

**FOREX TRADING DECISION MAKING USING RULE-BASED EXPERT  
SYSTEM  
WITH BOLLINGER BAND AND MOVING AVERAGE INDICATORS**

MUHAMAD HAFIZE BIN MASUTI

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## BORANG PENGESAHAN STATUS TESIS\*

JUDUL : FOREX TRADING DECISION MAKING USING RULE-BASED EXPERT SYSTEM WITH BOLLINGER BAND AND MOVING AVERAGE INDICATORS

SESI PENGAJIAN : 2013/2014

Saya MUHAMAD HAFIZE BIN MASUTI mengaku membenarkan tesis Projek Sarjana Muda ini disimpan di Perpustakaan Fakulti Teknologi Maklumat dan Komunikasi dengan syarat-syarat kegunaan seperti berikut:

1. Tesis dan projek adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan Fakulti Teknologi Maklumat dan Komunikasi dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan Fakulti Teknologi Maklumat dan Komunikasi dibenarkan membuat salinantesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. \*\* Sila tandakan (/)

_____	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
_____	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
_____	TIDAK TERHAD	

\_\_\_\_\_  
(TANDATANGAN PENULIS)

Alamat tetap: NO 1, JLN GEBANG  
1,18/16A, 40200, SHAH ALAM,  
SELANGOR.

\_\_\_\_\_  
(TANDATANGAN PENYELIA)

PUAN SITI AZIRAH BINTI  
ASMAI

Nama Penyelia

Tarikh: \_\_\_\_\_

Tarikh: \_\_\_\_\_

CATATAN: \* Tesis dimaksudkan sebagai Laporan Projek Sarjana Muda (PSM).  
\*\* Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa.

FOREX TRADING DECISION MAKING USING RULE-BASED EXPERT  
SYSTEM  
WITH BOLLINGER BAND AND MOVING AVERAGE INDICATORS

MUHAMAD HAFIZE BIN MASUTI

This report is submitted in partial fulfilment of the requirements for the  
Bachelor of Computer Science (Artificial Intelligence)

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY  
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2014

## DECLARATION

I hereby declare that this project report entitled  
FOREX TRADING DECISION MAKING USING RULE-BASED EXPERT  
SYSTEM WITH BOLLINGER BAND AND MOVING AVERAGE INDICATORS

is written by me and is my own effort and that no part has been plagiarized  
without citations.

STUDENT : \_\_\_\_\_ Date: \_\_\_\_\_

(MUHAMAD HAFIZE BIN MASUTI)

SUPERVISOR : \_\_\_\_\_ Date: \_\_\_\_\_

(DR. BURAIRAH BIN HUSSIN)

## **DEDICATION**

To my dearest parents, Mr Masuti bin Juni and Mrs Noriza binti Tetel for your love and support that give me strength and courage to finish this project. To my supervisor, Dr. Burairah bin Hussin, thank you for all the guidance and valuable advices from the beginning until the end of the final project. To my dear friends, special thank you for always be my side during my hard time. Thank you for all your support.

## ACKNOWLEDGEMENTS

Alhamdulillah, all praises to Allah s.w.t, I am very pleased and grateful of being able to finish my final project. Firstly and foremost I would like to express my sincere gratitude to my project supervisor, Dr Burairah bin Hussin for the guidance, patience, support, motivation and help throughout this project. I also would like to express my most appreciation to my family for their endless support, encouragement and love that really motivated me to complete this final project. Last but not least, I would like to thank you all my friends for their help and support during my hard time.

## **ABSTRACT**

The research based on rule-based expert system had been done on Artificial Intelligent field to implement into foreign exchange trading using Bollinger band and Moving average. There are many technique could be hybrid by technique of trading or the technique of AI. The important of this research may help the trader in make decision to enter market with recommended from the system either to buy, sell or no trade if not find the rule. Many researchers have been done in creating technique to trading. The difficult of the common technique that represented by research is there not detecting the trending market and the situation may make trader floating. The solid trading technique with implement of Artificial Intelligent may help trader to make decision. This project were using Swi-Prolog to develop the programme and Metatrader4 to setting the chart and trading platform. The outcome from this project is to produce decision making to trader in help them making decision on market.

