

**Optimization Analysis of Motor and Control System in Automatic Filling
Machine**

By

Adhika Pradipta
2-1752-032

MASTER'S DEGREE
in

MECHANICAL ENGINEERING – MECHATRONICS CONCENTRATION
FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY

SWISS GERMAN UNIVERSITY



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

August 2018

Revision after Thesis Defence on August, 1 2018

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.

Adhika Pradipta

Student

Date

Approved by:

Edi Sofyan, B. Eng., M.Eng., Ph.D

Thesis Advisor

Date

Dr. Ir. Hanny Berchmans, M.Sc

Thesis Co-Advisor

Date

Dr. Irvan S. Kartawiria, S.T., M.Sc.

Dean

Date

Adhika Pradipta

ABSTRACT

OPTIMISATION ANALYSIS OF MOTOR AND CONTROL SYSTEM IN AUTOMATION FILLING MACHINE

By

Adhika Pradipta

Edi Sofyan, B. Eng., M.Eng., Ph.D, Advisor
Dr. Ir. Hanny Brachmans, M.Sc, Co-Advisor

SWISS GERMAN UNIVERSITY

This research is performed to help students to understanding on industrial machine works. We now live in automation era and leaving behind the manual machining. Almost every process in industrial use automation machine that is controlled with only one person. With this evolution of technology we can increase the speed of production, reduce the work accident, and stability of quality product.

This automation is expected to increase the efficiency and effectiveness of a machine production. One of the automation machine that the students in ATMI Cikarang is producing a prototype of Automatic Filling Machine. This machine can be applied in some food industrial or other similar industries.

This prototype is based on filling machine in industries that uses for filling process to fill a container. This machine is controlled using *Programmable Logic Controller* (PLC) to control all of the process. This machine have 4 main process. First, is move the container from storage to rotary table. Second, rotary table will transfer to second station. In this station will fill the can using steel ball until reach the specific weight. Third is sealing the can. Fourth is transfer to next process.

The method that it used is Ziegler Nichols method and also uses trial and error. In this experiment get several different result that will input it in Simulink. Experimental results that can be used to choose the components that can be used for same project with this machine. It is expected that by using these experiments there will no longer be wrong component selection

Keywords: PLC, Dc motor, MatLab, Simulink, automation, filling process.



© Copyright 2018
by Adhika Pradipta
All rights reserved

SWISS GERMAN UNIVERSITY

DEDICATION

Thank you to ALLAH SWT for blessing me from start until last during my thesis process. I dedicate this work for My Lovely Parents, My Big Family and all my Friends.



ACKNOWLEDGEMENTS

Praise and great gratitude to Allah SWT to bless me so I can complete the thesis on time.

I would like to thank you to all off those who have given me help and guidance so that this thesis can be finished. Author would like to thank to :

1. Dr. Irvan S. Kartawiria, S.T., M.SC. as my Dean
2. Edi Sofyan, B.Eng, M.Eng, Ph.D as my My Advisor
3. Dr. Ir. Hanny Brachmans, M.Sc. as my Co- Advisor
4. all my friends who involved direct and indirect in supporting this thesis

Final words, the author say thank you so much indeed for all for those who I can not mentions the names. Hopefully this thesis can be useful for us and become the input for the parties in need.



SWISS GERMAN UNIVERSITY

TABLE OF CONTENTS

| | Page |
|------------------------------------|------|
| STATEMENT BY THE AUTHOR..... | 2 |
| ABSTRACT..... | 3 |
| DEDICATION..... | 5 |
| ACKNOWLEDGEMENTS..... | 6 |
| TABLE OF CONTENTS..... | 7 |
| LIST OF FIGURES..... | 10 |
| LIST OF TABLES..... | 13 |
| CHAPTER 1 – INTRODUCTION..... | 14 |
| 1.1 Background..... | 14 |
| 1.2 Research Problem..... | 14 |
| 1.3 Objectives..... | 14 |
| 1.4 Significance of Study..... | 14 |
| 1.5 Research Question..... | 15 |
| 1.6 Hypothesis..... | 15 |
| CHAPTER 2 - LITERATURE REVIEW..... | 16 |
| 2.2. Theoretical Perspectives..... | 16 |
| 2.2. Previous studies..... | 17 |
| CHAPTER 3 – RESEARCH METHODS..... | 22 |
| 3.1. Materials and Equipment..... | 22 |

| | | |
|-------|---|----|
| 3.2. | Flowchart how filling machine works | 22 |
| 3.3. | Flowchart Filling Process | 25 |
| 3.4. | Component of Design | 27 |
| 3.3.1 | Automatic Filling Machines | 27 |
| 3.3.2 | Filling station design | 28 |
| 3.3.3 | DC Motors | 29 |
| 3.3.4 | Software GX-Developer | 29 |
| 3.3.5 | PLC MITSUBISHI | 30 |
| 3.3.6 | Matrix Laboratory (MatLab)/Simulink | 30 |
| 3.3.7 | Matrix Laboratory (MatLab)/SimScape Multibody | 31 |
| 3.3.8 | Solidworks | 32 |
| | CHAPTER 4 – RESULTS AND DISCUSSIONS | 33 |
| 4.1. | Worm Gear Equation | 33 |
| 4.2. | Calculation Data | 34 |
| 4.3. | Approach to Determine the value of PID | 36 |
| 4.4. | Control System Ziegler Nichols Method | 37 |
| 4.4.1 | Open Loop System | 37 |
| 4.4.2 | Close Loop System Using PID | 39 |
| 4.4.3 | Experiment PID control before tuning | 40 |
| 4.4.4 | Experiment PID control after tuning 1 | 41 |
| 4.4.5 | Experiment PID control after tuning 2 | 43 |
| 4.4.6 | Experiment PID control after tuning 3 | 45 |

| | | |
|---|---|----|
| 4.5. | Control System Manual Calculation..... | 46 |
| 4.5.1 | Table Experiment | 46 |
| 4.5.2 | Experiment Open Loop system | 49 |
| 4.5.1 | Experiment Close Loop system..... | 50 |
| 4.5.3 | Experiment Close Loop system First Tune | 53 |
| 4.5.4 | Experiment Close Loop system Second Tune..... | 55 |
| 4.5.5 | Experiment Close Loop system Third Tune..... | 57 |
| 4.5.6 | Experiment Close Loop system Third Tune..... | 59 |
| 4.6. | Component That Design using SolidWorks | 61 |
| 4.7. | Simulink wiring | 62 |
| 4.8. | Graph without PID Controller | 63 |
| 4.9. | Graph with PID Controller in Simulink..... | 64 |
| 4.10. | After Tuning PID | 66 |
| CHAPTER 5 – CONCLUSIONS AND RECCOMENDATIONS | | 68 |
| GLOSSARY | | 70 |
| REFERENCES | | 71 |
| APPENDIX..... | | 73 |
| CURRICULUM VITAE..... | | 77 |