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AUTOMATED FOREX MARKET TRADING BOT FOR CURRENCIES VIA MT5 PLATFORM

By

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APPROVAL FORM

The undersigned certify that they have supervised the student Maranatha Chitare's dissertation entitled, "Automated Forex Trading BOT for Currencies via MT5 platform" submitted in partial fulfilment of the requirements for a Bachelor of Science Honours Degree in Information Technology at Bindura University of Science Education.

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ABSTRACT

Forex trading is a highly paying market and it is a field that many people are venturing into. Though one can make huge profits by trading forex, it is equally risky as one can also encounter serious losses when trading. Trading forex therefore calls for serious knowledge, skill and experience so that the losses can be minimized and the profits can be maximized as well. It calls for highly informed decisions by the trader to execute trades in the forex market so as to make significant and consistent profits. By analysing the price movements in the forex market, I find an automated trading system more efficient than human beings when trading because it is not driven by emotions. Most traders seem to use emotions to trade which poses a high risk of encountering losses when trading. The development of an automated trading bot for currencies via the meta-trader 5 platform will eliminate this problem and it will place orders on behalf of the trader without the involvement of the trader.

DEDICATION

This research is dedicated to my parents Mr. Calvin Chitare and Mrs. Varaidzo Christine Chitare for their unwavering and immense support throughout this entire journey. They have groomed me to become a fearless young man who has no doubt whatsoever that the future is more than bright. My dedication also goes to my sponsors Drs Strive and Tsistsi Masiyiwa who did not only cater for my school fees and social welfare but constantly taught me and reminded me that there is a tailor made God given purpose and mandate that I have to fulfill and prosper in it. Through them I was able to discover myself and with their mentorship I am becoming better and better by each day that passes. I also dedicate this to my family and friends who undoubtedly believed in me and always want to see fruition in my life.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE

PROBLEM IDENTIFICATION

1.1 Introduction

Forex (FX) refers to the global electronic marketplace for trading international currencies and currency derivatives (Mitchelle, 2021). It has no central physical location, yet the forex market is the largest, most liquid market in the world by trading volume, with trillions of dollars changing hands every day. Presently, Forex is defined as the largest financial market in the world with daily trading volume exceeding $5 trillion (Amiri et al, 2010). By purchasing or selling a certain amount of one currency "against" another, traders conduct Forex transactions. All of the exchange rates are shown in a table with three columns (Figure 1), one for each possible currency pair (for instance, USD/EUR), one for the buying rate, and a third for the selling rate. On average, this table is updated every second (Jorion, Sweeney 1996). The actual time base for Forex is the tick, which typically equates to one second. However, when trading is crowded and brokers are unable to synchronize fast with one another, this time period is extended (Baestaens, Van Den Bergh, Wood 1994).

figure 1. 1 Currency

Symbol	Offer	Request
USD-CHF	1.06563	1.06603
GBP-USD	1.53687	1.53715
USD-JPY	93.164	93.194
EUR-USD	1.34981	1.35001
AUD-USD	0.93291	0.93321
USD-CAD	1.00238	1.00294
EUR-GBP	0.87817	0.87844
EUR-CHF	1.43856	1.43895
EUR-JPY	125.753	125.813
GBP-JPY	143.174	143.229
GBP-CHF	1.63784	1.63849
EUR-CAD	1.35312	1.35400
EUR-AUD	1.44645	1.44715
USD-SGD	1.36930	1.39030
NZD-USD	0.71566	0.71656
CHF-JPY	87.395	87.455
EUR-NZD	1.88382	1.88582
AUD-JPY	86.917	86.969
AUD-NZD	1.30180	1.30379
AUD-CAD	0.93522	0.93592
AUD-CHF	0.99409	0.99479
CAD-CHF	1.06258	1.06338
CAD-JPY	92.892	92.972
NZD-JPY	66.678	66.778
USD-CKK	5.51289	5.51439
USD-NOK	5.90070	5.90710
USD-SEK	7.19538	7.20336
SGD-JPY	67.014	67.064
USD-HKD	7.75555	7.75615

The primary currencies are USD (U.S. Dollar), EUR (Euro), and GBP (Pound). These yield the 10 largest trading pairs, which increase to 24 when the Canadian if one includes the currencies CAD (Canadian Dollar), AUS (Australian. These yield the 10 largest trading pairs, which increase to 24 when the Canadian, Australian, and New Zealand dollars are added (New Zealand Dollar). Depending on your broker, you can trade in additional currency pairings, such as the Singapore Dollar (SGD), Hong Kong Dollar (HKD), and Danish Krone (DKK).

When trading in the Forex market, there are two types of strategies, which are commonly used for analyzing the movement of the market including fundamental and technical analysis (Neely et al, 1987). In the past, hedge funds, big businesses, and governments tended to be the only participants in the currency market, but now anyone can now trade FX. Individuals can open accounts and trade currencies at numerous investment companies, banks, and retail brokers. When you trade on the forex market, you purchase or sell a certain country's currency in relation to another currency. But unlike in a currency exchange kiosk, there is no actual physical transfer of funds from one party to another. Trading on electronic markets typically involves traders establishing a stake in a certain currency in the hopes that there will be some upward movement and strength in the currency they are buying (or weakness if they are selling) so that they can profit.

1.2 Background of the Problem

Many traders display high emotions when trading especially after encountering losses and this usually results in them losing more money when trading. Many forex traders lose their money when trading due to the different human behavior like emotions (Baddeley, 2012). Uncontrolled emotions lead to serious loss of money because at this point trading no longer becomes a business but a gamble. The reason why this becomes a gamble is because the trader will not have time to properly analyze the market price movement, and the danger of assuming how the market will move can result in serious unprecedented and uncalculated losses. Due to the expert skill needed to trade forex, there is need to create a trading BOT that trades efficiently without displaying any kind of emotions. A Trading Bot is a software that is used to analyze trading data of assets and then executes buy and sell orders on behalf of a trader. They act based on pre-programmed and pre-defined rules. The decision-making of the trading bots depends on the price movements in the foreign exchange market.

1.3 Problem Statement

Trading is a very profitable business in which one can venture in and start making a lot of money, but it is however very risky on the other hand and can lead to serious loss of money when done without proper understanding and lack of skill in the market. Many traders still lose their money in forex trading, even if they have a good trading strategy and this is mostly due to human trading behaviors. Due to these kind of behaviors, a vast and large amount of problems arise when trading forex (Baddeley, 2012). For an instant, the survey conducted by Rodriguez in 2016 demonstrated that many traders do well at the identification stage (Rodriguez, 2018). They can identify profitable trading opportunities and when to close the trades out at a profit, but they however ultimately lose as the average loss far outweighs the gain because they cut-loss or close the trades earlier rather than let the profit run and this is a problem that arises due to the human emotion. When some traders lose a trade, they use their emotions instead of using their trading strategy to open another trade immediately with the expectation that they will get a capital return and this may lead to the loss in trade again. As the Forex market is considered to be a highly liquid (Mancini et al, 2013) and a very sensitive market (Jin et al, 2013), every opened trade should be monitored carefully. This is be another problem for traders, who may have not enough time for monitoring the movement of the price. Proper risk management and proper analysis of price movements in the market is a great deal when it comes to trading, therefore it requires a lot of time to study, practice and acquire skill before one can get to trade using real money. This therefore calls for experience and skill in the market to be able to make consistent profits and to not take trade as a gambling. Thus if a trading BOT is implemented, efficient trades with minimized risk will go a long way in making consistent profits for the trader.

1.4 Research Aims

The main aim of this research is to produce a trading BOT for currencies that will automatically execute buy and sell orders on behalf of the trader so as to get rid of emotions when trading and minimize risk as well.

1.5 Research Objectives

- To design and implement a trading BOT for currencies in the forex market via the meta-trader 5 platform.
- To analyze the effectiveness of the trading BOT for placing currencies trades in the forex market.

1.6 Research Questions

The research will be guided on by a set of the following research questions:

- How is the trading bot for currencies in the forex market via mt5 going to execute trades by itself?
- To what extent is the designed trading bot for currencies performing in the forex market?

1.7 Research Propositions/ hypothesis

The research postulates that the use of a trading bot will enable traders to participate and trade currencies in the forex market without their direct involvement and no display of emotions will be shown. This therefore gives the following hypothesis:

i. **H_0** The trading bot will enable the automatic execution of trades without the human interference and accurately place orders in the forex market.
ii. **H_1** The trading bot will *not* enable the automatic execution of trades without the human interference and accurately place orders in the forex market.

