

# **DESIGN AND SIMULATION AUTOMATIC ROOM TEMPERATURE AND LIGHTING CONTROL BY USING FUZZY CONTROL**

By

MAUNG KYAW SOE MOE  
21452012

MASTER'S DEGREE

in

MECHANICAL ENGINEERING – MECHATRONICS CONCENTRATION

FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY



SWISS GERMAN UNIVERSITY  
EduTown BSD City  
Tangerang 15339  
Indonesia

March 2017

Revision after the Thesis Defense on 18 February 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.

[Maung Kyaw Soe Moe]

Student

Date

Approved by:

[Dr. Ir. Hanny Johanesh Berchmans, M.T., M.Sc.]

Thesis Advisor

Date

[Dena Hendriana, BSc. S.M., Sc.D]

Thesis Co-Advisor

Date

[Dr. Ir. Gembong Baskoro M.Sc.]

Dean

Date

## ABSTRACT

By

Maung Kyaw Soe Moe

Dr. Ir. Hanny Johanesh Berchmans, M.T., M.Sc., Advisor

Dena Hendriana, BSc. S.M., Sc.D, Co Advisor

SWISS GERMAN UNIVERSITY

*In air conditioning system, efficient operation of air conditioning equipment to suit the user demand is important and to achieve that, Fuzzy Logic controller can play a key role in formulating the next generation of control technology for the traditional air conditioning equipment. Similar kind of control system is needed also for the control of lighting system to achieve a better efficiency and better comfort level for the users.*

*The target of this research is to develop a fuzzy logic control which will allow less usage of energy by Optimum operation of air conditioning and Lighting which would also promote Conservation of Energy. The control system in this study also would need to achieve a Stable Climate Condition in the room within the limits of control set points including a Stable Visual Comfort in term of Lux level and promote convenient to the users by automatic control.*

*The control strategy proposed in this thesis work is fuzzy logic controller (FLC). A MATLAB fuzzy program tool is used to develop a fuzzy logic controller to achieve within the comfort parameters of temperature and artificial lighting as well as energy savings. Simulink program in MATLAB will also be used to simulate the fuzzy logic in this Thesis work. Based on the findings observed on the case study described in this Thesis Report, the savings achieved by the Fuzzy Logic Air Conditioning System is about 66% while the savings achieved by the Fuzzy logic Lighting Control System is about 23%. With these results, it can be concluded that the objective of this Thesis work has been full filled.*

*Keywords: Fuzzy, Split Air Conditioning Control, Lighting Control*



## DEDICATION

I dedicate this works to my family, friends and for the future of Mechatronics  
Engineering.



## ACKNOWLEDGEMENTS

I wish to thank the members of my Thesis committee for their support, patience and good humor. Their gentle but firm direction has been most appreciated. Thesis Advisors was particularly helpful in guiding me toward a qualitative methodology.

Finally, I would like to thank Dr. Ir. Hanny Johanes Berchmans, M.T., M.Sc., Dena Hendriana B.Sc., S.M., Sc.D., and Dr. Ir. Gembong Baskoro, M.Sc. They have provided me with confidence to complete my Master degree with excellence.

I have found my Master Degree program to be stimulating, effective and thoughtful, providing me with the tools and knowledge to explore into the world of Mechatronics engineering.

SGU  
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.....	7
LIST OF TABLES.....	7
CHAPTER 1 - INTRODUCTION.....	10
1.1 Background.....	10
1.2 Research Problem .....	12
1.3 Research Objective.....	12
1.4 Significance of Study.....	12
1.5 Research Question.....	13
1.6 Hypothesis.....	13
CHAPTER 2 - LITERATURE REVIEW .....	14
2.1 Theoretical Perspectives .....	14
CHAPTER 3 – RESEARCH METHODS .....	23
3.1 Introduction.....	23
3.2 Schedule of Thesis Study.....	23
3.3 Materials and Equipment .....	23
3.4 Analytical Method .....	24
CHAPTER 4 – RESULTS AND DISCUSSIONS.....	31
4.1 Initial Evaluation.....	31
4.2 Data Analysis .....	46
CHAPTER 5 – CONCLUSION AND RECCOMENDATIONS .....	50
5.1 Conclusion .....	50
5.2 Recommendations.....	52
REFERENCES .....	53
CURRICULUM VITAE.....	54

