

TABLE OF CONTENT

APPROVAL PAGE	iii
STATEMENT	iv
MOTTO AND DEDICATION PAGE.....	v
FOREWORD.....	vi
TABLE OF CONTENT	viii
LIST OF FIGURES	xi
LIST OF TABLES.....	xiv
INTISARI.....	xv
ABSTRACT	xvi
CHAPTER I INTRODUCTION	1
1.1 Background	1
1.2 Research Problem	2
1.3 Scope of Problem	2
1.4 Research Objectives.....	3
1.5 Research Benefits	3
1.6 Research Method	3
1.7 Organization of the Thesis	4
CHAPTER II LITERATURE REVIEW.....	5
CHAPTER III THEORETICAL BASIS.....	11
3.1 Embedded System	11
3.1.1 Hardware Components	11
3.1.2 Software Components.....	13
3.2 Air Pollution Standard Index.....	14
3.3 Arduino UNO assembled with Ethernet Shield and Pollutant Sensors..	18
3.3.1 Ethernet Shield	19
3.3.2 MQ-7 Gas Sensor Module	20
3.3.3 MQ-131 Gas Sensor	20
3.3.4 DSM501 Particulate Matter Sensor.....	21
3.4 Noise Reduction	23

3.4.1	Simple Moving Average	24
3.4.2	Kalman Filter Algorithm.....	25
3.4.3	Savitzky-Golay Algorithm.....	26
CHAPTER IV	ANALYSIS AND DESIGN	28
4.1	Requirement Analysis.....	28
4.1.1	General Description.....	28
4.1.2	User System Specification	29
4.1.3	System Requirement Analysis	29
4.1.4	Functional Requirement Analysis	29
4.1.5	Non-Functional Requirement Analysis	30
4.2	Model Design.....	30
4.2.1	System Design.....	30
4.2.2	Kalman Filter Algorithm (KFA) Smoothing Process.....	32
4.2.3	Simple Moving Average (SMA) Smoothing Process.....	35
4.2.4	Savitzky-Golay Algorithm (SGA) Smoothing Process	35
4.2.5	Calibration Process	37
4.2.6	Use Case Diagram	38
4.2.7	Activity Diagram.....	39
4.2.8	User Interface Design	40
4.2.9	Class Diagram	41
4.2.10	Hardware Design.....	42
4.3	Testing Design.....	43
4.3.1	Web Application Testing Design	43
4.3.2	Data Testing Design	44
CHAPTER V	IMPLEMENTATION.....	47
5.1	System Specification	47
5.1.1	Software Specification.....	47
5.1.2	Hardware Specification.....	47
5.2	System Implementation	48
5.2.1	Hardware Implementation.....	48
5.2.2	Software Implementation of Arduino.....	52
5.2.3	Web Application Implementation	58

5.3	Testing Implementation	60
5.3.1	Data Testing	60
5.3.2	Web application testing	61
CHAPTER VI RESULT AND DISCUSSION		65
6.1	Data Testing Result.....	65
6.1.1	MQ-7 Data Testing Result	65
6.1.2	MQ-131 Data Testing Result	70
6.1.3	DSM501A Data Testing Result.....	72
6.1.4	Smoothing Algorithm Dynamic Memory and Storage Usage	74
6.2	Web Application Result.....	76
6.2.1	Connection Testing of Ethernet Shield to the Web Server	76
6.2.2	Home Section Result	77
6.2.3	Parameter Section Result	79
6.2.4	Scenarios Testing Result.....	81
CHAPTER VII CONCLUSION.....		86
7.1	Conclusion.....	86
7.2	Future Work	87
BIBLIOGRAPHY.....		88