1.8 Justification/Significance of Study

Many traders who trade currencies on the forex market have some strategies that work quite well in terms of the risk to reward ratio, but as humans most traders get carried away and they trade based on their emotion and they end up making losses. The use and application of AI has become a great deal in the forex market and there has been much contribution using AI with regards to the analysis of price action in the market. The aim of this project is to produce an efficient trading bot that will be able to place trades on behalf of the trader without any sign of emotion displayed basing on the application of predefined and programmed set of rules.

1.9 Scope

This project only focuses only producing a trading BOT that will work only for traders that trade currencies in the forex market and not any other trading instruments beyond currencies. The bot will only be implemented via the meta-trader 4 or meta-trader 5 trading platform.

1.10Assumptions

The researcher assumed that:

- The user is computer literate.

- ❖ There are enough resources for the implementation of the trading BOT for currencies in the forex market.

1.11Limitations

- ❖ The bot cannot work without internet connection.
- ❖ The bot can cease to make profits over time due to dynamic changes in price movements in the forex market over time.

1.12 Definition of terms

- Forex (FX) - refers to the global electronic marketplace for trading international currencies and currency derivatives (Mitchelle, 2021).
- Artificial Intelligence – is the science and Engineering domain concerned with the theory and practice of developing system that exhibit the characteristics we associate with intelligence in human behavior, (Tecuci, 2012).
- Algorithm – is a series of unambiguous and finite steps followed by a computer to solve a problem, (Rao, 2020).

1.13Conclusion

This chapter has been on problem identification and it has enlightened several contributions to the development of the system. The next chapter will be the literature review of what is currently happening in the forex market internationally and where related work that has been done concerning the problem to be addressed in this research.

CHAPTER TWO

2.1 LITERATURE REVIEW

The previous chapter has been on problem identification and it has enlightened several contributions to the development of the system. This chapter will focus on the literature review. Literature review is an overview of what is known and of what is not known about a given topic. It is the wide-ranging rapid of earlier research on an issue (Causon, 2015). It is a process of understanding a field of study by analysing published and unpublished scholarly and research work. This chapter serves to highlight what has been done before as a flash back to what efforts have been done. This information is very useful to the success of this project as different articles and sources will be reviewed to check how researches have done addressing the same issue and how the researcher's system under design will meet the fall backs of existing system.

2.2 Introduction

In this research, an automated trading bot for trading currencies on the forex market is developed so as to reduce the risk that traders face in the market by the use of artificial intelligence and by the implementation of technical analysis. The proposed method enables the trader to efficiently trade in the market by displaying no emotion and allowing the trading bot to act as per its predefined instructions by the use of technical indicators. Foreign exchange trading, commonly known as forex or FX trading, is a type of trading that involves simultaneously buying and selling several currencies on the international market. In this very dynamic market, forex traders try to make money by trading one currency for another. With a daily trading volume of close to $5 trillion, the forex market is acknowledged as the biggest and most liquid financial market in the world. Because of this, more and more people are becoming interested in forex trading. As a result, some businesses began to create Forex trading bots to aid dealers in their currency trades. This

research is mainly going to talk about the trading bot that will be implemented to place trades automatically for the trader with the use of proper risk management.

2.3 Trading Bots

Forex bots, commonly referred to as forex trading bots, are automatic software programs that produce trading signals similar to other trading bots (Robins, 2021). A Trading Bot is a software that is used to analyze trading data of assets and then executes buy and sell orders on behalf of a trader. Most of these robots are created to interact with Meta-Trader and the MQL scripting language, allowing traders to handle their trades and provide trading signals or position orders. These bots can be very helpful and profitable for Forex traders, which contributes to their widespread use by traders. In fact, the vast majority of Forex traders employ these bots for their trading, especially the experienced professional traders. The following are some benefits of using Expert Advisors or Forex trading robots:

- Both experienced and beginner Forex traders can use them.
- They analyze the historical data rapidly and accurately.
- They don’t act impulsively or emotionally.
- They provide 24/7 trading.

Technical Analysis

Technical analysis is the study of historical market data, including price and volume (Chen, 2021). Using insights from market psychology, behavioral economics, and quantitative analysis, technical analysts aim to use past performance to predict future market behavior. The two most common forms of technical analysis are chart patterns and technical (statistical) indicators. Technical analysis is a forecasting method of price movements using past prices, volume, and open interest. Pring (2002), a leading technical analyst, provides a more specific definition: “The technical approach to investment is essentially a reflection of the idea that prices move in trends that are determined by the changing attitudes of investors toward a variety of economic, monetary, political, and psychological forces. The art of technical analysis, for it is an art, is to identify a trend reversal at a relatively early stage and ride on that trend until the weight of the evidence shows or proves that the trend has reversed.” (p. 2). The phrase "technical analysis" is used to refer to a wide range of tactics that depend on how a stock's price activity is interpreted. The majority of technical analysis is concerned with predicting if a current trend will last and, if not,

when it will turn around. Trend lines are revered by some technical analysts, while others choose candlestick formations, and yet others favor bands and boxes produced by a mathematical visualization. To identify probable entry and exit points for trades, the majority of technical analysts employ a combination of instruments. For instance, a chart formation may lead to a short seller's entry point, but the trader may examine moving averages for several time frames to confirm the likelihood of a breakdown. Chart analysis, pattern recognition analysis, seasonality and cycle analysis, and automated technical trading systems are only a few of the forecasting methods included in technical analysis. Although several recent studies aim to examine visual chart patterns using pattern recognition algorithms, academic research on technical analysis is typically restricted to methods that may be described in mathematical forms, especially technical trading systems. An array of trading rules that emerge from parameterizations make up a technical trading system, and each trading rule provides trading signals (long, short, or out of market) based on the parameter values it is given. Moving averages, channels, and momentum oscillators are a few well-liked technical trading methods.

Technical analysis has been widely employed by market participants like brokers, dealers, fund managers, speculators, and individual investors in the financial industry since Charles H. Dow first published the Dow hypothesis in the late 1800s. According to three numerous surveys, practitioners believe technical analysis plays a big part in their work. For instance, futures fund managers heavily rely on computer-guided technical trading systems (Cheung, Chinn, and Marsh, 2000). 30 to 40 percent of foreign exchange traders globally think that technical analysis is the primary factor influencing exchange rates in the short-term up to six months (Cheung and Wong, 2000).

Most academics are skeptical of technical analysis, in contrast to the opinions of many practitioners. Instead, they tend to think that markets are informationally efficient and that present prices contain all relevant information (Fama, 1970). Therefore, it is useless to try to profit from the knowledge that is currently available in efficient markets. In a famous passage, Samuelson (1965) argues that: "…there is no way of making an expected profit by extrapolating past changes in the futures price, by chart or any other esoteric devices of magic or mathematics. The market quotation already contains in itself all that can be known about the future and in that sense has discounted future contingencies as much as is humanly possible." (p. 44)

Nevertheless, in recent decades rigorous theoretical explanations for the widespread use of technical analysis have been developed based on noisy rational expectation models (Treynor and Ferguson 1985; Brown and Jennings 1989; Grundy and McNichols 1989; Blume, Easley, and O'Hara 1994), behavioral (or feedback) models (De Long et al. 1990a, 1991; Shleifer and Summers 1990), disequilibrium models (Beja and Goldman 1980), herding models (Froot, Scharfstein, and Stein 1992), agent-based models (Schmidt 2002), and chaos theory (Clyde and Osler 1997). For example, Brown and Jennings (1989) demonstrated that under a noisy rational expectations model in which current prices do not fully reveal private information (signals) because of noise (unobserved current supply of a risky asset) in the current equilibrium price, historical prices (i.e., technical analysis) together with current prices help traders make more precise inferences about past and present signals than do current prices alone (p. 527).

Numerous empirical studies have examined the profitability of technical trading rules in a range of markets since Donchian (1960) with the aim of identifying lucrative trading rules, evaluating market efficiency, or both. Fewer research have examined futures markets; the majority of studies have focused on stock markets, both domestically and abroad, as well as foreign exchange markets. The majority of technical trading studies that were conducted until the middle of the 1980s replicated just one or two trading methods. Statistical tests of trading profits, data spying issues, out-of-sample verification, and parameter (trading rule) optimization were not taken into account in these research, even if transaction costs were subtracted to calculate the net returns of technical trading techniques. Technical trading studies, however, significantly improved upon the shortcomings of early studies after the mid-1980s and frequently incorporated some of the following aspects in their testing procedures: In comparison to earlier studies, (1) more trading systems were tested; (2) returns were adjusted for risk and transaction costs; (3) parameter (trading rule) optimization; and (4) statistical tests were conducted using either traditional statistical tests or more advanced bootstrap methods, or both.

