

CHAPTER I

INTRODUCTION

1.1 Background

Cryptocurrency is a kind of digital currency that can be used exactly like a normal currency worldwide. This new type of currency has attracted the attention of many people, from investors to researchers alike. Reaching over 2 trillion dollars in trading volume, this new currency has grabbed the attention of many [1]. Figure 1.1 shows a significant increase of trading volume from January 2018 to July 2021. There is an initial spike of trading volume in January 2018. However, the rising popularity of cryptocurrency is very apparent from January 2021 to July 2021. The popularity that cryptocurrencies has gained in the last couple of years has created a new area for investors to invest in.

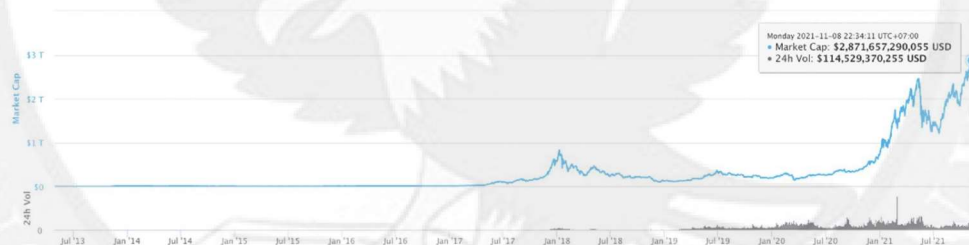


Figure 1.1 Cryptocurrency Trading Volume in the Recent Years
Source: CoinMarketCap

Investing in this new area of investment is surprisingly different compared to conventional methods like a conventional stock market [2]. The lack of indices that support how the price chart will move is one of the major differences of cryptocurrency. Compared to conventional stock trading, there is no supporting statistics like financial report or balance sheet that describes how each cryptocurrency is performing [3], [4]. Many investors use these documents as a

supporting information to decide whether a company is worth investing or not [5], [6]. Without any supporting documents, the cryptocurrency market is very volatile, meaning that prices are very unpredictable and can fluctuate in a very short period. Also, without any supporting documents, investors can only rely on patterns at the price candles to predict whether the price will go up or down [7]. This has made cryptocurrencies very difficult to predict [8], [9].

Due to the raising popularity of cryptocurrency in the recent years, more traders joined the cryptocurrency market [10], [11]. Following this momentum, traders are also trying to find a method of trading that is reliable and accurate since the cryptocurrency market can be quite difficult to predict and analyze. This is when a new type of cryptocurrency called programmatic trading has emerged [12]. Programmatic Trading is a type of trading where a robot is used to automate the trading process of investors. This method utilizes computing power to automate the cryptocurrency trading process to maximize profit gained from trading [13]. The problem of course is the accuracy and the performance of each trading robots. There are various methods that researchers have developed to see how well the robots predict and analyze the cryptocurrency market. This type of trading is very useful in the cryptocurrency market because with the help of computers, traders could take advantage of patterns that are almost impossible to infer by the human mind [13].

The researchers have made robots with different methods such as robots with Prediction Models only, robots with Reinforcement Learning only, there are also some researches that combined both machine learning methods [14]. As mentioned, there are three types of Machine learning methods that researchers used

to predict the cryptocurrency market as shown in Table 1.1. These machine learning methods are:

- Prediction Model.
- Reinforcement Learning.
- Hybrid.

Prediction Models are a type of machine learning methods that predicts a value in the future based on the correct state. This type of machine learning method usually generates a flag that predicts the price that should appear in the future. Reinforcement Learning is an automatic type of machine learning that constantly improve based on past experiences. This type of machine learning will automatically buy or sell cryptocurrency and learn from the action that it took. The final and most interesting one is the Hybrid machine learning method, where researchers combined a prediction model with reinforcement learning.

