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Enhancing Sustainability with an Automated Financial Literacy Expert Advisor to Train and Educate on Generating Passive Income from Forex Trading

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Abstract: The study recommends developing and developing Expert Advisors (EAs) to facilitate with foreign exchange market trading by leveraging financial technology to increase financial literacy and investing techniques. An EA model and forecasting model that analyses trading details and promptly provides a seller with precise outcomes for purchasing and selling extremely cost-effective guidelines save time. EAs are meant to automate trading procedures by analysing price movements and making accurate buying and selling recommendations using the SMA (Simple Moving Average) and ADX (average directional index) approach. This reduces decision-making time, increases accuracy, and makes investment more accessible. The study's purpose is to encourage people to generate passive income through forex trading by matching their short-term and long-term financial goals with developing fintech trends for future financial sustainability. The proposed system is also user-friendly as it enables a trader to set and perform several trading processes strategies, and the model considers the trades that corresponds to each approach. This would be a valuable study as its inspiration to build passive income in the foreign exchange and technology market enables potentials contributing towards future sustenance of interested people in the society. As future sustenance of people is taken care of, then the society could experience developments meeting the needs of the present and progressively making it easier for future generation to maintain and improve.

Keywords: Average Directional Index (ADX), automation, Expert Advisors (EAs), foreign exchange market literacy, forex trading, Simple Moving Average (SMA).

Introduction

Information Systems development is now recognised as capable of leading to development which can be in simple terms be understood to refer to a state of improvement. Every nation strives to fully actualize this enormous potential. This is a desirable state for any society. An important aspiration of people is to sustain the state of development they might be, and to continue to grow more into further developmental state. Brown (2017) explains that sustainable development (SD) is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. In this regard of Information Systems development, we must plan for ways that would ensure that future Information Systems developers are able learn to do their work effectively without any compromising situation. This was desirable to be achieved without incurring major social costs (Stockhus, 2011; Zanten & Tulder, 2021). For example, the advent of the COVID-19 pandemic in 2019 and the lockdown in 2020 have taught the world the need to plan and be able to quickly overcome any compromising situation. Such situations include the need to have in addition to one’s active job, some additional passive income generating jobs that can be done even while being at home in a lockdown, and so without incurring major physical costs.

One of such ways to facilitate some additional passive income generating jobs involve the trading of currency, stock and indices in the forex market. The global decentralized or over-the-counter market for currency trading is known as the foreign exchange market, every currency's foreign exchange rate is set by this market (Desai et al., 2007; Slaný, 2009). The forex trading market is not easy, even though it can guarantee big profits or loss. Lyons et al

(2006) concur that it requires the experience that tends to be built to be able to produce regular results over months or even years. Sometimes, the most significant factor in raising profitability is based on the trader's emotional impact (Slaný, 2009). Traders are also swept away by uncertainty and greed because of the high level of price volatility, so they come out and break the current trading structure. Expert advisors and metrics are also needed, which can assist in decision-making and automation of trading operations so that trading can take place regularly without psychological influences being affected (Osunbor & Egwali, 2016; Torre et al., 2023).

Slaný (2009) submitted a forex market prediction architecture that is self-adapting using genetic programming. The objective was to design an adaptive system of simple predictors that can be utilized by humans and the host system in ascertaining predictors for trading. However, the system had a high ratio of incorrect projected predictor results.

Significant financial difficulties have been brought to light by the COVID-19 outbreak, especially for individuals confined without paid leave. Many self-employed professionals, including physicians, attorneys, dentists, and accountants, as well as small company owners, have had major financial losses, making it impossible for them to make money even while they are working (Ellul et al., 2020; Pokhrel & Chhetri, 2021). People who depend on several side jobs to pay for necessities like food and rent have been particularly severely impacted. Since success in contemporary education includes more than simply academic achievement, it also entails financial competence, this crisis emphasizes the need of financial literacy, particularly for young people (Ellul et al., 2020). Giving pupils the fundamental life skills they need to successfully manage their money now and in the future is vital to preparing them for success in the future (Douagi et al., 2021).

A forex expert advisor is introduced in this paper as a solution for automating trading strategies. It is designed to assist individuals with limited time or expertise to analyze the market effectively. With advancements in technology, automated forex trading streamlines the trading process by reducing the need for manual decision-making and execution (Bolloju & Sugumaran, 2012; Torre et al., 2023). These robots, also known as algorithmic software, operate based on predefined rules and conditions set by the developers (Osunbor & Egwali, 2016; Torre et al., 2023). While their primary role is to provide support, more advanced versions have the potential to enhance trading performance further, offering a comprehensive approach to managing trades efficiently.