2.4 Survey Studies

Survey research makes an effort to closely examine market participants' actions and experiences as well as capture their perspectives on how a market functions. Typical data sets make it difficult to see these features. The earliest survey study on technical analysis was conducted by Stewart (1949), who examined the trading patterns of clients of a significant Chicago futures commission

firm between 1924 and 1932. The outcome showed that traders, regardless of their size and familiarity with the traded commodity, generally failed in their grain futures trading. In futures markets, novice investors were more likely to be long than short. On days when prices were falling, long positions were typically opened, while short bets were started on days when prices were rising. Trading against the direction of the current price movement therefore seemed to be in vogue. However, a typical profitable speculator demonstrated a propensity to buy on price reversals during upward price swings and sell on upswings that followed downward price swings, indicating that profitable speculators followed market trends.

In 1961, Smidt (1965) examined the trading activity of novice investors in the US commodity futures markets. In this poll, about 53% of participants claimed to use charts primarily or occasionally to spot patterns. The chartists tended to trade more commodities than the other traders, despite the fact that their occupations scarcely had any connection to commodity information (non-chartists). Only 24% of traders who used charts had been in the business for six years or longer, compared to 42% of non-charters. Chartists had a small propensity to pyramid more often than other traders. It's interesting to observe that only 10% of chartists nearly always held long positions, compared to 29% of non-chartists.

The opinions of market participants on how the foreign currency market operated in 1985 were polled by The Group of Thirty in 1985. The responders included 15 securities firms and 40 big banks from 12 different nations. According to the survey's findings, 97% of bank respondents and 87% of securities firms thought the market was significantly impacted by the usage of technical analysis. The Group of Thirty reported that “Technical trading systems, involving computer models and charts, have become the vogue, so that the market reacts more sharply to short term trends and less attention is given to basic factors (p. 14).”

In 1986, a survey of significant public futures funds' advisory panels was conducted by Brorsen and Irwin (1987). More than half of the advisors who participated in the poll said they heavily rely on computer-guided technical trading techniques. The majority of fund advisors appeared to trade according to technical principles, fine-tuning the settings of their trading algorithms using historical data that differed per adviser, with two years being the shortest period. Due to liquidity costs, futures funds typically maintained 80% of their positions in the contract that was closest to them, and the typical number of commodities they traded remained fairly stable over time.

Technically traded public and private futures funds were thought to control 23% of the open interest on average across ten significant futures markets, making them large enough to impact prices if they traded concurrently.

According to Frankel and Froot (1990), the demand for dollars on foreign exchange markets may alter over time as a result of the substitution of one forecasting approach for another. The survey findings from Euro money magazine for companies that forecast foreign exchange were the source of the proof. The publication claims that just three forecasting businesses used technical analysis in 1978, while the remaining 19 organizations used fundamental research solely. However, the distribution has changed after 1983. Only one company reported utilizing fundamental analysis and eight reported using technical analysis in 1983. Eighteen firms used technical analysis in 1988, while seven seemed to concentrate on fundamental analysis.

In 1988, chief foreign exchange traders in the London market participated in a survey by Taylor and Allen (1992) to learn how they used technical analysis. According to the survey findings, 64% of respondents said they used moving averages and/or other trend-following systems, while 40% said they used other trading methods such oscillators or momentum indicators. Additionally, about 90% of respondents stated that they used some form of technical analysis when forming their exchange rate expectations over the shortest time frames (intraday to one week), with 60% of respondents believing that technical analysis is at least as significant as fundamental analysis.

Menkhoff (1997) looked into the actions of foreign exchange specialists in Germany in 1992, including dealers and fund managers. According to his poll, 87% of the dealers gave technical analysis a weight of over 10% when making decisions. The importance of technical analysis was perceived to be 35% on average, and other professionals gave similar opinions. The respondents assigned a weight of between 34% and 40% to technical analysis, believing it to have an impact on their choice from intraday to 2-6 months. Other intriguing results included: (1) professionals who preferred technical analysis were younger than other participants; (2) institutional size had no relationship to the preferred use of technical analysis; and (3) neither chartists nor fundamentalists indicated any significant differences in their educational backgrounds.

The use of technical and fundamental analysis by foreign exchange traders in Hong Kong in 1995 was examined by Lui and Mole (1998). The dealers thought that when it came to predicting trends and turning points, technical analysis was more helpful than fundamental analysis. Technical

analysis showed to be essential to dealers at the shorter time horizons up to 6 months, which is consistent with prior survey results. Moving averages and/or other trend-following systems were deemed by respondents to be the most beneficial technical analysis. The average historical period used by the dealers was 12 months long, with daily data being the most common frequency.

In 1995, Hong Kong, Tokyo, and Singapore's interbank foreign exchange markets were the subjects of an investigation by Cheung and Wong (2000). According to the results of their poll, approximately 40% of the dealers thought technical trading was the main factor influencing exchange rates in the medium term (within 6 months), and even in the long term, about 17% thought it was.

Cheung, Chinn, and Marsh (2000) conducted a survey of foreign exchange dealers headquartered in the UK regarding technical analysis in 1998. In this poll, 33% of participants identified as technical analysts, a 20% increase from the previous survey conducted five years prior. Furthermore, 26% of the dealers said that the most crucial element influencing exchange rate changes over the medium term is technical trading.

Cheung and Chinn (2001) presented the findings of a 1998 survey of foreign currency traders based in the US. About 30% of the traders who responded to the poll said their trading approach is best described as technical trading. Only 19% of traders said they engaged in technical trading five years prior. According to 31% of traders who answered, technical trading was the main factor influencing changes in currency rates up to six months.

The relevance of technical and fundamental analysis among foreign currency traders and financial journalists was the subject of a survey conducted in 1996 in Frankfurt, London, Vienna, and Zurich, according to Oberlechner (2001). Up to a 3-month forecasting horizon, technical analysis appeared to be a more significant forecasting tool for foreign currency traders than fundamental analysis; but, up to a 1-month forecasting horizon, it appeared to be more significant for financial journalists. On shorter forecasting timeframes, forecasting methods varied depending on the trading location. Traders in smaller trading locations (Vienna and Zurich) emphasized technical analysis more than traders in larger trading locations, from intraday to a 3-month forecasting horizon (London and Frankfurt). In their trading techniques, traders typically use both technical and fundamental analysis. One of the two forecasting strategies was only used solely by 3% of the traders. Finally, the importance of technical analysis seems to rise across all trading horizons

relative to 1988 (the year Taylor and Allen performed a survey), when comparing the survey results for foreign exchange traders in London to the earlier results of Taylor and Allen (1992).

In conclusion, survey studies show that technical analysis is frequently employed by professionals in the futures and foreign exchange markets and is viewed as a key element in predicting price fluctuations over shorter time periods. There was, however, no research supporting stock market traders.

2.5 Empirical Studies

Various technical trading systems have been put to the test for profitability in a number of empirical studies, many of which also had consequences for market efficiency. Based on an overall assessment of each study's treatment of transaction costs, risk, data snooping issues, parameter optimization and out-of-sample verification, and statistical tests used, the previous empirical studies in this report are divided into two groups: "early" studies and "modern" studies. Early studies often focused on one or two trading systems and took transaction costs into account when calculating the net returns of 17 trading rules. With a few exceptions, out-of-sample verification and parameter optimization were not included, risk was not well managed, statistical assessments of trading profits and data snooping issues were frequently ignored, and the handling of risk was inadequate. Modern studies, in contrast, use the growing computing power of computers to simulate up to thousands of technical trading rules, account for transaction costs and risk, assess the out-of-sample performance of optimized trading rules, and test the statistical significance of trading profits using various bootstrap techniques or conventional statistical tests.

Although there is some overlap between early and contemporary research, this report considers Lukac, Brorsen, and Irwin's (1988) work to be the first modern study since it was one of the first technical trading studies to significantly outperform earlier studies in many ways. The researchers took into account 12 technical trading systems, tested out-of-sample for optimal trading rules using a statistical significance test, and evaluated trading rule performance after taking risk and transaction costs into account. As a result, early research start with Donchian's (1960) study and contain 42 studies up until 1987, while recent studies include the years 1988–2004 with 92 studies.

The quantity of technical trading research conducted over numerous decades is seen in Figure 1.It is noteworthy that during the past ten years, academics have become significantly more interested in technical trading rules, particularly in the stock market and foreign exchange markets. About

half of all empirical research carried out since 1960 were technical trading studies, which were undertaken between 1995 and 2004. This study reviews and discusses representative studies that include distinctive elements of each category. Tables that detail each empirical study's marketplaces, data frequencies, in- and out-of-sample durations, trading systems, benchmarking tactics, transaction costs, optimization, and findings are also included in the report.