Table 1.1 Machine Learning Methods with Examples

<i>Prediction Model</i>	<i>Reinforcement Learning</i>	<i>Hybrid</i>
<i>Support Vector Machine (SVM)</i>	<i>Deep Q-Learning</i>	<i>Double Deep Q-Learning + LSTM</i>
<i>Long Short-Term Memory (LSTM)</i>	<i>Double Deep Q-Learning</i>	<i>Double Deep Q-Learning + ANN</i>
<i>Artificial Neural Network (ANN)</i>	<i>Duelling Double Deep Q-Learning</i>	<i>Double Deep Q-Learning + MLP</i>

Extensive research has also been done by researchers around the globe. Many types of machine learning like:

- SVM [14]–[16],
- CNN [17],

- ANN [14],
- LSTM [14], [17],
- MLP [17],
- Q-Learning [18],
- Double Deep Q-Learning [18],
- Dueling Double Deep Q-Learning [18],

and many other machine learning types has already been researched by other researchers before. These machine learning types has been used by other researchers to make a cryptocurrency trading robot. A lot of machine learning techniques has already been researched by other researchers including combined (hybrid) methods such as:

- Double Deep Q-Learning with Long Short-Term Memory (LSTM) [17].
- Double Deep Q-Learning with Convolutional Neural Network (CNN) [17].
- Double Deep Q-Learning with Multilayer Perceptron (MLP) [17].

However, a combination of Double Deep Q-Learning with Support Vector Machine based machine learning has not been research just yet. This research aims to tighten the knowledge gap of this domain by building and measuring the performance of Double Deep Q-Learning with Support Vector Machine.

1.2 Problem Identification

The difficulty of predicting the cryptocurrency market has been the focus of this research. There are some factors that contributes to the volatility of the cryptocurrency market such as the lack of information regarding a cryptocurrency of stock pair (financial report or something similar), and other contributing factors

such as money laundering. There are many efforts that has been done by traders and researchers alike such as:

1. Using statistical calculations manually.
2. Find a familiar pattern that can be used to predict future prices.

These methods are prone to failure because doing statistical calculations manually is prone to human error and looking for familiar patterns in the price charts is limited because the human mind cannot always remember all the patterns. For example, a trader has read a book that lists out different patterns that happen in the cryptocurrency market. The trader cannot always recall all the thousands of patterns that exist in that book. A problem also arises when the book does not list out all the patterns exist in the cryptocurrency market. This is very likely because the human mind cannot possibly infer every single pattern of the dynamics of the cryptocurrency market. Using computers to predict the prices can be useful since computers are not prone to human error, and by using machine learning types, computers can infer patterns that is almost impossible to infer by the human mind. There are many machine learning methods that has been researched by other researchers and this research aims to evaluate the performance of a trading robot with Double Deep Q-Learning and Support Vector machine.

1.3 Problem Scope

- a. Building an automatic trading robot using Double Deep Q-Learning with Support Vector Machine-based machine learning.
- b. Comparing the performance of the combined trading robot with basic Double Deep Q-Learning robot.
- c. Using this robot to automate the trading process in the BTCIDR market.

- d. Using prices data from the market charts to predict future values of cryptocurrency price.

1.4 Problem Formulation

- a. How can we build a cryptocurrency trading robot to maximize profit by combining Double Deep Q-Learning and Support Vector Machine?
- b. How will the hybrid robot perform against basic Double Deep Q-Learning trading robot?

1.5 Research Purposes

This research aims to create a hybrid robot by combining Double Deep Q-Learning reinforcement learning method with Support Vector Machine. Relevant data will be collected from this hybrid trading robot and then the performance of this hybrid robot will be compared against a normal Double Deep Q-Learning trading robot. The trading robot that will be created in this research is an automated trading robot, which means that the robot will automatically analyse, buy, sell, or hold the cryptocurrency by itself without external interference.

1.6 Outline of the Thesis

The writing in this study is divided into at least five chapters, where each chapter has a discussion of different goals and contents. The outline is as follows:

Chapter I Introduction. This chapter discusses a brief description of the background of the problem why this research was carried out to reach the research objectives. This chapter contains the background of why this research is conducted

and some introduction regarding cryptocurrency, cryptocurrency market, and cryptocurrency investment.

Chapter II Theory Study. This chapter discusses the theories that will be used or the research that has been carried out related to the formulation of the problems discussed in Chapter 1. This section is the key part to determine the method that will be used in the next section. This chapter contains all the supporting theories that will be used to conduct this research.

Chapter III Research Methodology. This chapter contains the research design and or test design. This chapter contains the design of the system and a brief explanation of the code implemented within the system.

Chapter IV Results and Discussion. Describe the results of the research that has been carried out and make an argument for what is produced by attaching a thesis or scientific work that has been or will be published. This chapter contains thesis that thoroughly provide the result of this research.

Chapter V Conclusions and Suggestions. This chapter describes the conclusions based on the results of the research obtained, as well as constructive suggestions that need to be developed for future research so that the next research will be better. This contains the conclusion of this research and some suggestions on what to improve in the future.