Background of the research problem

Since the health influence of COVID-19 on families, the pandemic has impacted household finances for the following years and is expected to continue to affect them. A strategy would be essential to one's financial security, prioritizing spending and leveraging money effectively. After COVID-19 in 2020, many countries and school districts opted to close schools and offer classes, whether for credit or not, which, along with widespread lockdowns, caused significant financial hardship for many families (Bozkurt et al., n.d.; Pokhrel & Chhetri, 2021). The overwhelming majority of households in South Africa rely either on two incomes or on single parents with a single source of income. When children no longer go to school while mothers and fathers go to work (even virtually) a great majority of parents still must either pay for more child-care (if they dare) or take their personal time away from home to cope with their children(Pokhrel & Chhetri, 2021). Thus, during and after the pandemic of COVID-19 many individuals suffered from less income, retrenchment, lack of job opportunities etc. because businesses and even schools were not operating (Carranza et al., 2020).

Carranza et al (2020) concurred that resulted in people who lack financial literacy having no means to save money for raining days or invest in long-term or short-term goals. It is thus vital to find a way to have several incomes and not rely on one income. Disciplined money management is necessary to generate passive income since emotional control and financial decisions are intimately related (Grable et al., 2020). A thorough grasp of the benefits of investing is made possible by efficient cost and return monitoring, which is ensured by effective money management. Managing strategy and emotions is crucial since trading, especially in forex, requires a precise balance between risk and reward. Uncontrolled emotions, on the other hand, might compromise prudent financial management by causing rash choices that deviate from predetermined plans (Grable et al., 2020). Lack of trading discipline, where feelings frequently take precedence over logical judgment, is one factor contributing to the difficulties faced by many forex traders (Grable et al., 2020; van Zanten & van Tulder, 2021).

Retail foreign exchange trading has proven to be a lucrative means of making profits, even though it occupies just 6% of foreign exchange market (Amirdhavasani et al., 2020). As a result, more people have wanted to get involved in this sector and with usage of electronic trading, it has managed to speed up the whole trading process (Amirdhavasani et al., 2020; Desai et al., 2007). Irrespective of electronic trading technologies, trading Needs dedication and several other important factors for progress. These considerations include knowledge and appropriate

tools, managed impulses, and high wealth. Introduction of the idea of leveraging by online retail traders allows people to exchange forex markets without the need for huge money (Amirdhavasani et al., 2020; Desai et al., 2007; Mehta et al., n.d.).

Financial literacy has become an important component of living across the world, allowing people to efficiently manage their resources. Whether for short-term needs, long-term aspirations, or maintaining a preferred lifestyle, financial literacy provides people with vital skills including personal money management, budgeting, and saving (Carranza et al., 2020; Grable et al., 2020). These skills assist people to make sound financial decisions and attain financial security. Conversely, a lack of these abilities, known as financial illiteracy, can result in bad financial decisions, debt, and missed chances for wealth accumulation (Carranza et al., 2020). As a result, encouraging financial literacy is critical to fostering long-term personal and economic success.

The purpose of the research, the research questions and objectives

The main aim of the study is to develop financial expert adviser software for training and educating young people about financial literacy education, to explore and provide ideas for possible intervention to the teaching of forex market information system, technology to young people, with the hope of enhancing developing skills of independence financial freedom.

The main research question of this study relates to how to enhance financial literacy by developing financial expert advisor software for train and educating young people about risk management, money management, investing and time management education? The followings are the sub-questions:

- How appropriate are the methods used by schools and universities for teaching and training financial literacy education?
- What are the current technologies, techniques and tools that can be used in developing financial expert advisor software for financial literacy?
- How can we develop financial expert financial literacy software for financial literacy education?

The main objective of the research is to implement a financial expert advisor system to train and educate young people about financial literacy by developing an automated forex robot (expert advisor).

Benefits, Importance, contributions and use of the study

Financial education in schools and universities has numerous benefits, including instilling positive financial habits in students during their formative years, preparing students for the workforce or part-time jobs while in college, and providing them with the necessary skills to make informed financial decisions throughout their lives (Grable et al., 2020; Pokhrel & Chhetri, 2021). Financial literacy may be taught more successfully by providing educators with access to suitable tools and technology. This student-driven approach not only improves technology literacy, but it also serves as an effective incentive (Grable et al., 2020). When students use their newly acquired information to produce meaningful projects, their comprehension becomes embedded, preparing them for long-term financial success.

The findings of this study could contribute greatly to the benefit of young people considering that financial expert advisor software for financial literacy (teaching, testing and training young people about risk management money management and investing, time management) is a major concern in the government industry, education system (Bolloju & Sugumaran, 2012; Osunbor & Egwali, 2016; Pokhrel & Chhetri, 2021). It will also provide information system and technology that will improve knowledge on young people skills of independence financial freedom and upgrade traditional methods of education young people at school, developing a new approach of making teaching or learning a fun factor for young people is one of the objectives the study wants to achieve (Stockhus, 2011).