## ABSTRAK

Penyelidikan berdasarkan sistem pakar berasaskan peraturan telah dilakukan di bidang Kepintaran Buatan untuk dilaksanakan ke dalam urus niaga pertukaran asing menggunakan Bollinger band dan Moving Average. Terdapat banyak teknik boleh digabungkan dengan teknik perdagangan atau teknik AI. Kepentingan kajian ini boleh membantu peniaga dalam membuat keputusan untuk memasuki pasaran dengan disyorkan daripada sistem sama ada untuk membeli, menjual atau perdagangan tidak jika tidak mendapati peraturan. Banyak penyelidikan telah dilakukan dalam mewujudkan teknik untuk dagangan. Kesukaran kebanyakan teknik yang digunakan oleh penyelidikan adalah tidak mengesan trend pasaran dan keadaan itu boleh membuat peniaga menanggung kerugian. Teknik urus niaga yang kukuh dengan menggunakan elemen kepintaran buatan boleh membantu peniaga untuk membuat keputusan. Projek ini telah menggunakan Swi-Prolog untuk membangunkan program dan MetaTrader4 sebagai platform carta dan perdagangan. Hasil daripada projek ini adalah untuk menghasilkan keputusan kepada peniaga dalam membantu mereka membuat keputusan di pasaran.



## TABLE OF CONTENTS

<b>CHAPTER</b>	<b>SUBJECT</b>	<b>PAGE</b>
	<b>FORM STATUS OF THESIS</b>	<b>II</b>
	<b>DECLARATION</b>	<b>IV</b>
	<b>DEDICATION</b>	<b>VI</b>
	<b>ACKNOWLEDGEMENTS</b>	<b>VII</b>
	<b>ABSTRACT</b>	<b>VIII</b>
	<b>ABSTRAK</b>	<b>IX</b>
	<b>LIST OF FIGURES</b>	<b>X</b>
	<b>LIST OF TABLES</b>	<b>XII</b>
	<b>LIST OF ABBREVIATIONS</b>	<b>XIV</b>
<b>CHAPTER 1</b>	<b>INTRODUCTION</b>	
	1.1 Project Background	1
	1.2 Problem Statements	2
	1.3 Objectives	3
	1.4 Scopes	3
	1.5 Project Significance	3
	1.6 Expected Output	4
	1.7 Conclusion	4

<b>CHAPTER 2</b>	<b>LITERATURE REVIEW AND PROJECT METHODOLOGY</b>	<b>PAGE</b>
2.1	Introduction	5
2.2	Decision Making in Forex Trading	5
	2.2.1 Domain	6
	2.2.2 Existing System	7
	2.2.3 Technique	9
2.3	Project Methodology	11
2.4	Project Requirement	16
	2.4.1 Software Requirement	16
	2.4.2 Hardware Requirement	17
2.5	Project Schedule and Milestone	18
2.6	Conclusion	22

<b>CHAPTER 3</b>	<b>RESEARCH METHODOLOGY</b>	<b>PAGE</b>
3.1	Introduction	23
3.2	The Philosophy of Trading	23
3.3	Scenario of Expert System in Making Decision	24
	3.3.1 Bollinger Band	25
	3.3.1.1 Setting of Bollinger Band	27
	3.3.2 Moving Average	30
	3.3.3 Combination of Bollinger Band and Moving Average	31
3.4	Identifying Decision to Entry in Forex Base on Bollinger Band and Moving Average	32
3.5	Represent the Scenarios into Rule-Based Expert System	37
3.6	Decision Tree	37

	3.7	Conclusion	41
<b>CHAPTER 4</b>		<b>IMPLEMENTATION</b>	
	4.1	Introduction	42
	4.2	Program Development	42
		Environment Setup	
	4.3	Software	43
		Configuration Management	
	4.3.1	Rule-Based Expert System	43
		into	
		KBS structure Using	
		Swi-Prolog	
	4.3.2	Design of Swi-Prolog	44
	4.3.3	Metatrader4 Chart Setup	45
		4.3.3.1 Setting of Bollinger Band	46
		4.3.3.2 Setting of	48
		Moving Average	
	4.3.4	Integration between	48
		Swi-Prolog application	
		and Metatrader4	
	4.4	Develop the Programming Code	49
	4.5	Implementation Status	50
		4.5.1 Snapshot of application	50
	4.6	Conclusion	50
<b>CHAPTER 5</b>		<b>ANALYSIS</b>	<b>PAGE</b>
	5.1	Introduction	51
	5.2	Test Plan	52
		5.2.1 Test Organization	52
		5.2.2 Test Environment	53
	5.3	Test Implementation	53
		5.3.1 Experimental Description	53