2.6 Technical Trading Systems

It is helpful to first introduce and explicitly identify the main categories of technical trading methods before going into historical study. A set of trading rules that can be applied to provide trading signals make up a technical trading system. The timing of trading signals is often determined by one or two factors in a simple trading system. A trading system's rules are all the product of parameterizations. For instance, the Dual Moving Average Crossover method, which has two parameters—a short moving average and a long moving average—can provide hundreds of trading rules by varying how the two parameters are combined. The most well-known technical trading system types include moving averages, channels (support and resistance), momentum oscillators and filters. With the exception of filter rules, these approaches have been extensively utilized by academics, market participants, or both, and, in well-known publications on technical analysis including Schwager (1996), Kaufman (1998), and Pring (2002). Before moving average methods became common in academic research, filter rules were thoroughly examined by academics for several decades (the early 1960s through the early 1990s). This section provides an overview of the key trading strategies for each major category, including Alexander's Filter Rule, Relative Strength Index, Outside Price Channel (Support and Resistance), and Dual Moving Average Crossover.

Dual Moving Average Cross-Over

The most straightforward and well-liked trend-following trading strategies among professionals are those based on moving averages (Taylor and Allen 1992; Lui and Mole 1998). The (dual) moving average method is one of the few statistically well-defined technical trading strategies, according to Neftci (1991). The Dual Moving Average Crossover system determines when the short-term trend crosses above or below the long-term trend to produce trading signals. The system's specifications are as follows:

A. Definitions
   1. Shorter Moving Average over s days at time t $(SMA_t) = \sum_{i=1}^{s} P_{t-i+1}^{c} / s$, where P_t^c is the close at time t and $s < t$.
   2. Longer Moving Average over l days at time t $(LMA_t) = \sum_{i=1}^{l} P_{t-i+1}^{c} / l$, where $s < l \leq t$.

B. Trading rules
   1. Go long at P_{t+1}^{o} if $SMA_t > LMA_t$, where P_{t+1}^{o} is the open at time $t+1$.
   2. Go short at P_{t+1}^{o} if $SMA_t < LMA_t$.

C. Parameters: s, l.

Outside Price Channel

Price channels are another widely utilized technical trading strategy after moving averages. The phrase "trading range breakout" or "support and resistance" may be used to describe the price channel. Price channel systems' defining trait is that market movement to a new high or low implies a continuation of the established trend. As a result, all price channels produce trading signals based on a comparison between the price level today and the price level from a certain number of days ago. The Donchian (1960) trading technique, which used just two prior calendar week's ranges as a channel length, is comparable to the Outside Price Channel system. A sell signal is generated once the closing price breaks outside (below) the lowest price in the price channel, and a buy signal is generated whenever the closing price is outside (higher than) the highest price in the channel length (given time interval). The system's specifications are as follows:

A. Definitions
   1. Price channel = a time interval including today, n days in length.
   2. The Highest High $(HH_t) = \max\{P_{t-1}^{h}, \ldots, P_{t-n+1}^{h}\}$, where P_{t-1}^{h} is the high at time $t-1$.
   3. The Lowest Low $(LL_t) = \min\{P_{t-1}^{l}, \ldots, P_{t-n+1}^{l}\}$, where P_{t-1}^{l} is the low at time $t-1$.

B. Trading rules
   1. Go long at P_t^c if $P_t^c > HH_t$, where P_t^c is the close at time t.
   2. Go short at P_t^c if $P_t^c < LL_t$.

C. Parameter: n.

Relative Strength Index

One of the most well-known momentum oscillator systems is the Relative Strength Index, which Wilder established in 1978. The name "momentum oscillator" comes from the fact that trading signals are derived from values that "oscillate" above and below a neutral point, which is often assigned a value of zero. The momentum oscillator, in its most basic form, contrasts the price now with the price n days ago. The momentum oscillator calculates the speed of directionally moving prices. When a price changes direction quickly, it might be overbought or oversold at some time. Likewise, when a price changes direction quickly, it can also be oversold. A response or reversal is on the horizon in either scenario (Wilder 1978).

Momentum values can be thought of as smoothed price movements, just like traditional moving averages. Moving averages typically are unable to predict a shift in trend in advance, while momentum oscillators often can because momentum values typically decline before a trend reverse has occurred. The Relative Strength Index was created to address two issues that arise when creating meaningful momentum oscillators: (1) erroneous erratic movement, and (2) the requirement for an objective scale for oscillator amplitude.

The system's specifications are as follows:

A. Definitions

1. Up Closes at time t $(UC_t) = P_t^c - P_{t-1}^c$, if $P_t^c > P_{t-1}^c$. P_t^c is the close at time t.
2. Down Closes at time t $(DC_t) = -(P_t^c - P_{t-1}^c)$, if $P_t^c < P_{t-1}^c$.
3. Average Up Closes over n days at time t, $t+1$, $t+2$, … :

   $AUC_t = \sum_{i=1}^{n} UC_{t-i+1}/n$, $AUC_{t+1} = (AUC_t \times (n-1) + UC_{t+1})/n$,

   $AUC_{t+2} = (AUC_{t+1} \times (n-1) + UC_{t+2})/n$, ….
4. Average Down Closes over n days at time t, $t+1$, $t+2$, … :

   $ADC_t = \sum_{i=1}^{n} DC_{t-i+1}/n$, $ADC_{t+1} = (ADC_t \times (n-1) + DC_{t+1})/n$,

   $ADC_{t+2} = (ADC_{t+1} \times (n-1) + DC_{t+2})/n$, ….
5. Relative Strength at time t $(RS_t) = AUC_t / ADC_t$.
6. Relative Strength Index at time t $(RSI_t) = 100 - (100/(1 + RS_t))$.
7. Entry Thresholds $(ET, 100 - ET)$: RSI values beyond which buy or sell signals are generated.

B. Trading rules

1. Go long when RSI falls below ET and rises back above it.
2. Go short when RSI rises above $100 - ET$ and falls back below it.

C. Parameters: n, ET.[10]

Alexander's Filter Rule

Alexander (1961, 1964) was the first to present this technique, and numerous researchers thoroughly tested it up until the early 1990s. Since then, moving average techniques have taken its position as the preferred way among academics. When today's closing price increases (decreases) by x% over (below) its most recent low, this method gives a buy (sell) signal (high). Moves in either direction that are less than x% are ignored. In order to study the remaining price movements, all price movements that are smaller than a given size are filtered away. Alexander (1961, p. 23) argued that "If stock price movements were generated by a trendless random walk, these filters could be expected to yield zero profits, or to vary from zero profits, both positively and negatively, in a random manner." Specifications of the system are as follows:

A. Definitions and abbreviations
    1. High Extreme Point (HEP) = the highest close obtained while in a long trade.
    2. Low Extreme Point (LEP) = the lowest close obtained while in a short trade.
    3. x = the percent filter size.
B. Trading rules
    1. Go long on the close, if today's close rises x% above the LEP.
    2. Go short on the close, if today's close falls x% below the HEP.
C. Parameter: x.

There have been a ton of technical trading systems proposed, and these are only four examples. Readers could consult Wilder (1978), Barker (1981), or other technical analysis texts for further instances. Additionally, additional applications of technical analysis, such as charting, are not covered by the examples given above. The majority of technical analysis books cover a broad range of visual chart patterns, and several recent scholarly works (e.g., Chang and Osler 1999; Lo, Mamaysky, and Wang 2000) have also looked at how well different chart patterns predict future prices by creating pattern recognition algorithms.

Stochastics Oscillator

The Stochastic Oscillator (also called "Stochastic indicator") is an indicator that seeks to understand how strong the market's momentum is (Bombardia, 2020). The market is overbought when the Stochastic Oscillator is very high and the market is oversold when the Stochastic Oscillator is very low.

The Stochastic Indicator demonstrates the market's momentum by looking at the market's current price in relation to its recent range (highs and lows). The Stochastic indicator was developed by George Lane in the 1950s, and is broken down into 2 parts:

1. %K = ((latest CLOSE price - lowest price over the last N periods) / (highest price over the last N periods - lowest price over the last N periods)) x 100
2. %D = 3 day simple moving average of %K

*This indicator can be applied to any time frame chart (hourly, daily, weekly), but for this example we'll look at the stochastics on a daily chart.

"N" periods can be customized to whatever one wants, but the most common setting is "14". This means that the Stochastics indicator is:

1. %K = ((latest CLOSE price - lowest price over the last 14 days) / (highest price over the last 14 days - lowest price over the last 14 days)) x 100
2. %D = 3 day simple moving average of %K

As you can see, %K basically looks at where the market is right now in relation to its range over the past 14 days. Meanwhile, %D smooths out %K, making %K less choppy and sensitive to the market's daily price changes.

