

**IMPLEMENTING ROS FOR AUTONOMOUS MOBILE ROBOT BASED ON
LIDAR NAVIGATION**

By

Aulia Syamil
11301006

BACHELOR'S DEGREE

In

MECHANICAL ENGINEERING – MECHATRONICS CONCENTRATION
FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY



SWISS GERMAN UNIVERSITY
The Prominence Tower
Jalan Jalur Sutera Barat No. 15, Alam Sutera
Tangerang, Banten 15143 - Indonesia

August 2017

**IMPLEMENTING ROS FOR AUTONOMOUS MOBILE ROBOT BASED ON
LIDAR NAVIGATION**

By

Aulia Syamil
11301006

BACHELOR'S DEGREE

In

MECHANICAL ENGINEERING – MECHATRONICS CONCENTRATION
FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY



SWISS GERMAN UNIVERSITY
The Prominence Tower
Jalan Jalur Sutera Barat No. 15, Alam Sutera
Tangerang, Banten 15143 - Indonesia

August 2017

Revision after Thesis Defence on 25th July 2017

STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.

Aulia Syamil

Student

Date

Approved by:

Dr. Rusman Rusyadi, B.Eng., M.Sc

Thesis Advisor

Date

Dr. Ir. Gembong Baskoro, M.Sc

Dean

Date

Aulia Syamil

ABSTRACT

**IMPLEMENTING ROS FOR AUTONOMOUS MOBILE ROBOT BASED ON
LIDAR NAVIGATION**

By

Aulia Syamil

Dr. Rusman Rusyadi, B.Eng., M.Sc, Advisor

SWISS GERMAN UNIVERSITY

The purpose of this thesis is to implement ROS framework to establish an autonomous mobile robot based on radio controlled car platform. The navigation system in this work will be designed for corridor environment, using a wall follower technique. A Laser Range Finder (LRF) as primary sensor will be used to determine angle and range of detected wall or object. To compute and process the data, Mini PC will be used and mounted onto the platform. Lastly, Arduino Microcontroller controls the steering movement, and motor speed through Electronic Speed Controller (ESC) by sending PWM signals. LRF and Microcontroller, will be connected into Jetson TK1 through USB interface.

Keywords: Laser Range Finder, Wall Follower, Mini PC, Robot Operating System, Arduino, Radio Controlled Car, Autonomous Mobile Robot, RPLIDAR



SWISS GERMAN UNIVERSITY

DEDICATION

I dedicate this work for Allah SWT, Ayah, Mama, Abang, Kakak, Pak Rusman, and all of my friends who supports me to finish this thesis.



ACKNOWLEDGEMENTS

First of all, I am grateful to Allah SWT. for good health, wellbeing, guidance, and blessing to let me complete this thesis report.

I wish to express my sincere thanks to my beloved family; Ayah, Mama, Kakak, Abang for the supports and attention.

I take this opportunity to express my deepest gratitude to Pak Rusman as my thesis advisor. I am extremely thankful for his time and place, valuable guidance, lessons, encouragement, and patience extended to me.

Lastly, I would like to thank my friends who helped me to finish this report.



TABLE OF CONTENTS

	Page
STATEMENT BY THE AUTHOR.....	3
ABSTRACT.....	4
DEDICATION.....	6
ACKNOWLEDGEMENTS.....	7
TABLE OF CONTENTS.....	8
LIST OF FIGURES.....	11
LIST OF TABLES.....	13
CHAPTER 1 - INTRODUCTION.....	14
1.1 Background.....	14
1.2 Objectives.....	15
1.3 Thesis Problem.....	15
1.4 Thesis Scope.....	15
1.5 Thesis Limitation.....	15
1.6 Thesis Outline.....	16
CHAPTER 2 - LITERATURE REVIEW.....	17
2.1 Introduction.....	17
2.2 Navigation.....	17
2.3 Robotic Operating System.....	18
2.4 Laser Range Finder.....	20
2.5 Mini PC.....	21
2.5.1 Odroid XU4.....	22
2.5.2 Nvidia Jetson TK1.....	22
2.6 Arduino Microcontroller.....	23
2.6.1 Arduino Nano.....	24
2.6.2 Arduino Micro.....	24
2.6.3 Arduino Uno.....	25
2.7 Radio Controlled Car.....	26
2.8 Ackermann Steering Principle.....	26
2.8.1 Parallel Steering Arms.....	27
2.8.2 Angled Steering Arms.....	29
2.9 Wall Following Control.....	30
2.9.1 Bang Bang Control.....	30
2.9.2 P and PD Control.....	32
2.9.3 Determining Distance.....	33
2.10 Concluding Remarks.....	35

CHAPTER 3 – RESEARCH METHODS	36
3.1 General Methodology	36
3.2 System Design	37
3.3 Component Selection.....	37
3.3.1 Light Detection and Ranging (LIDAR).....	38
3.3.2 Nvidia Jetson TK1	39
3.3.3 Arduino Nano	40
3.3.4 Tamiya TT-01 Type ES.....	40
3.4 ROS Download and Installation on Jetson TK1	40
3.5 Package.....	41
3.5.1 RPLIDAR Package.....	41
3.5.2 MIT RACECAR Package	42
3.5.3 Teleop Package.....	43
3.6 Platform Mounting Design	45
3.7 Arduino Wiring	46
3.8 Experiments.....	46
3.8.1 RC Car Test.....	46
3.8.2 Hardware Test	47
3.8.3 Wall Follow Test	47
4 CHAPTER 4 – RESULTS AND DISCUSSIONS	48
4.1 RC Car	48
4.1.1 Steering.....	48
4.1.2 Turn Radius	51
4.2 Platform Mounting Design	51
4.3 Hardware Test	53
4.3.1 NVidia Jetson TK1	53
4.3.2 Teleop.....	55
4.3.3 RPLIDAR.....	59
4.4 Wall Follower.....	59
4.4.1 Wall Follower.....	60
4.4.2 Window Angle	61
4.4.3 PD Tuning	66
CHAPTER 5 – CONCLUSIONS AND RECOMMENDATIONS	71
5.1 Conclusions	71
5.2 Recommendations	71
GLOSSARY	72
REFERENCES	73
APPENDIX A – RC CAR MECHANICAL PARTS	76
APPENDIX B – DATA SHEET.....	78
APPENDIX C – PROGRAM CODE	85
APPENDIX D – LAUNCH FILES.....	101

APPENDIX E – BILL OF MATERIALS	102
CURRICULUM VITAE	103