	5.3.2	Test Data	58
		5.3.2.1 Criteria of Candlestick	59
	5.4	Test Result and Analysis of BBMA Technique	61
		5.4.1 Test Result of BBMA Trading	61
		Performance Using Trading System	
		5.4.2 Analysis of BBMA Trading System	66
	5.5	Conclusion	68
<b>CHAPTER 6</b>	<b>CONCLUSION</b>		
	6.1	Introduction	69
	6.2	Observation on Strengths and Weaknesses	69
	6.3	Contribution	70
	6.4	Future Work of BBMA technique project	70
	6.5	Conclusion	71
REFERENCES			72
APPENDICES			
	APPENDIX A-	BBMA BRUNEI	73
	APPENDIX B-	PROJECT SCHEDULE & MILESTONE	75
	APPENDIX C-	THE SAMPLE OF CODING	81
	APPENDIX D-	SNAPSHOT OF APPLICATION	83
		SWI-PROLOG FIRING RULE	

## LIST OF FIGURES

DIAGRAM	TITLE	PAGE
2.1	Formula Condition of Rule	8
2.2	Existing problem when trending.	10
2.3	General structure of Knowledge Based System	11
2.4	KBS structure	12
2.5	Rapid application development (RAD)	13
2.6	Flowchart for the process in this project	15
3.1	Example an analysis from expert for making sell decision	24
3.2	Expansion Bollinger Band	25
3.3	Behaviour of Bollinger Band	27
3.4	Setting Bollinger Band	28
3.5	Bollinger Band in Candlesticks Chart	28
3.6	Bollinger Band Characteristic	29
3.7	Combination three Moving Average	31
3.8	Combination of Bollinger Band and Moving Average	31
3.9	Scenario to entry after complete the rule	33
3.10	Decision making in selling A technique	34
3.11	Decision making in selling B technique	34
3.12	Decision making in selling C technique	35
3.13	Decision making in re-entry sell technique	35

<b>DIAGRAM</b>	<b>TITLE</b>	<b>PAGE</b>
3.14	Decision making in buy in “market hilang volume”(MHV) technique	36
3.15	Decision tree for BBMA technique	38
3.16	Bearish path of BBMA Technique	39
3.17	Bullish path of BBMA Technique	40
4.1	The cycle to tackle expert knowledge	43
4.2	Flowchart in making programming in Swi-Prolog	45
4.3	Setting Bollinger Band	46
4.4	Bollinger Band in Candlesticks Chart	47
4.5	Illustration of how trader make trading	48
5.1	Metatrader4 Platform	65
5.2	Open Offline Chart Dataset	65
5.3	Chart after insert BBMA setting	66
5.4	Graph of trading performance regarding trading plan structure	56
5.5	Stop loss performance	57
5.6	Historical center	58
5.7	Candlestick detail	59
5.8	Sample of candlestick in metatrader4	60
5.9	Graph of hit take profit (tp)	65
5.10	Graph of balance and equity testing	65
5.11	Sample of trading using BBMA system	67

## LIST OF TABLES

TABLES	TITLE	PAGE
2.1	List of Software Requirement	16
2.2	List of Hardware Specification	17
2.3	Schedule of Project	18
2.4	Milestone PSM 1	19
3.1	Setting used for Bollinger band in metatrader4 chart	28
3.2	Parameter and input for moving average setting	30
3.3	Scenario of checking market movement/trend	32
3.4	Scenario to entry after complete the rule	33
3.5	Represent the rule into binary true-false	36
3.6	Variable and attribute of the rule represent in table	37
4.1	Set of rule represent to table	44
4.2	Setting for Bollinger Band in Metatrader4 Chart	46
4.3	Setting for Moving Average in Metatrader4 Chart Setting	48
5.1	Expert Background	52
5.2	Sample Templates of Analysis	55
5.3	Trading Plan	56