Here's an example of stochastics with a daily chart of the S&P 500:

Figure 1. 2 Chart taken from trading view

So how does this illustrate the market's momentum?

1. As the market trends higher, the market will be at the upper end of its 14 day range. Hence, %K will go up, and %D will follow %K higher.
2. As the market trends lower, the market will be at the lower end of its 14 day range. Hence, %K will go down, and %D will follow %K lower.

Most charts also add an "envelope" around the stochastic indicator to demonstrate when the market is "overbought" and "oversold". These levels can be customized to anything you want, but in general:

80 = overbought
20 = oversold

Due to the way it's calculated, Stochastics cannot exceed 100 and cannot fall below 0.

Technical Indicators

Technical indicators are heuristic or pattern-based signals produced by the price, volume, and/or open interest of a security or contract used by traders who follow technical analysis volume (James Chen 2021). Technical analysts utilize indicators to forecast future price changes by examining historical data. The Relative Strength Index (RSI), Money Flow Index (MFI), stochastics, moving average convergence divergence (MACD), and Bollinger Bands are a few examples of popular technical indicators. By examining statistical trends gleaned from trading activity, such as price movement and volume, technical analysis is a trading discipline used to assess investments and spot trading opportunities. Technical analysts concentrate on price movement patterns, trading signals, and many other analytical charting tools to assess a security's strength or weakness, in contrast to fundamental analysts who attempt to determine a security's underlying value based on financial or economic facts.

Any security with previous trading data can be used for technical analysis. Stocks, futures, commodities, fixed-income, currencies, and other assets are included in this. Throughout this research, often study on currencies is to be done, but one can use these ideas with any kind of

security. In fact, technical analysis is far more prevalent in commodities and forex markets, where traders focus on short-term price movements.

Technical indicators, commonly referred to as "technicals," are more concerned with previous trade data than corporate fundamentals like earnings, revenue, or profit margins. This data include price, volume, and open interest. Since technical indicators are made to examine short-term price changes, active traders frequently utilize them, but long-term investors can also use them to find profitable entry and exit opportunities.

Types of Indicators

There are two basic types of technical indicators:

1. **Overlays:** Technical indicators that use the same scale as prices are plotted over the top of the prices on a stock chart. Examples include moving averages and Bollinger Bands.
2. **Oscillators:** Technical indicators that oscillate between a local minimum and maximum are plotted above or below a price chart. Examples include the stochastic oscillator, MACD, or RSI.

   When assessing securities, traders frequently employ a wide range of technical indicators. Traders must select the indicators that perform best for them and become familiar with how they operate out of the thousands of possibilities available. To generate trade ideas, traders may also combine technical indicators with less objective types of technical research, like examining chart patterns. Given their quantitative nature, technical indicators can also be included in automated trading systems. In this research we will make use of a technical indicator called stochastics which is an oscillator indicator.

2.7 Related work

Simple MA Cross - expert for Meta-Trader 4 is a trading bot that was created by Lungile Mpofu in 2020 and the author uploaded it on MQL5 portal. This trading bot was designed to place buy and sell orders automatically by using two moving averages. Whenever there is a cross over between these two moving averages, the bot automatically executes a buy or sell order depending on the direction of the cross over. This bot is however not efficient in that it does not have anything

that governs the crossover, which means that at any given point it crosses over, there is a trade that is executed regardless of the price movement direction.

Perfect Score MT5 is a trading bot that was created by MT5 in 2020. This robot enters the market at the opening of **The London stock exchange** (LSE). It is based on short-term reversal patterns that use **the tendency of currency pairs to move towards their average value during the LSE session**. The EA does not use indicators, grid, martingale, and arbitrage. The trading system is suitable for both experienced traders and beginners. The EA has protection against high spreads and allows you to trade with a fixed or automatic lot size. This trading bot is however not efficient since it can only be active in the London stock exchange session only. In other sessions like the New York session the trading bot will not work.

EA Gold materials mt5 is a specialist Advisor made specifically for gold trading. The job is based on the launching of orders on the Gold Stuff mt5 indicator, so the adviser works on the "tendency Follow" strategy, which means after the trend. This bot is however not efficient in that it only trades gold only and not any other currency pair.

2.8 Review of Existing System

Currently, many trading systems that are available are not very good in terms of risk management. They are good at executing trades whenever a certain condition or trend is met, but when it comes to managing the risk to reward ratio, it is not very pleasing. The reason for this is because the bots might not be making use of take profit and stop loss points. Another factor is even if these bots can have takeprofit and stoploss points, they do not have a trailing stop which is the point at which the trade locks some profits such that if there is a reversal, the trade will still close in profits. Lastly most of the bots that exist have a profit to loss ratio of 1:1, which is not quite good. What it only means is that for every loss made when the stop loss point is hit, the same amount of profit squares with the loss if a loss happens. When a trader wins a trade, s/he must at least gain more than what they could have possibly lost.

2.9 Proposed System

The proposed system is based on a set of predefined and programmed set of rules that includes placing buy and sell orders automatically, set take profits and stop losses, and implement trailing stops for every trade that would have been executed. The trading bot will achieve this by

confirming the entry point of executing a trade by different conditions that have to be met first before it can place any orders. It is only when these conditions are met that the bot executes trades.

2.10 Conclusion

This chapter gave a review of different researches undertaken by different authors to address the issue of improving efficiency in forex trading, so as to minimise losses and make consistent profits with the elimination of emotions in trading. The researcher did a full assessment of the algorithms used by the existing systems and found some gaps which he then filled and improved. The next chapter is going to look at research methodology, which is how the research was executed.

CHAPTER 3

3.0 INTRODUCTION

The process of examining how the research is being conducted is referred to as research methodology. In this case, we examine the many procedures a researcher typically uses to analyse his research challenge, as well as the reasoning behind them. The researcher must understand not just the technique but also the research methodologies.

3.1 RESEARCH DESIGN

The term "research design" refers to a comprehensive approach used to combine various elements of the research study in a way that will help to successfully address the research challenge. The research design also includes instructions on how data is gathered, measured, and analysed. Because the research is based on testing hypotheses, it will be an experimental study. The researcher constructed a prototype that is a representation of the real system in order to carry out the experimental study. The prototype will be tested for precision and effectiveness. The researcher used MQL5 programming language which is implemented on Meta Quotes Editor. MQL5 uses more of c++ programing language syntax.

3.1.1 REQUIREMENTS ANALYSIS

This section below shows the functional and non-functional requirements of the system. These are the basic requirement that the researcher aims to achieve with the given system.

3.1.1.1 Functional Requirements

This refers to what the system should do depending on some specific user input.

- The system must be able to read chart data and execute buy and sell orders.
- The system must be able to input take profit and stop loss positions.
- The system must be able to trail stop.
- The system must be able to produce trade history reports.

3.1.1.2 Non Functional Requirements

These apply on the whole system not only the independent components. Non-functional requirements include factors such as reliability, accuracy and overall system performance. The non-functional requirements of the proposed system are centered on the accuracy of the execution

of trades and the effectiveness of take profit points and stop losses points. System performance during performing some functional requirements is also taken into consideration.

- The system must be reliable.
- The system must be accurate.
- The system must be easy to install.

3.1.1.3 Software Requirements

- Windows 10 operating system
- Meta trader 5 software
- Meta Quotes editor

3.2 System Development

Description of the overview of the system and how it was developed. It specifies all the software tools and models used in the development of the system.

3.2.1 System Development Tools

In this section is the list of the design tools used by the researcher to design the system prototype.

3.2.2 Engine Design Tools

- MQL5
- Meta-quotes editor

3.2.3 System Development Methodology

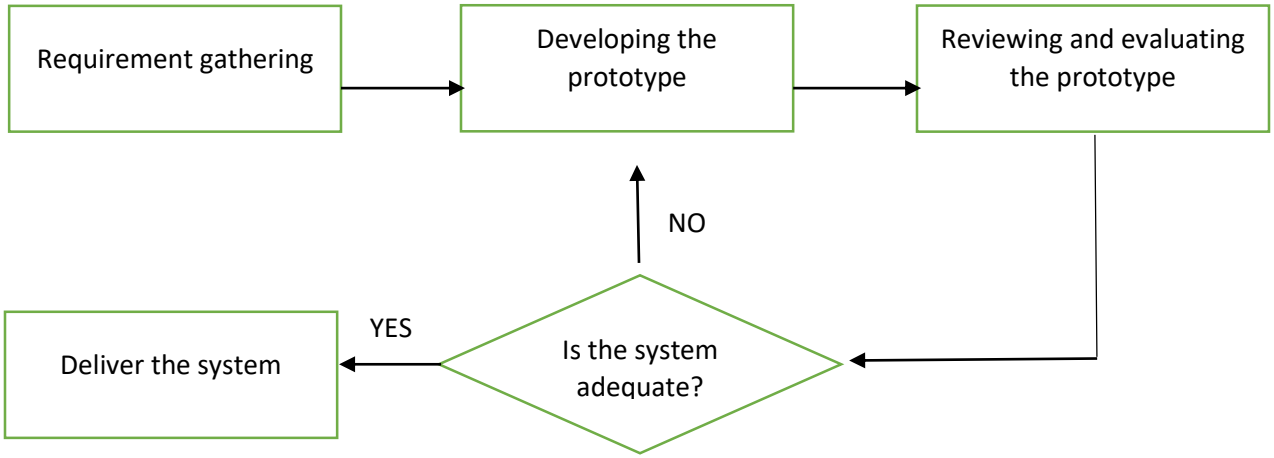
The series of tasks that make up a system development methodology are utilized to conduct research. Software development activity is divided into separate parts by a methodology. Following the evolutionary prototyping model, the system was created. The model of evolutionary prototyping is described in more detail below.

