TABLE OF CONTENTS

APPROVAL i

SELF DECLARATION AGAINST PLAGIARISM ii

ABSTRACT iii

ABSTRAK iv

ACKNOWLEDGEMENTS v

LIST OF CONTENTS vi

List of Figures viii

List of Tables x

Abbreviations xii

1 INTRODUCTION 1
- 1.1 Rationale . . . 1
- 1.2 Theoretical Framework . . . 2
- 1.3 Conceptual Framework . . . 2
- 1.4 Problem Statements . . . 2
- 1.5 Hypothesis . . . 2
- 1.6 Assumption . . . 3
- 1.7 Scope and Delimitation . . . 3
- 1.8 Importance of The Study . . . 3

2 REVIEW OF LITERATURE AND STUDIES 4
- 2.1 Related Literature . . . 4
  - 2.1.1 Chart . . . 4
  - 2.1.2 Sudoku . . . 4
  - 2.1.3 Number Theory . . . 13
    - 2.1.3.1 Congruences . . . 13
    - 2.1.3.2 Euler Function . . . 14
- 2.2 Related Studies . . . 14

3 RESEARCH METHODOLOGY 16
- 3.1 Research Design . . . 16

3.1.1 System Design and Implementation . . . 16
3.1.1.1 Concealing Process . . . 17
3.1.1.1.1 Message Encoding . . . 18
A. Converting Message to Binary . . . 19
B. Chart Scale Modification . . . 19
C. Generating Message Code . . . 21
3.1.1.1.2 Generating Easy and Evil Sudoku Puzzle . . . 22
3.1.1.1.3 Generating Modulus Number . . . 29
3.1.1.2 Revealing Process . . . 33
A. Solving Sudoku Puzzle . . . 33
B. Message Extraction . . . 33
3.1.2 Experiment Scenario . . . 35
3.1.2.1 Suspicion Analysis . . . 35
3.1.2.2 Security Analysis . . . 35
3.1.2.3 Robustness Evaluation . . . 35
3.2 Population/Sampling . . . 36
3.3 Instrumentation and Data Collection . . . 36
3.4 Tools for Data Analysis . . . 36

4 PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA 37
4.1 Presentation of Data . . . 37
4.1.1 The Result of Experiment For Suspicion Analysis . . . 37
4.1.2 The Result of Experiment For Security Analysis . . . 38
4.1.2.1 Security Analysis of Previous Method . . . 38
4.1.2.2 Upper Bound Probability of Successful Guessing Attack 38
4.1.2.3 Implemented Probability of Successful Guessing Attack 40
4.1.3 The Result of Experiment for Robustness Evaluation . . . 44
4.2 Data Analysis . . . 48
4.2.1 Suspicion Analysis of Modified Graphstega Based on Chart Scale Modification . . . 48
4.2.2 Security Analysis of Modified Graphstega Based on Chart Scale Modification . . . 48
4.2.3 Robustness Evaluation of Modified Graphstega . . . 50
4.3 Summary of Findings . . . 51

5 CONCLUSION AND RECOMMENDATIONS 54
5.1 Conclusion . . . 54
5.2 Recommendation . . . 55

Bibliography 57

A The Result of Security Level Experiment 58

B The Result of Robustness Experiment 63

C Curriculum Vitae 72