APPENDIX A.....	MATLAB PROGRAM (FUZZY & SIMULINK) IN CD
-----------------	---

## LIST OF FIGURES

Figures	Page
Figure 2.1: Schematic of Air Conditioning System.....	15
Figure 2.2: Schematic of for Flow of Cooling System.....	17
Figure 2.3: The flow of the Freon in compressor.....	17
Figure 2.4 Occupancy sensor with a manual override switch .....	19
Figure 2.5 Daylight brightness sensor.....	20
Figure 2.6 Block Fuzzy Logic Controller.....	21
Figure 3.1 - Schedule of the Thesis Study.....	22
Figure 3.2 Air Conditioning Controller Design Process.....	24
Figure 3.3 Lighting Controller Design Process.....	24
Figure 3.4 Block Diagram System.....	26
Figure 3.5 Typical University Teaching Classroom....	26
Figure 3.6 Technical Specification of Osram 38W T8 Lamp.....	27
Figure 3.7 Technical Specification of Daikin 2.64kW Spli Unit.....	28
Figure 3.8 Technical Specification of 840CMH 80W Outdoor Air Fan.....	28
Figure 3.9 Flow Chart for the Preparation of Simulink Program.....	30
Figure 4.1 Membership Functions Lighting Control System.....	29
Figure 4.2 Surface Viewer, Fuzzy Rules for the Lighting Control System.....	30
Figure 4.3 Simulink Program for the Lighting Control System.....	31
Figure 4.4 Inputs for Simulink Program of the Lighting Control System.....	32
Figure 4.5 Output for the Lamp Group A.....	32
Figure 4.6 Output for the Lamp Group B.....	33
Figure 4.7 Membership Functions for Air Con Control System.....	37
Figure 4.8 Simulink Program developed for Air Con Control System.....	40
Figure 4.9 Input for Simulink Program or Air Con Control System.....	40
Figure 4.10 Surface Viewer, Fuzzy Rules for Air Con System .....	41
Figure 4.11 Simulink Output for Compressor Speed.....	41
Figure 4.12 Simulink Output for Air Con Fan Speed.....	42
Figure 4.13 Simulink Output for Outdoor Air Fan Speed.....	42



## LIST OF TABLES

Tables	Page
Table 4.1 Rules for the Lighting Control System.....	28
Table 4.2 Inputs for the Lighting Control System.....	33
Table 4.3 Range of Power for the output equipment of Lighting System .....	34
Table 4.4 Outputs for the Lamp Group A.....	34
Table 4.5 Outputs for the Lamp Group B.....	35
Table 4.6 Range of Input for Air Conditioning System.....	35
Table 4.7 Rules for the Air Conditioning Control System.....	36
Table 4.8 Status of Lamp.....	43
Table 4.9 Input for Simulink program of Lighting Control System .....	43
Table 4.10 Lamp Group A output for Simulink program.....	44
Table 4.11 Lamp Group B output for Simulink program.....	44
Table 4.12 Range of Power for Air Con System Equipment.....	45
Table 4.13 Input for Air Conditioning Control System.....	46
Table 4.14 Output 1 (Compressor) for Air Conditioning Control System.....	47
Table 4.15 Output 2 (Air Con Fan ) for Air Conditioning Control System.....	48
Table 4.16 Output 3 (Outdoor Air Fan) for Air Conditioning Control System.....	49
Table 5.1 Energy and Cost savings achieved for Air Conditioning Control System.....	50
Table 5.2 Energy and Cost savings achieved for Lighting Control System.....	51