The financial expert advisor for FME (Forex Market Education) could improve the financial literacy of young people worldwide to such an extent that when young people go into an environment, they would still have financial freedom, first as young people and later as elders. Financial expert advisor for FME has the potential to reduce lack of finance, unemployment, and enhance lifestyles in life (Carranza et al., 2020). The focus of Financial expert advisor for FME is on the young people and the investors, traders facilitating their learning and financial literacy. Financial expert advisor software will create a learning environment that is fun and educative. It could provide enough information about financial literacy so that one can be independent financially(Osunbor & Egwali, 2016).

Cohen (2022) supports for the employment of forex robots, often known as algorithmic trading systems. Cohen (2022) distinguishes four sorts of these systems: trend-following, scalping, news-based, and range-bound systems. He emphasizes various advantages of adopting forex robots, including the elimination of human mistake, the removal of subjectivity, the emphasis on statistical data, and the capacity to act promptly and without delay. Johnson (2011), on the other hand, underlines the value of professional financial advisers, pointing out that they give customers with freedom and assist them avoid emotional traps typical in trading, such as anxiety and greed. Cohen (2022) contends that these emotions, which frequently impede decision-making, may be handled by hiring experienced consultants. Unlike human traders, expert advisers adhere to defined rules and norms, resulting in reliable and emotion-free trading methods.

One of the better components of forex expert advisor is that most of them are designed to automatically analyse the forex market pattern using SMA (Simple Moving Average) and ADX (average directional index). SMA is the simplest moving average to establish. It is just the average price for the selected time (Cavdar & Aydin, 2020). The average is named "moving" because it is displayed on the chart bar by bar, generating a line that moves along the chart as the average value changes. Some traders use ADX, a technical analysis indicator, to estimate the strength of a trend (Cavdar & Aydin, 2020). This suggests the trader does not have to do 18 critical works on the study of the demand itself. This saves about 80 percent of the manually completed job. Analyzing the market is a time-consuming aspect for traders or investors. This is further supported in an article which notes that the trading mechanism is protected by expert advisors and that deep knowledge of the forex market is not needed (Cavdar & Aydin, 2020; Osunbor & Egwali, 2016). It's like a plug and play where the software is just running and making it do all the job.

Limitations and disadvantages

Despite the benefits and the hypotheses about how forex expert advisor can offer greater value, the industry still struggles to generate viable forex expert advisor. Many of the specialist advisors on the market who are available operate either in the short term or market situations. This study reveals a widespread limitation: most forex expert advisers fail to perform well at times of extreme market volatility (Bolloju & Sugumaran, 2012).Similar to Bolloju and Sugumaran, (2012) and Osunbor and Egwali (2016) concur to ensures that forex financial expert advisor would need to be continuously programmed to keep up with the demand, but this is perceived to be an annoyance for both the trader and the developer. Different currency has different habits. There would also be a need for new approaches to the market. This means that an expert adviser can only work on a single currency and not for others. This imposes a constraint on trade in other currencies as well as a decline in opportunities.

One possible disadvantage of having EAs is the lack of human connection. Human intuition and judgment are crucial, regardless of how sophisticated the EA is. While reducing emotional influence in decision-making is good, completely removing human participation may pose new issues (Osunbor & Egwali, 2016). It is critical to frequently review the EA's performance to verify that it is consistent with your trading strategy and objectives.

The next section reviews the related literature. The focus on the literature review will be based on related thesis about financial expert advisor software for financial education. This is followed by the methodology section that discusses the methods used in this research to achieve the objectives and the system architecture. This is then followed by the section that explains the system results followed by the evaluation results and lastly the conclusion.

Literature Review

Introduction

This section presents the literature review relevant to the building blocks and activities of using financial expert advisor models trading forex markets. There has been a lot of controversy and conversation about the use and creation of forex robots (Ciccozzi et al., 2019; Torre et al., 2023). While some traders claim that it is dangerous, others say it is not dangerous to use a forex robot to do all the dealing, risk management, money management and executing trades. Some merchants see it as lucrative, and some see it as a risky gamble to take (Lyons et al., 2006).

A forex expert adviser may either help with or completely automate the trading process. In this context, the emphasis will be on studying methods to automate all or most elements of forex trading. Simon and Köln (2015) established a business microstructure model to assist trading choices, which serves as the basis for this strategy. The goal was to research the foreign exchange effect intervention on currencies and on trading conditions for foreign exchanges. Results have demonstrated that the adjustment of drastic situations can have destabilizing consequences on the activity of foreign exchange markets and that the path preferred to enforce official action has significant

ramifications on its influence on foreign currency (Cavdar & Aydin, 2020; Simon & Köln, 2015). EAs are very useful for these adjustments.

