

TABLE OF CONTENTS

PREFACE	v
TABLE OF CONTENTS	vi
LIST OF FIGURES	ix
LIST OF TABLES	x
INTISARI	xi
ABSTRACT	xii
CHAPTER I INTRODUCTION	1
1.1 Research Background	1
1.2 Research Problem	2
1.3 Research Scope	3
1.4 Research Objective	3
1.5 Research Benefit	3
CHAPTER II LITERATURE REVIEW	4
2.1 Machine Learning for Stock Prediction	4
2.2 Neural Network for Stock Prediction	4
2.3 CNN-LSTM	5
2.4 Stock Prediction using Technical Indicators	6
2.5 Cross Validation for Time Series	6
2.6 Sliding Window Segmentation	7
CHAPTER III THEORITICAL FOUNDATION	12
3.1 Stock Exchange	12
3.2 Technical Indicator	12
3.2.1 Trend-Following Indicator	13
3.2.1.1 Moving Average	13
3.2.1.2 EMA	14
3.2.1.3 MACD	14
3.2.1.4 Upper Bollinger Bands	14
3.2.1.5 Lower Bollinger Bands	15
3.2.2 Oscillator Indicator	15
3.2.2.1 Stochastic	15

3.2.2.2	Relative Strength Index	16
3.2.2.3	William's % R	16
3.2.2.4	Commodity Channel Index	17
3.3	Sliding Window	17
3.4	Rolling Basis Cross Validation	18
3.5	Normalization	19
3.6	Forecasting Model with Time Series Approach	20
3.6.1	LSTM	20
3.6.2	CNN	22
3.6.3	CNN-LSTM	25
3.7	Performance Evaluation	26
3.7.1	Mean Absolute Error	27
3.7.2	Root Mean Squared Error	27
3.7.3	Mean Absolute Percentage Error	27
3.7.4	R-Squared	27
3.7.5	Student's T-test	28
CHAPTER IV	RESEARCH METHODOLOGY	29
4.1	Description	29
4.2	Data Collection and Preprocessing	30
4.3	Experimental Design	31
4.3.1	LSTM	31
4.3.2	CNN	33
4.3.3	CNN-LSTM	34
4.4	Performance Evaluation	36
CHAPTER V	IMPLEMENTATION	37
5.1	Hardware and Software Specification	37
5.2	Implementation of Data Preparation	37
5.2.1	Feature Engineering	37
5.2.2	Normalization	38
5.2.3	Sliding Window	38
5.2.4	Rolling Basis Cross Validation	39
5.3	Implementation of Models	40
5.3.1	LSTM	40

5.3.2	CNN	40
5.3.3	CNN-LSTM	40
5.4	Evaluation	41
CHAPTER VI RESULTS AND DISCUSSION		43
CHAPTER VII CONCLUSION AND FUTURE WORK		49
7.1	Conclusion	49
7.2	Future Work	49
REFERENCES		50