3.2.4 Evolutionary Prototyping

A software prototype is a working version with a few restricted functions. The prototype is an additional effort that should be taken into account when estimating effort because it occasionally lacks the exact logic found in the final software program.

Users can review developer proposals and test them out before implementation using prototypes. Additionally, it aids in comprehending user-specific requirements that the product developer might

not have taken into account. An illustration of evolutionary prototyping is shown in the diagram below:



3.2.5 Basic Steps for prototyping

Requirement gathering

All of the fundamental criteria and specifications for the prototype are acquired at this step in the evolutionary prototyping process. At this point, both functional and non-functional criteria are established.

Developing the prototype

After gathering requirements, a prototype is created using the specifications provided by the users; as a result, the prototype should be able to analyze the market price movements and trade, as well as provide reports. These features might not exactly match the system that will be created.

Reviewing and evaluating the prototype

Some project stakeholders are introduced to and given a demonstration of the prototype. Since it is being incorporated into the prototype that is being constructed, the presentation's audience input is extremely important.

Revising and enhancing the prototype

The results produced after evaluating the prototype are used to enhance the prototype which is under development. At this stage, changes are incorporated into the prototype until the project stakeholders are satisfied. When the all the requirements are met then the system is then delivered otherwise the prototype is enhanced and revised again.

3.3 Summary of how the system works

The automated forex market trading bot for currencies via the mt5 platform mainly uses the stochastics indicator to determine the opening positions when trading. The Stochastic Indicator demonstrates the market's momentum by looking at the market's current price in relation to its recent range (highs and lows). The Stochastic indicator is broken down into 2 parts:

1. %K = ((latest CLOSE price - lowest price over the last N periods) / (highest price over the last N periods - lowest price over the last N periods)) x 100
2. %D = 3 day simple moving average of %K

The market is overbought when both the %K and %D periods are over level 80 of the stochastics and the market is oversold when also when both of these periods are below level 20 of the stochastics.

3.3.1 BUY POSITION: The bot executes a buy order only when the market is oversold ie the stochastics is below level 20, and if and only if there is a crossover between the %K and %D period below the 20 level.

figure 3. 1 BUY POSITION EXECUTION BY THE BOT

3.3.2 SELL POSITION: The bot executes a sell order only when the market is overbought i.e. the stochastics is above level 80, and if and only if there is a crossover between the %K and %D period above the 80 level.

figure 3. 2 SELL POSITION EXECUTION BY THE BOT

3.3.3 Take Profit and Stop Loss points: Stop loss and take profit points are the points at which the bot closes any open trade when these points are reached. When the trade hits a stop loss position, the trade closes in a loss because this is the point at which the trading bot closes the trade so as to manage risk. The take profit point is also a well calculated point at which the bot closes

the trade in profits and it does not exceed this level. This is done so that there is consistency in trading.

3.4 System Design

This stage defines how the system components and data satisfy the specified requirements.

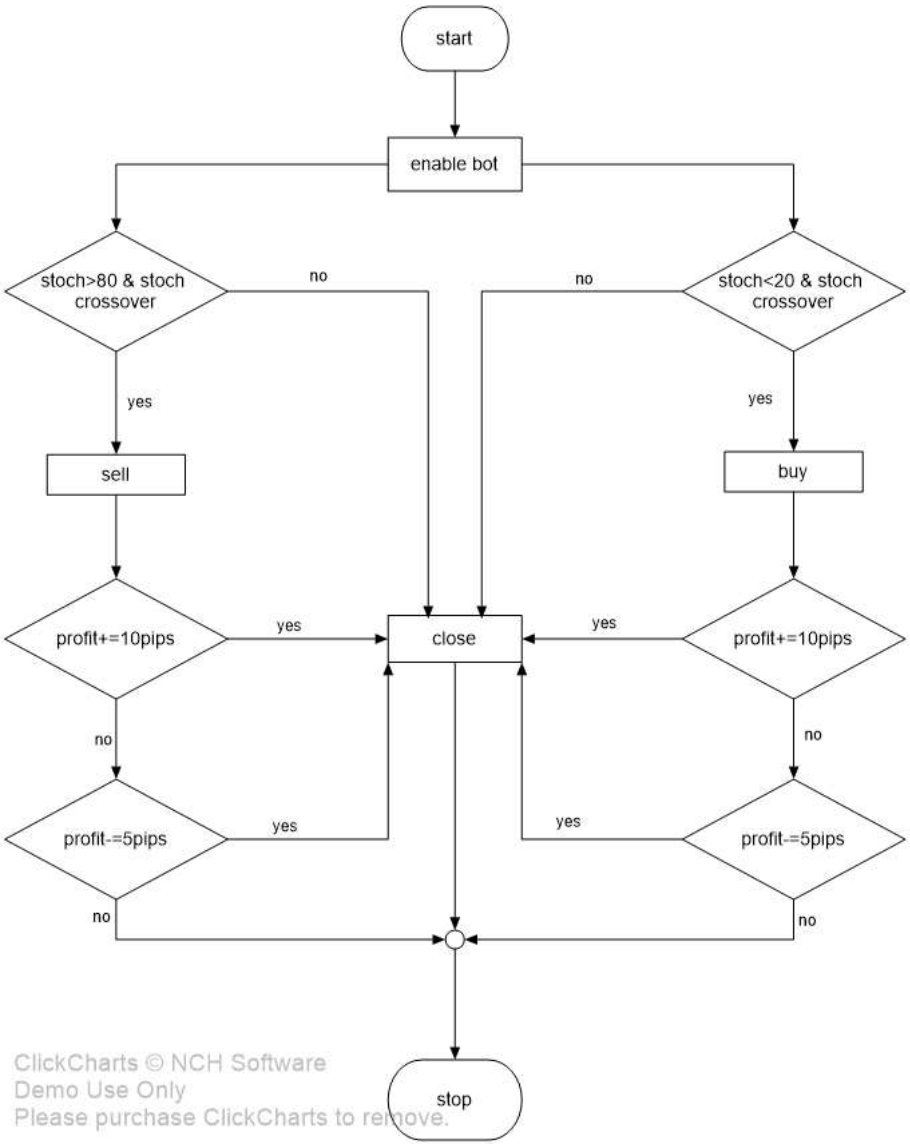
3.4.1 Dataflow Diagrams

This is a graphical representation of the flow of data through information. A DFD is designed to show how a system is divided into smaller portions and to highlight the flow of data between those points.

3.4.2 Proposed System Flow chart

A system flowchart shows how the system work from the starting point up until it reaches the stopping step. The proposed system for facial recognition initiates its operation whenever a user is authenticated. Secondly, after the user has been authenticated, the homepage pops out which shows some options to do. At this stage, the user starts by capturing image datasets whenever the dataset is available. Contrary, the user can train the available dataset. After the dataset has been trained, the user can initiate the face recognition functionality to get the live video feed from the webcam. Lastly, the user can print out all the reports thus some reports are generated by the system. The diagram below illustrates the system flowchart.

