewers'** comments are enclosed.

The conference received papers from about 20 different countries and regions during the submission period. And there are about 100 papers accepted by our reviewers who are the international experts from all over the world. The selected papers could be published in the journal with high quality. According to the recommendations from reviewers and technical program committees, we are glad to inform you that your paper (entitled above have been selected for publication and oral presentation. You are invited to present your paper and studies during our ICESR conference that would be held on 13-14 December, 2014, Kuala Lumpur, Malaysia.

The ICESR 2014 is co-sponsored by Asia Pacific Chemical, Biological & Environmental Engineering Society (APCBEES)

This papers of ICESR 2014 will be published the APCBEE Procedia (Journal under Elsevier, ISSN: 2212-6708) and will be included in ScienceDirect and sent to be reviewed by Scopus, EI Compendex and ISI Proceedings.

(Important Steps for your registration): Please do finish all the 8 steps on time to guarantee the paper published in the proceeding successfully:

1. Revise your paper according to the Review Comment in the attachment carefully. (Five authors at most each paper)

No Plagiarism

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Appendix F List of Publications, Exhibition, Conferences

The development of an automated system in detecting environmental data for monitoring forest activity. International Conference on Environmental Systems Research (ICESR 2014), Kuala Lumpur, Malaysia, 13-14 December, 2014 (Participant)

A Real Time Development Study for Automated Centralized Remote Monitoring System at Royal Belum Forest (ICESR 2015) 17th International Conference on Environmental Systems Research, Istanbul, Turkey, 28-29 September, 2015 (2nd Author)

Remote Sensing Assessment for Monitoring Royal Belum Forest Activity: A Review. International Conference on ICT in Education (ICict), Perak, Malaysia,30 September-2 October 2015. (Submitted-Participant)

Shafiril, S., Yusoff, A., & Yusoff, N. C. (2016). The Development of an Automated System in Detecting Environmental Data for the Monitoring of Forest Activity. ***International Journal of Environmental Science and Development*****, *7*(7), 532.**

Yusoff, A., Shafiril, S., Abas, A., & Yusoff, N. C. (2015). A Real Time Development Study for Automated Centralized Remote Monitoring System at Royal Belum Forest.

Edu-InERI EXPO, UPSI 2013, Bronze Medal. (Participant)

(PECIPTA 2015) on the 4th – 6th December 2015 at Kuala Lumpur Convention Centre. (Participant)

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Appendix G SPSS Paired Sample T-Test Analysis

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Temperature2	32.7060	30	1.87354	.34206
	Temperature1	29.9500	30	1.64710	.30072
Pair 2	Humidity1	56.9333	30	1.48981	.27200
	Humidity2	46.6000	30	1.65258	.30172
Pair 3	Hydrogen1	23.0000	30	3.66013	.66825
	Hydrogen2	22.5833	30	3.64853	.66613

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Temperature2 & Temperature1	30	.575	.001
Pair 2	Humidity1 & Humidity2	30	-.179	.343
Pair 3	Hydrogen1 & Hydrogen2	30	.995	.000

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Temperature2 - Temperature1	2.75600	1.63624	.29874	2.14502	3.36698	9.226	29	.000
Pair 2	Humidity1 - Humidity2	10.33333	2.41523	.44096	9.43147	11.23519	23.434	29	.000
Pair 3	Hydrogen1 - Hydrogen2	.41667	.34947	.06380	.28617	.54716	6.530	29	.000

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Appendix H Two Group Manova Analysis

Correlations

		Temperature	Humidity	Hydrogen
Temperature	Pearson Correlation	1	-.705**	.363**
	Sig. (2-tailed)		.000	.004
	N	60	60	60
Humidity	Pearson Correlation	-.705**	1	-.010
	Sig. (2-tailed)	.000		.941
	N	60	60	60
Hydrogen	Pearson Correlation	.363**	-.010	1
	Sig. (2-tailed)	.004	.941	
	N	60	60	60

**. Correlation is significant at the 0.01 level (2-tailed).

Between-Subjects Factors

		Value Label	N
Location of the forest	1	Upper Part	30
	2	Lower Part	30

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Descriptive Statistics

	Location of the forest	Mean	Std. Deviation	N
Temperature	Upper Part	29.9500	1.64710	30
	Lower Part	32.7060	1.87355	30
	Total	31.3280	2.23379	60
Humidity	Upper Part	56.9333	1.48981	30
	Lower Part	46.6000	1.65258	30
	Total	51.7667	5.43877	60
Hydrogen	Upper Part	23.0000	3.66013	30
	Lower Part	22.5833	3.64853	30
	Total	22.7917	3.62932	60

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Box's Test of Equality of Covariance Matrices[a]

Box's M	31.078
F	4.888
df1	6
df2	24373.132
Sig.	.000

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

a. Design: Intercept + RBP

Levene's Test of Equality of Error Variances[a]

	F	df1	df2	Sig.
Temperature	.504	1	58	.481
Humidity	.776	1	58	.382
Hydrogen	.005	1	58	.945

