CONTENTS

APPROVAL PAGE

SELF DECLARATION AGAINST PLAGIARISM

ABSTRACT **iv**

ACKNOWLEDGEMENTS **v**

PREFACE **vii**

CONTENTS **viii**

LIST OF FIGURES **xi**

LIST OF TABLES **xiii**

LIST OF ABBREVIATION **xiv**

LIST OF ABBREVIATION **xiv**

LIST OF SYMBOL **xv**

LIST OF SYMBOL **xv**

ACHIEVEMENTS **xvi**

ACHIEVEMENT **xvi**

1 INTRODUCTION **1**

1.1 Background 1
1.2 Problem Formulation 3
1.3 Objectives and Benefits of the Research 4
1.4 Problem Limitations 5
1.5 Hypothesis 6
1.6 Research Methodology 7
1.7 Research Method 10

2 REVIEW LITERATURE **12**
2.1 Medical Imaging and Its Security Challenges 12
2.1.1 Definition and Types of Medical Imaging 12
2.1.2 Threats to the Confidentiality and Integrity of Medical Data 13
2.1.3 The Importance of Medical Image Security Systems 14
2.2 Encryption and Decryption of Digital Images 15
2.2.1 Basics of Digital Image Encryption 15
2.2.2 Definition of Visual Stego Encryption 16
2.2.3 Permutation and Diffusion Process 19
2.2.4 Basics of Digital Image Decryption 20
2.2.5 General Flow of Medical Image Encryption and Decryption 21
2.3 Chaos Systems and Lorenz Algorithms 22
2.3.1 The Concept of The Chaos Systems in Cryptography 22
2.3.2 Structure and Properties of The Lorenz Algorithms 24
2.3.3 Application of Lorenz in Image Permutation and Diffusion . 27
2.4 Steganography and Embedding Techniques 29
2.4.1 Understanding Steganography and Its Functions 29
2.4.2 Embedding Techniques in Spatial and Frequency Domains . 30
2.4.3 Application of DWT for Embedding Secret and Signature . 31
2.5 Integration of Digital Signatures 33
2.6 Visual Meaningful Encrypted Image (VMEI) 36
2.7 Image Denoising 38
2.7.1 Non-Local Means (NLM) Denoising 38
2.8 System Quality Evaluation 40
2.8.1 Peak Signal-to-Noise Ratio (PSNR) 40
2.8.2 Bit Error Rate (BER) 41
2.9 Related Studies 42

3 SYSTEM MODEL AND DESIGN **44**
3.1 System Model 44
3.2 Simulation Scenario 46
3.2.1 Encryption Simulation Scenario 46
3.2.2 Decryption Simulation Scenario 49
3.3 Evaluation System 51
3.3.1 PSNR Evaluation (Peak Signal-to-Noise Ratio) 51
3.3.2 BER Evaluation (Bit Error Rate) 52
3.3.3 Evaluation Strategy in System Implementation 53
3.4 Integration of User Roles and System Process Flow 53

3.5 Data Acquisition and Analysis Scenarios 56

4 RESULT AND ANALYSIS 62

4.1 Dataset Analysis 62

4.1.1 Preprocessing Dataset 63

4.2 Algorithm Implementation 64

4.2.1 Modeling and Application of the Lorenz Algorithm 64

4.2.2 Application of Discrete Wavelet Transform 66

4.2.3 Application of Permutation and Embedding 68

4.2.4 The Role of Rotation, Alpha and Initial Condition Parameters 70

4.2.5 Application of Decryption and Denoising 73

4.3 System Evaluation Based on Test Scenarios 75

4.3.1 Evaluation Based on Image Resolution 76

4.3.2 Evaluation Based on Alpha Embedding Variations 81

4.3.3 Evaluation Based on Initial Condition 85

4.3.4 Evaluation Based on Rotation 87

4.3.5 Evaluation of The Application of Parameter Combinations . 89

4.3.6 Evaluation of Results Based on User Roles 91

4.4 Research Comparison 95

5 CONCLUSION 98

5.1 Conclusions 98

5.2 Future Works 99

REFERENCES 100

Lampiran 109