



TABLE OF CONTENTS

ABSTRACT.....	I
PLAGIARISM STATEMENT.....	II
TABLE OF CONTENTS.....	III
TABLE LIST.....	V
FIGURE LIST.....	VI
CHAPTER I . INTRODUCTION.....	1
1.1. Background.....	1
1.2. Problem Statement.....	3
1.3. Research Objective.....	3
1.4. Research Scope.....	3
1.5. Research Benefits.....	4
CHAPTER II. LITERATURE REVIEW.....	5
CHAPTER III. THEORETICAL BASIS.....	11
3.1 Deep Learning.....	11
3.2 Sentiment Analysis.....	12
3.2.1. Aspect-Based Sentiment Analysis (ABSA).....	12
3.3 Data Preprocessing.....	14
3.3.1. Data Cleaning and Normalization.....	14
3.3.2. Tokenization.....	15
3.3.3. Padding and Truncation.....	16
3.4 Natural Language Processing.....	16
3.4.1 Transformers.....	17
3.4.2 Bidirectional Encoder Representations from Transformers (BERT).....	18
3.4.3 Long Short-Term Memory (LSTM).....	24
3.4.4 Bidirectional Long Short-Term Memory (BiLSTM).....	28
3.4.5 Attention Layer.....	31
3.5 Loss Functions.....	33
3.5.1 Binary-Cross Entropy Loss.....	33
3.5.2 Cross Entropy Loss.....	34
3.6 Evaluation Metrics.....	34
3.6.1 Confusion Matrix.....	35
3.6.2 Accuracy.....	35
3.6.3 Precision.....	36
3.6.4 Recall.....	36
3.6.5 F1-Score.....	36
CHAPTER IV. RESEARCH METHODOLOGY.....	37
4.1 Research Description.....	37
4.2 Dataset Acquisition.....	38
4.2.1 Dataset Overview.....	39



4.2.2 Aspect Categories.....	41
4.2.3 Aspect and Sentiment Labelling.....	42
4.3 Data Labelling.....	43
4.3.1 Aspect-Sentiment Pair Extraction.....	43
4.4 Data Pre-Processing.....	44
4.4.1 Data Cleaning and Normalization.....	44
4.4.2 Tokenization.....	45
4.5 Model Architecture.....	45
4.5.1 Input Layer.....	47
4.5.2 Tokenization Layer.....	47
4.5.3 Embedding Layer.....	47
4.5.4 BERT Layer.....	48
4.5.5 BiLSTM Layer.....	48
4.5.6 Attention Layer.....	48
4.5.7 Classification Layer.....	49
4.5.8 Output Layer.....	49
4.6 Model Training.....	49
4.6.1 Data Splitting.....	50
4.6.2 Training Process.....	50
4.6.3 Hyperparameter Tuning.....	53
4.7 Model Evaluation.....	55
CHAPTER V. IMPLEMENTATION.....	56
5.1 Research Environment.....	56
5.2 Dataset Overview and Label Formatting.....	56
5.3 Data Preprocessing.....	59
5.4 Model Development.....	61
5.4.1 Dataset Preparation.....	61
5.4.2 Model Architecture Implementation.....	65
5.4.3 Combined Training Process.....	67
5.4.4 Combined Evaluation Process.....	70
5.5 Model Training and Evaluation.....	73
CHAPTER VI. RESULTS AND DISCUSSION.....	76
6.1 Prediction Results.....	76
6.2 Model Evaluation Results.....	76
6.3 Error Analysis.....	79
CHAPTER VII. CONCLUSION.....	81
7.1 Conclusion.....	81
7.2 Future Works.....	81
REFERENCES.....	83