

CONTENTS

APPROVAL PAGE	ii
SELF DECLARATION AGAINST PLAGIARISM	iii
ABSTRACT.....	iv
ACKNOWLEDGMENTS	v
PREFACE	vi
CONTENTS.....	vii
LIST OF TABLES.....	x
LIST OF FIGURES	xi
LIST OF ABBREVIATIONS	xiv
LIST OF SYMBOLS	xv
CHAPTER I.....	1
INTRODUCTION	1
1. 1 Background.....	1
1. 2 Problem of Identification	2
1. 3 Objectives	2
1. 4 Hypothesis.....	3
1. 5 Scope of Works.....	4
1. 6 Research of Methodology	4
CHAPTER II.....	6
LITERATURE REVIEW	6
2.1 Solution Concept Design	6
2.2 Mobile Robot Avoid Moving Obstacle.....	8
2.3 Mobile Robot With Mecanum Wheeled	9
2.3.1 Mecanum Wheeled Model	12
2.3.2 Kinematic Model of Mobile Robot with Mecanum Wheeled.....	12

2.3.3	Dynamic Model of Mobile Robot with Mecanum Wheeled [13]	16
2.4	Control Methods	24
2.4.1	Control Lyapunov Function (CLF)	25
2.4.2	Control Barrier Function (CBF)	27
2.4.3	Control Lyapunov-Barrier Function (CLBF)	28
2.4.4	Hybrid Automaton	29
2.5	Illustration of Combined Lyapunov-Barrier Function (CLBF) Control Method and Hybrid Automaton	31
2.6	Latitude and Longitude	33
CHAPTER III		35
SYSTEM DESAIN AND MODEL		35
3.1	System Model	35
3.1.1	Block Diagram	35
3.1.2	Hardware Design	37
3.1.2.1	Autonomous Mobile Robot Design	37
3.1.2.2	Circuit Schematic of Autonomous Mobile Robot	38
3.2	Procedure for Designing Control Lyapunov-Barrier Function (CLBF) Method	42
3.3	Design of Lambda (λ) Value	46
3.4	Design of CLF for Each Waypoint	51
3.5	Design of CBF Against Moving Obstacle	54
3.6	Design of Control Lyapunov-Barrier Function (CLBF)	55
3.7	Design of Hybrid Automaton	57
3.8	Simulation, Implementation, and Data Retrieval Scenarios	63
CHAPTER IV		66
RESULTS AND ANALYSIS		66
4.1	Sensor Test Results	66

4.1.1	Testing of JGA25-370 Encoder Sensor Against Pulse Width Modulation	66
4.1.2	Testing of MPU 6050 Sensor Against Rotary Angles	72
4.1.3	Testing of Ultrasonic HC-SR04 Sensor	73
4.1.4	Testing of GPS Adafruit V3 Sensor.....	77
4.2	Simulations	80
4.2.1	Updating Unsafe State In A Circle Against Obstacles.....	81
4.2.2	AMR Against Moving Obstacle	82
4.3	Implementations of AMR Against Moving Obstacles.....	82
CHAPTER V		98
CONCLUTIONS AND RECOMMENDATIONS		98
5.1	Conclutions	98
5.2	Recommendations.....	99
REFERENCES		100
APPENDIX.....		102
Appendix A (View from AMR and Location of Experiment).....		102
Appendix B (Overall Experimental Data)		103