

## LIST OF CONTENTS

|   |             |
|---|-------------|
| <b>ABSTRACT .....</b>                       | <b>iii</b>  |
| <b>ABSTRAK.....</b>                         | <b>iv</b>   |
| <b>PREFACE .....</b>                        | <b>v</b>    |
| <b>LIST OF CONTENTS.....</b>                | <b>vii</b>  |
| <b>LIST OF FIGURES.....</b>                 | <b>x</b>    |
| <b>LIST OF TABLES.....</b>                  | <b>xii</b>  |
| <b>LIST OF APPENDIX.....</b>                | <b>xiii</b> |
| <b>LIST OF SYMBOLS.....</b>                 | <b>xiv</b>  |
| <b>TERMINOLOGY .....</b>                    | <b>xv</b>   |
| <b>CHAPTER 1 INTRODUCTION.....</b>          | <b>1</b>    |
| I.1 Research Background.....                | 1           |
| I.2 Problem Statements .....                | 4           |
| I.3 Research Objectives .....               | 4           |
| I.4 Problem Boundaries .....                | 4           |
| I.5 Benefit of Research .....               | 4           |
| I.6 Writing Systematics .....               | 5           |
| <b>CHAPTER II LITERATURE REVIEW .....</b>   | <b>6</b>    |
| II.1 Industry 4.0.....                      | 6           |
| II.2 Green Manufacturing.....               | 7           |
| II.3 Model System Green Manufacturing ..... | 8           |
| II.4 Energy .....                           | 12          |
| II.5 Technology Adaptation .....            | 12          |
| II.5.1 Automation System.....               | 12          |
| II.5.2 Automation Components .....          | 12          |
| II.5.2.1 Controller.....                    | 14          |
| II.5.2.2 Actuator .....                     | 15          |
| II.6 Punching Machine .....                 | 16          |
| II.7 Programmable Logic Controller .....    | 16          |

|  |           |
|--|-----------|
| II.8 CX-Programmer v9.1 .....                          | 17        |
| II.9 Previous Research.....                            | 17        |
| <b>CHAPTER III RESEARCH METHODOLOGY.....</b>           | <b>19</b> |
| III.1 Conceptual Model.....                            | 19        |
| III.2 Problem Solving Systematics .....                | 20        |
| III.2.1 Identification Phase.....                      | 22        |
| III.2.2 Initiation Phase.....                          | 22        |
| III.2.2.1 Literature Review .....                      | 23        |
| III.2.3 Creative Phase.....                            | 23        |
| III.2.4 Implementation Phase.....                      | 23        |
| III.2.5 Analysis Phase .....                           | 23        |
| III.2.6 Conclusion and Suggestion Phase .....          | 24        |
| <b>CHAPTER IV COLLECTING AND DATA PROCESSING .....</b> | <b>25</b> |
| IV.1 Identification of System .....                    | 25        |
| IV.1.1 Overall Process Flow .....                      | 25        |
| IV.1.2 Existing Condition .....                        | 29        |
| IV.2 Design of Green Manufacturing System .....        | 30        |
| IV.2.1 Color Identification .....                      | 30        |
| IV.2.2 Improvement Object .....                        | 31        |
| IV.2.3 Green Improvement .....                         | 31        |
| IV.3 Technology Adaption .....                         | 32        |
| IV.3.1 System Requirement .....                        | 34        |
| IV.3.2 Excel Configuration .....                       | 38        |
| IV.3.3 PLC Configuration& PLC Programming .....        | 40        |
| IV.3.4 PLC Program Script.....                         | 42        |
| IV.3.5 Input and Output Address Identification.....    | 42        |
| IV.3.6 Program Transfer from PC to PLC .....           | 44        |
| IV.3.7 Scenario Testing PLC Program.....               | 45        |
| IV.3.8 HMI Design .....                                | 46        |

|   |           |
|---|-----------|
| IV.3.9 Scenario Testing HMI.....                              | 48        |
| IV.4 Calculation of AC Motor Energy Consumption.....          | 48        |
| <b>CHAPTER V SYSTEM ANALYSIS .....</b>                        | <b>51</b> |
| V.1 Analysis Of Automation System Result.....                 | 51        |
| V.1.1 Analysis of Excel Configuration.....                    | 51        |
| V.1.2 Analysis of Program on Main Process .....               | 51        |
| V.1.3 Analysis of Program on Main Process.....                | 51        |
| V.1.4 Analysis of PLC Program Scenario Testing result .....   | 55        |
| V.1.5 Analysis of Human Machine Interface (HMI).....          | 57        |
| V.1.6 Analysis of HMI Scenario Testing result.....            | 58        |
| V.2 Analysis Consumption Energy conversion to cost.....       | 59        |
| V.3 Analysis of automation impact to green manufacturing..... | 60        |
| <b>CHAPTER VI CONCLUSION AND SUGGESTION .....</b>             | <b>61</b> |
| VI.1 Conclusion.....  | 61        |
| VI.2 Suggestion .....   | 61        |
| <b>REFERENCES .....</b>                                       | <b>62</b> |