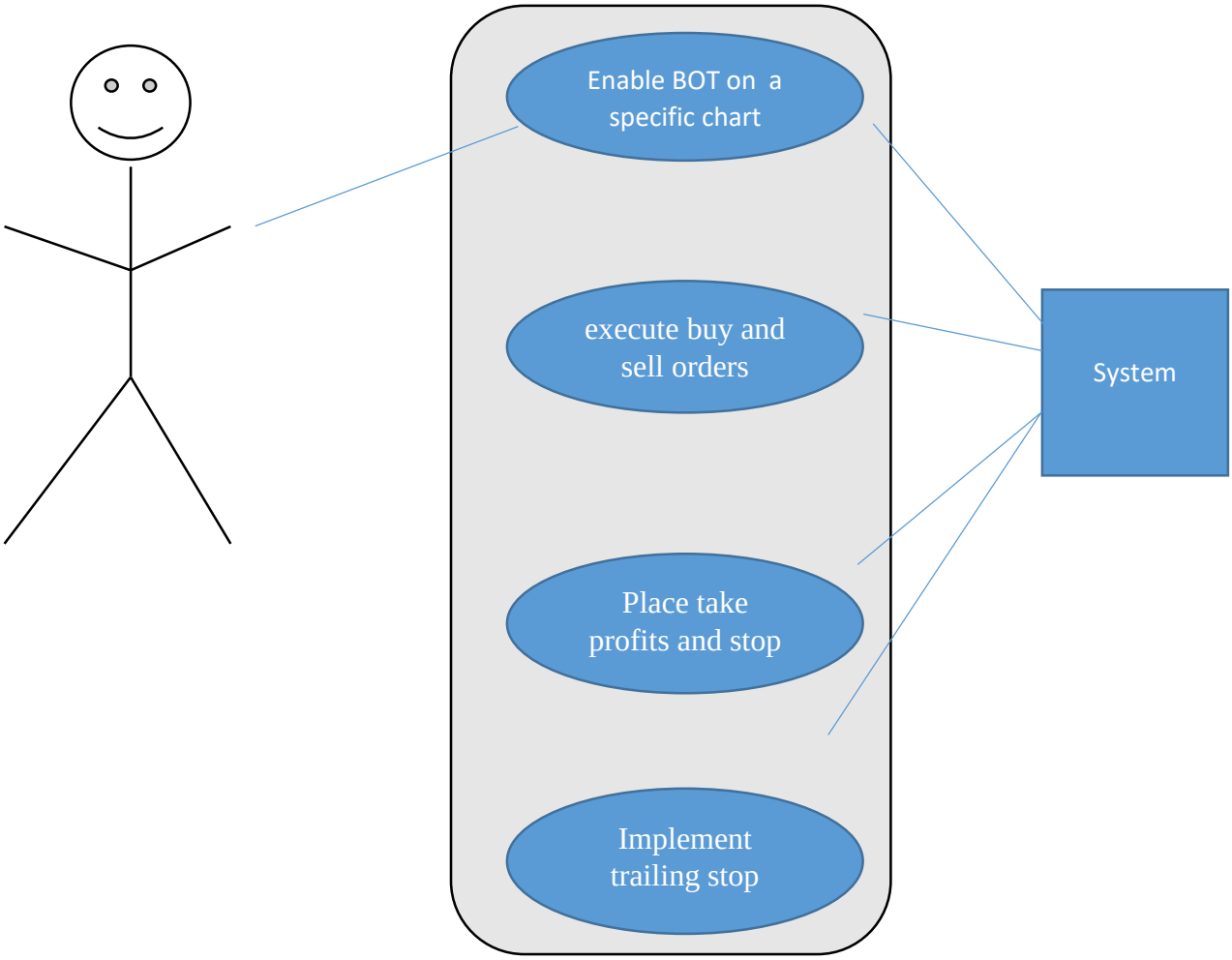
figure 3. 3 system flowchart



3.4.3 USE CASE DIAGRAM

A use case diagram that includes actors and their actions clearly illustrates how the administrator and subject interact with the system. A use case diagram describes the series of actions taken by a system in response to a user action. Throughout the whole development process, use cases are employed to specify the functional needs of a system. The administrator, who oversees all system administration tasks, and the test subjects, who offer testing faces via the webcam, make up this use case. The use case diagram is detailed in the diagram below.

figure 3. 4 system Use Case diagram



DATA COLLECTION METHODS

As a method of gathering information, the researcher used observation. The author exposed the system to various scenarios over the course of several cycles and watched how it behaved. The researcher had the opportunity to examine the system's accuracy and the solution's response time through observation. The researcher also employed literature reviews as an additional technique for gathering data. It concentrated on comprehending the historical evolution of expert advisor systems to trading. This includes an overview of the historical context, the development of trading robots technology in different industries, and strategies and procedures for automatic trading bots.

IMPLEMENTATION

The system is now functioning as a trader who is trading the EURO/USD currency pair.

figure 3. 5 screenshot of the application of the trading bot in mt5 platform

The trading bot name is the one highlighted in blue called stochastics. It is appearing under the Expert Advisors tab. The user must double click it and it must show on the right top corner to show that it is implemented on the specific currency pair the trader wants to trade.

figure 3. 6 screenshot of the trading bot allowing the user to input their own values

Upon clicking the trading bot called stochastics, the system allows the user/trader to input their own stochastics values and even modify the take profit and stop loss points depending on their equity which is their account balance. This option allows the user to implement their own strategy.

CHAPTER 4

4.0 Introduction

After the system has been fully constructed, it is necessary to evaluate the effectiveness of the devised solution. The matrices utilized to evaluate the efficiency and efficacy of the produced solution were accuracy, performance, and response time. Meaningful findings were obtained through the analysis of the data gathered in the preceding chapter. The behaviour of the constructed system was also examined under various circumstances, and the results were shown in a tabular format. The white box, black box, and unit testing all play significant roles in predicting how the system would behave under certain circumstances.

4.1 Testing

This chapter demonstrates the tests that were conducted and the outcomes that were obtained. Testing is a crucial step in the development process. The functional and non-functional requirements of the suggested solution are compared to the testing results.

4.1.1 Black box testing

Black box testing enables someone to test a system against its functional and occasionally non-functional needs without having any knowledge of the system's internal structure. The test mostly concentrated on accessing the outcomes when the trade is over. We also looked at several additional features, such as how the bot execute trades. Thus, the primary goal of black box testing was to determine whether the system performed as predicted according to the requirements.

Figure 4. 1 black box testing

4.1.2 White box testing

The core workings of the system, such as error handling, can be tested by developers and other stockholders using white box testing. This test was done by the author to see how the system responded to scenarios such as operating without an internet connection

The system did not run without internet connection. Though the bot was implemented successfully without an internet connection, the bot could not place trades because it could not fetch live data from the market which requires an internet connection. This means that the bot can never work without internet.

4.2 System tests

Black box testing

To produce the results the researcher used black box testing. Black box testing refers to a method of software testing which examines the functionalities of the system without penetrating through the internal functions or structures. During testing, a sample of different trades were taken in

various conditions and were used to draw certain conclusions on how the system performs. The testing results were produced and they consist of false acceptance rate as well as false rejection rate. Some students and some random people carried out the testing of the system with illustrations shown in the below figures;

Figure 4. 2

Figure 4. 3

4.2.1 Hardware used for testing

Lenovo laptop which has the following specifications:

• Intel core i3 @ 2.10 GHZ

• 4GB RAM

• 64-bit Operating System. 4

4.2.2 Conditions for testing

The results produced where based on the following conditions:

• The trading bot will be implemented on different timeframes.

• The trading bot will be put to trade different currencies.

4.1.3 Evaluation measures and Results

In terms of trade execution

4.1.4 False Acceptance Rate

This is a situation where the trading system falsely identifies an unprogrammed setup and it places a trade based on the wrong conditions. Relating this error to the developed system, false rejection happens when a false setup is regarded as correct and the bot opens positions on the wrong setups. FAR should remain at a minimum because if the rate is high it means that the system is not meeting

its objectives. This is also called False Match, False Positive or Type I error. FAR is calculated as follows:

FAR = Number of False Acceptances / Number of testing trades

Table 4. 1 False Acceptance

Number of testing trades	**False accepted executed trades**	**FAR**
20	0	0%

Table 1 shows the False Acceptance Rate of 0% attained from the system. It can be deduced that the system throws a zero percent False Acceptance Rate even when a large number of trades are executed.

4.1.5 False Rejection Rate

The false rejection rate is the instance of a security system failing to verify or identify an authorized trade setup. Relating this error to the developed system, false rejection happens when a valid trading setup is regarded as unknown. FRR is calculated as follows: FRR = Number of False Rejections / Number of testing faces.

Table 4. 2 False Rejection

Number of testing trades	**False rejected executed trades**	**FRR**
20	0	0%

Table 2 shows the False Rejection Rate of 0% attained from the system. It can be deduced that the system throws a zero percent False Rejection Rate even when a large number of trades are executed.