<b>TABLES</b>	<b>TITLE</b>	<b>PAGE</b>
<b>5.4</b>	<b>Stop loss plan</b>	<b>57</b>
<b>5.5</b>	<b>Performance table of trade</b>	<b>61</b>
<b>5.6</b>	<b>Number of entry</b>	<b>64</b>



## LIST OF ABBREVIATIONS

PSM	-	Projek Sarjana Muda
FOREX	-	Foreign Exchange
USD	-	United States Dollar
EUR	-	Euro
GBP	-	Great British Pound
BB	-	Bollinger Band
MA	-	Moving Average
MACD	-	Moving Average Convergence-Divergence
PIP	-	Percentage of Point
KBS	-	Knowledge Based System
RAD	-	Rapid Application Development
BBMA	-	Bollinger Band Moving Average
CS	-	Candlestick
EMA	-	Exponential Moving Average
TP	-	Take Profit
SL	-	Stop Loss
AI	-	Artificial Intelligent

## CHAPTER I

### INTRODUCTION

#### 1.1 Project Background

Foreign Exchange (Forex) is the largest financial market in the world , high liquidity because many transactions traded on the daily currency transactions in excess of more than 1 trillion USD ( United State Dollars ). With a variety of techniques either technical or fundimantal using as indicators to predict rising or falling world currencies , the purpose is just one of the best decisions for entry the position. In this project of Forex Decision Making Using rule base expert system base on Moving Average and Bollinger Band Indicator will develop a system to help the trader to decide whether to short or long in their entry adopt the indicators. Strategy making buy or sell decisions will be taken from experts and transform into a rule base expert system. Example, if the market EUR / JPY is above Bollinger Band (BB) and Moving Average (MA) in the market is down, it will make a decision when the market will rise again and recommend to the trader to face the possibility of the market . In the end of this project, will expect this system will able to help traders to make decision to their trading position.

A Forex transaction is a process of buying of one currency and selling of another, like example buying Euro currency and sell it to Japanese Yen later. At its core are exchange rate and market timing (2013). Several forecasting techniques have been proposed in order to gain some advantages(2012). The style of trading will use technical indicator which is Moving Average (MA) and Bollinger Band (BB). By using expert knowledge, it will transform into rule base to make decision whether to short or long. There are many currency but for this project will test into several currency only. They are many technique of hybrid indicator using to make as indicator to trade such as Relative Strength Index (RSI), Moving Average Convergence-Divergence (MACD) etc.

By using Bollinger Band to trace the Volatility is based on the standard deviation, which changes as volatility increases and decreases and Moving Average to analyze data points by creating a series of averages of different subsets of the full data set.

This project focuses on how to make decisions based on technical trades Bollinger Bands and Moving Averages founded by adopt rule base expert system to make decision making. This technique will make recommendations to the trader to decide to buy or sell when the conditions have been fulfilled.

## **1.2 Problem Statements**

All traders now day trades using platform such as metatrader4, 5 as platform subscribe by broker to give the data visualize to trader to make analysis in decision to long or short. Many of traders have deficulty hard to make best decision in case of many factor. The decision buy or sell must be accurate as the expert ask to do. Most traders lack confidence in their entry and many who do not follow the rules of proper methods. The right decision in make buy or sell are importaint in trading.

### **1.3 Objectives**

In making a decision as deciding to start a buy or sell entry, it necessarily requires an appropriate method of trading. This can be adjusted with Bollinger Bands and moving averages as an indicator that the artificial intelligent though the knowledge of rule-based expert system to make decision making. Therefore, the objective of producing these systems are:

1. To design a decision making system using rule base system based on Moving Average and Bollinger Band
2. To develop a rule based expert system for decision making.
3. To validate a rule base expert system with expert/empirical data.

### **1.4 Scopes**

The application is to ease the trader in making the decision to sell or buy position. It can be used at any chart currency as eur/usd, gbp/usd and others.

### **1.5 Project Significance**

This project will bring benefits to the university especially BITI course. By this smart applications will help the particular trader in decision making. In a near future, some improvement can be done to make this such system more intelligent, effective and can be distributed to community not only in educational area but also in many fields like statistic in fuzzy element, rule base and others.