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + RBP

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[c]
Intercept	Pillai's Trace	1.000	50095.039[b]	3.000	56.000	.000	1.000	150285.118	1.000
	Wilks' Lambda	.000	50095.039[b]	3.000	56.000	.000	1.000	150285.118	1.000
	Hotelling's Trace	2683.663	50095.039[b]	3.000	56.000	.000	1.000	150285.118	1.000
	Roy's Largest Root	2683.663	50095.039[b]	3.000	56.000	.000	1.000	150285.118	1.000
RBP	Pillai's Trace	.925	228.762[b]	3.000	56.000	.000	.925	686.286	1.000
	Wilks' Lambda	.075	228.762[b]	3.000	56.000	.000	.925	686.286	1.000
	Hotelling's Trace	12.255	228.762[b]	3.000	56.000	.000	.925	686.286	1.000
	Roy's Largest Root	12.255	228.762[b]	3.000	56.000	.000	.925	686.286	1.000

a. Design: Intercept + RBP

b. Exact statistic

c. Computed using alpha = .05

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[d]
Corrected Model	Temperature	113.929[a]	1	113.929	36.615	.000	.387	36.615	1.000
	Humidity	1601.667[b]	1	1601.667	647.063	.000	.918	647.063	1.000
	Hydrogen	2.604[c]	1	2.604	.195	.660	.003	.195	.072
Intercept	Temperature	58886.525	1	58886.525	18925.120	.000	.997	18925.120	1.000
	Humidity	160787.267	1	160787.267	64957.010	.000	.999	64957.010	1.000
	Hydrogen	31167.604	1	31167.604	2333.924	.000	.976	2333.924	1.000
RBP	Temperature	113.929	1	113.929	36.615	.000	.387	36.615	1.000
	Humidity	1601.667	1	1601.667	647.063	.000	.918	647.063	1.000
	Hydrogen	2.604	1	2.604	.195	.660	.003	.195	.072
Error	Temperature	180.470	58	3.112					
	Humidity	143.567	58	2.475					
	Hydrogen	774.542	58	13.354					
Total	Temperature	59180.925	60						
	Humidity	162532.500	60						
	Hydrogen	31944.750	60						
Corrected Total	Temperature	294.399	59						
	Humidity	1745.233	59						
	Hydrogen	777.146	59						

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Appendix I First Order Structure Analysis using AMOS

Regression Weights: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
UP <--- T1	.668	.128	5.213	***	par_1
UP <--- H1	.358	.096	3.727	***	par_2
UP <--- HY1	.054	.054	1.006	.314	par_3
LP <--- T2	.568	.089	6.361	***	par_7
LP <--- H2	.308	.068	4.507	***	par_8
LP <--- HY2	.111	.076	1.455	.146	par_9

Standardized Regression Weights: (Group number 1 - Default model)

	Estimate
UP <--- T1	.550
UP <--- H1	.407
UP <--- HY1	.093
LP <--- T2	.598
LP <--- H2	.425
LP <--- HY2	.130

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Covariances: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
H1 <--> HY1	1.072	.640	1.674	.094	par_4
T1 <--> H1	.884	.333	2.659	.008	par_5
T1 <--> HY1	.462	.449	1.028	.304	par_6
H2 <--> HY2	.139	.171	.818	.413	par_10
T2 <--> H2	.287	.161	1.786	.074	par_11
T2 <--> HY2	.088	.130	.683	.495	par_12

Correlations: (Group number 1 - Default model)

	Estimate
H1 <--> HY1	.321
T1 <--> H1	.555
T1 <--> HY1	.191
H2 <--> HY2	.151
T2 <--> H2	.345
T2 <--> HY2	.126

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Appendix J Turnitin Digital Receipt



turnitin

Digital Receipt

This receipt acknowledges that Turnitin received your paper. Below you will find the receipt information regarding your submission.

The first page of your submissions is displayed below.

Submission author:	M2014 1000004 Sharizuan Bin Sha...
Assignment title:	testing turnitin
Submission title:	Thesis Proofread
File name:	THESIS_ACRSS_Edited.docx
File size:	26K
Page count:	149
Word count:	21,877
Character count:	120,418
Submission date:	23-Feb-2016 11:54AM
Submission ID:	582237704

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

Appendix K Proofread Receipt

MPWS Rich Proofreading Sdn Bhd
63-1, Jalan Kajang Impian 1/11, Taman Kajang Impian, Seksyen 7
Bandar Baru Bangi, 43650, Selangor, Malaysia
Tel: 03-89127212 **Fax:** 03-89289212
Email: mpws.proofreading@gmail.com
Website: www.proofandread.com

To: **Universiti Pendidikan Sultan Idris**
Perak, Malaysia

Tel: 601129302280
Email: cloudywolfshah86@yahoo.com
Field of Study: Robotic,Programming

Attention: **Shahrizuan Bin Shafiril**

PAYMENT RECEIPT

Date:	15/02/2016
Receipt No:	MRP16/Feb15/I001A
Invoice No:	MRP16/Feb15/I001A
Folder No:	4740
Type of Document:	Thesis
Status:	Paid

No.	Item & Description	Page Number/ Word Count	Price Per Page/ Per Word (RM)	Total Price (RM)
1	Proofread Normal Rate (Turnaround time = 23rd February 2016, 10:00 pm)	38	6.00	228.00
RINGGIT MALAYSIA:			**Total** RM	228.00
TWO HUNDRED TWENTY EIGHT AND ZERO CENTS ONLY			**Paid** RM	228.00

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi

05-4506832 pustaka.upsi.edu.my Perpustakaan Tuanku Bainun Kampus Sultan Abdul Jalil Shah PustakaTBainun ptbupsi