4.1.6 Trade Setup Recognition Rate

Trade Setup Recognition rate is defined as the rate at which the system correctly recognizes a trade setup and places a trade, and it is expressed as a percentage. Recognition is calculated as follows:

Trade Setup Recognition Rate = number of recognized trade setups /total number of executed trades* 100%

Table 4. 3 Trade Setup Recognition

Test Case	**Total number of trades**	**Total number of recognised trade setups**	**Trade Setup Recognition rate**
1	10	10	100%
2	20	20	100%

Table 4.3 shows the Trade Setup Recognition rate. This was achieved based on a sample of 30 testing trades. The rate was 100% which means 30 trade setups out of 30 trades were recognized and executed correctly.

In terms of the risk to reward ratio

The below images shows a report of the total number of trades executed by the trading bot on different timeframes of the GBP/USD currency pair. The images show the total net profit made after deducting the gross loss from the gross profit. They also show a summary of the exact total number of short trades (buy positions) and the number of long trades (sell positions) that the trading bot executed. The images also show the number of trades that made a profit and also the number of trades that made a loss. These metrics are expressed in terms of percentage as shown in the report.

Figure 4. 4 GBP/USD 1 hour time frame trade results

Figure 4. 5 GBP/USD 30 mins time frame trade results

Figure 4. 6 GBP/USD 5 mins time frame trade results

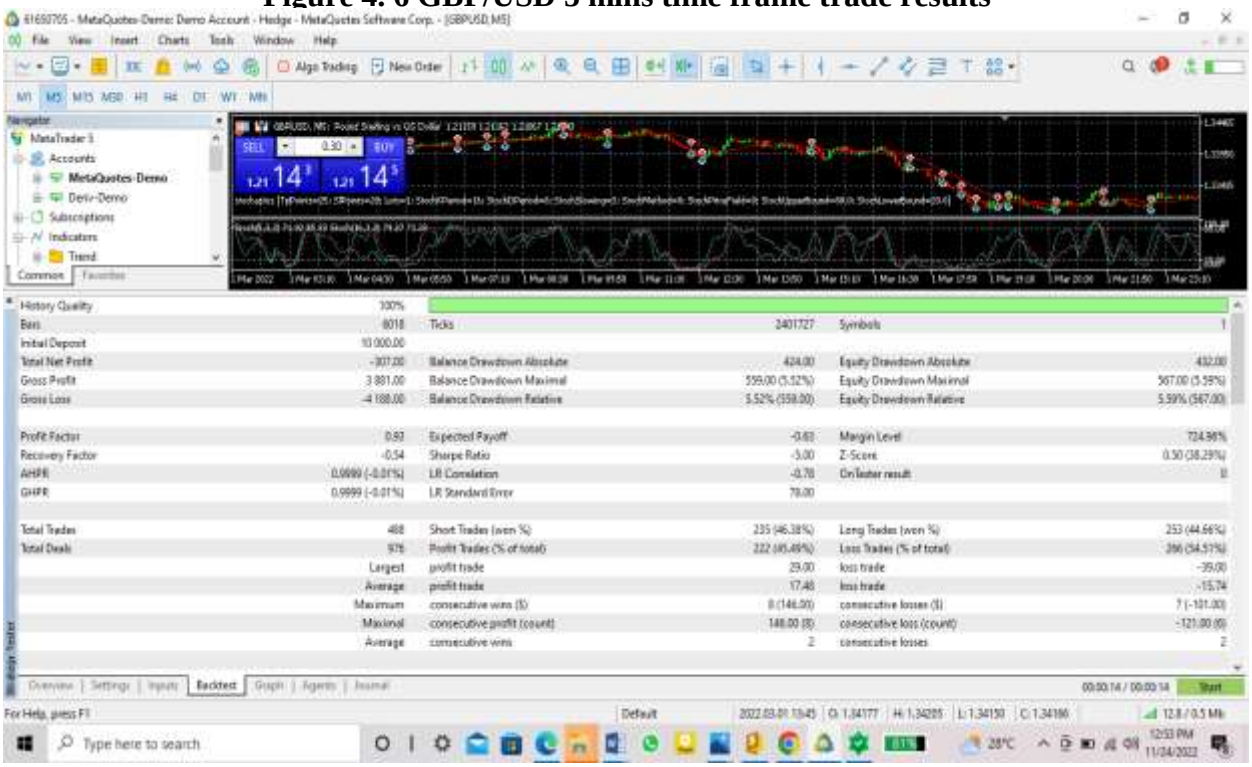


Figure 4. 7 GBP/USD 1 min time frame trade results

Table 4. 4 GBP/USD TRADE RESULTS

Time Frame	Total Trades executed	Buy positions opened	Sell positions opened	Total Won Trades	Win %	Total loss trades	Loss %	Gross profit	Gross loss	Net Profit
1 hour	41	17	24	22	53.66%	19	46.34%	$409.00	$335.00	$74.00
30 min	80	38	42	39	48.75%	41	31.25%	$708.00	($721.00)	($13.00)
5 min	488	235	253	222	45.49%	266	54.51%	$3881.00	($4188.00)	($307.00)
1 min	2632	1278	1354	1200	45.59%	1432	54.41%	$21317.00	($23694.00)	($2377.60)

4.2 Research Findings

The trading bot for currencies is 100% efficient in terms of the execution of trades. Once the trading bot identifies a valid setup, it instantly places an order. The bot executed every trade and performed very well with extreme accuracy. The trading bot is however not as effective in terms of producing high profits. I used different time frames of the same currency pair to see how the bot performed in terms of profit making. The results show that the bot is more effective on higher time frames. It is more reliable to use for swing traders (traders who trade for long hours). The bot will not perform very well for scalpers who only trade for a few minutes and already gets out of the market.

4.3 Conclusion

The results discussed in this chapter clearly proves that the introduction of the automatic trading bot for currencies via the mt5 platform is a noble idea since the testing of the system produced favorable results with Trade Setup Recognition rate of 100%. The bot did not perform very well in terms of profit making. The above results show that the bot is more efficient on higher time frames.

CHAPTER 5

RECOMMENDATIONS AND FUTURE WORK

5.1 Introduction

In the previous chapter, the researcher focused on the presentation and analysis of obtained data. This chapter covers the research development of the solution in line with the set objectives. This chapter will also examine the difficulties encountered by the researcher in designing and carrying out this study.

5.2 Aims and Objectives Realization

The aim of this research was to create an automated trading bot for currencies via the meta-trader 5 platform so as the deal with the notion of emotions that traders display when they trade in the forex market. This aim was fully achieved. The objectives set by the researcher were also achieved. The objectives were as follows;

- To design and implement a trading BOT for currencies in the forex market via the meta-trader 5 platform.
- To analyze the effectiveness of the trading BOT for placing currencies trades in the forex market.

All these objectives were met as illustrated in chapter 3 and 4.

1.14Research Questions

The research question were answered:

- How is the trading bot for currencies in the forex market via mt5 going to execute trades by itself?

As illustrated in chapter 3 and 4, a trading bot for currencies in the forex market via the mt5 platform was designed and implemented well. The bot executed trades by itself and close trades by itself. The bot also made use of take profit and stop loss points for every trade executed. It also made use of a trailing stop which is the point at which it closes a trade in case there is a reversal in the price movement. This trailing stop ensured that profits were locked and losses were minimized.

- To what extent is the designed trading bot for currencies performing in the forex market?

As illustrated in chapter 3 and 4, the designed trading bot proved to be very accurate when it comes to the execution of trades in the forex market. The bot is very effective as it showed 100% accuracy on executing trades. The bot is however not as much effective on making profits. The bot performs better on higher timeframes. The results showed that using this bot to trade on lower timeframes can lead to serious losses.

All the objectives were met.

5.3 Challenges Faced

During the research period the researcher has encountered various drawbacks. The researcher was not able to device very powerful strategies to make huge profits on lower timeframes in the forex market, which means that the system is limited to swing traders and not scalpers. This therefore means that not everyone can make use of the system. To counter this problem, the researcher provided a mechanism for users to input their own values and settings so as to implement their own strategies to the bot. The other challenge is that the system needed a laptop with high computational power so that it does not drag. The last challenge was that the researcher always needed internet to develop and implement the system. The system can never run without an internet connection.

5.4 Recommendations

For the purposes of improving this research project, I recommend the application of more algorithms that can help this trading system to even perform better in lower time frames. It is also of great importance for this trading system to be able to be diverse so that it begins to trade other instruments like synthetic indices apart from currencies.

5.5 Future work

In future, I can use this work in improving the reward to risk ratio by implementing better powerful strategies that do not only focus on the elimination of emotions when trading, but also focus on achieving high profits for the traders with the most minimal losses.

5.6 Conclusion

The system for automated trading bot for currencies via the mt5 platform was successfully implemented and the researcher accumulated new knowledge and experience during the course of the project. Conclusively, this research project was a success.

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