## 1.6 Expected Output

This system should be able to help traders in making the decision to sell or buy the currency markets.

## 1.7 Conclusion

The aim of this project is to design and develop an application for helping trader to trade by using rules by expert knowledge. The application is aim to be used for any chart of currency such as in Metatrader 4 that provide chart directly from broker and as trader can use to trade wisely.

Despite this system have limitation on its how trader trade by using the indicator that have suggested in early discussion, but if trader have a good discipline and good emotional control by following the rule, the chance to fail in trading will be decrease. In future significance, some improvement or chancing the indicator with reliable other indicator will be help the trader to make more accuracy in making decision to start trade.

## **CHAPTER II**

### **LITERATURE REVIEW AND PROJECT METHODOLOGY**

#### **2.1. Introduction**

In application development, it will with a variety of resources, certainly going through a phase methodology to unlock the strengths and weaknesses of the technique. In this project, adopt rule-based techniques for making decisions in forex trading indicator based on Bollinger Bands and Moving Average was selected to develop this application. In this chapter, the fact and findings, project methodology, project requirement, and project schedule and milestones were discussing.

#### **2.2. Decision Making in Forex Trading**

Fact and findings is references or past researches that have been found in the internet, books, expert, journals and documentation.

Many trading methods using decision making can be used in many artificial intelligent techniques. Forex traders nowadays more focused on the use of indicators available on MetaTrader 4 and then make the rules as a condition of entry to buy or

sell. Therefore, with sufficient drill and practice will help traders to be more confident in making a decision.

In Artificial Intelligent, using rules and trading methods derived from experts can be translated in the form of rule-based decision, the rule-base used to formed from the rules applied by expert in making the decision to start trading.

### **2.2.1. Domain**

Foreign exchange is a largest market flow money in the world. A process that requires trading technical analysis methods are reviewed first. There are several methods used in technical analysis and various indicators used to obtain the results for the start of the transaction.

The artificial intelligent method will implement in this project are using rule base expert system. The rule is based on priority of the rule base. The term rule is used type of knowledge from expert to be representation by define as an IF-THEN structure that related to expert information.

The rule is consists of two part. The IF part as antecedent (premise or condition) and THEN part as consequent (conclusion or action). The set in rule can be joined by operator AND (conjunction) or any operator related.

In a research paper of a Smart Agent to Trade and Predict Foreign Exchange Market by Mohamed Taher Alrefaie, Alaa-Aldine Hamouda was proposed a design of agent to react with environment. By using data of candlestick which contain open, close, high, and low price of each candlestick, they have make selection module base on prediction tools to make decision. Using rule-base to find the operator in case every rule to be fire. In prediction model, they use genetic programming to generate a trading rule. The design is good but I disagree with changing technical indicator wisely. (Mohamed and Alaa-Aldine, 2013)

Secondly a research paper of a Learning Adaptive Bollinger Band System by Matthew Butler and Dimitar Kazakov. They have purposed an algorithm using Bollinger band as indicator. By using a few condition as rules to entry the market as a requirement. This method cannot catch-up the point when market in trending, it will make a big floating when not tackle this problem early.

### **2.2.2. Existing Systems**

There are many systems that have been developed by an expert using the sentiment analysis with different methods and languages. Each of the methods has their own weakness, but it still can get the accuracy whether it is positive or negative.

For instance, a system that was founded by Matthew Butler and Dimitar Kazakov in the journal "A Bollinger Band Adaptive Learning System" has made optimization to find the optimal functioning of the market. They have introduced a novel forecasting algorithm that is a blend of micro and macro modelling perspectives when using Artificial Intelligence (AI) techniques. The micro part concerns the adjusting of specialized markers with populace based advancement calculations. This involves taking in a set of parameters that improve some monetarily alluring wellness work as to make an element indicator processor which adjusts to changing business sector situations. The macro part concerns joining together the heterogeneous set of indicators delivered from a populace of advanced specialized pointers. They execute this two of part into learning versatile Bollinger Band framework so as to discover the "following tick" forecast of value yet give signs to the future pattern. (Kazakov, 2012)