Expert Advisors (EAs)

EAs function by allowing users to establish conditions for initiating, managing, and terminating trades, then using a set of binaries (yes/no) rules to make judgments. Traders can create their own EA or use one created by others. EAs employ advanced trading methods by incorporating many binary rules into a dynamic mathematical model (Cohen, 2022). This enables them to examine data and make transactions virtually instantly, speeding up the decision-making process (Cohen, 2022; H. Wang et al., 2019). The various reasons why expert advisors are popular include the followings: Timesaving, emotionless trading, flexibility, back testing and accessibility as explained below.

Timesaving: Hundreds of markets can be tracked by a correctly programmed EA which ensures traders do not need to track price changes 24 hours a day to discover new possibilities. traders can use an EA for the market, but open and close their own positions or allow it to open positions on your behalf, keeping track of your running profits or losses (Miśkiewicz et al., 2019; Slaný, 2009). Investors/traders can determine how long you want to commit to the markets with an EA mounted.

Emotionless trading: Emotions may greatly impact trading decisions. They may induce traders to hold losing trades for longer than required due to fear of loss, or to enter trades rashly following a huge gain. Automating transactions reduces emotional bias since algorithms depend only on objective market data and trends, making judgments based on logic rather than emotion (Mehta et al., 2020).

Flexibility: EAs can be utilized in any market accessible via MT4, allowing traders and investors to analyze price swings, check financial accounts, evaluate technical indicators, and monitor the most recent available balances (Cavdar & Aydin, 2020). They allow for the efficient processing of large volumes of information. EAs are strong instruments that help companies and investors by allowing the design of very sophisticated algorithms capable of watching numerous markets concurrently.

Backtesting: Developing a trading strategy is only the first step; putting your confidence in it to handle your money entails major risk. This is why most traders backtest their expert advisors (EAs) before deploying them on live markets. Backtesting allows traders to review large amounts of historical data and assess the EA's performance, allowing them to detect and fix any problems before risking real money (Cohen, 2022; Simon & Köln, 2015).

Accessibility: Although the four points point to important benefits, they are applicable to all electronic trading devices, not only EAs. It might be difficult to create a trading algorithm from scratch, but importing an EA only entails choosing a package and modifying it to your specifications. The ease of use of EAs is arguably the most significant element influencing their broad adoption as electronic trading instruments.

Research on financial literacy

Many financial literacy experts believe that a large percentage of consumers lack the information required to make educated financial decisions in their own best interests (Lyons et al., 2006; Pokhrel & Chhetri, 2021). Experts generally agree that financial knowledge is intimately related to self-interested financial conduct (Lyons et al., 2006) However, there are concerns about the efficacy of the financial system education to enhance financial literacy (Carranza et al., 2020). There is a disparity between the importance of education in improving financial literacy and its influence on both short- and long-term financial habits. How can formal education, which is linked to financial literacy, successfully change financial behavior unless it first fosters a grasp of financial principles?

Platform and Language of programming

MetaTrader, developed by MetaQuotes Tech Corp, is the dominant platform for retail forex trading on the internet, with the most recent versions being MetaTrader 4 and MetaTrader 5. MetaTrader is widely used by brokers all over the world, and many of them also provide their own custom trading tools. The platform is popular among traders because of its adaptability and wide range of analytical methodologies (Cohen, 2022; Simon & Köln, 2015). MetaQuotes also provides a programming language, MQL4 or MQL5, which allows users to construct bespoke programs, scripts, and expert advisors that improve trading capabilities (Mehta et al., 2020; Simon & Köln, 2015; Slaný, 2009). This capability streamlines the trading process, allowing developers to customize their solutions to individual requirements.

Prior to the introduction of platforms such as MetaTrader and its associated programming languages, powerful trading systems were normally only available to banks and large financial firms. In the world of electronic trading, each broker may have their own trading platform, but they must all follow the National Futures Association's (NFA) criteria (Ben Mrad Douagi et al., 2021; Cohen, 2022). The NFA specifies critical criteria for electronic trading platforms, including verification mechanisms (such as passwords and digital certificates), encryption, transaction logging standards, and pricing and slippage restrictions capabilities (Mehta et al., 2020; Simon & Köln, 2015; Slaný, 2009). These criteria guarantee that brokers provide a secure and dependable trading environment for their clients.

Automated exchange in forex

When technology advances, the trade process can now be streamlined. In brief, automatic forex trading removes much of the decision-making and implementation process that investors historically used to do manually. The forex robot or an algorithmic program is programmed to operate on a condition set by the programmers. It is mainly called Expert Advisor, but the reference used in this article is financial expert adviser. Its purpose is primarily to assist, or to aid the whole trade process (Osunbor & Egwali, 2016). Instead of watching the stock quote headlines, investors can now access the charts at real-time prices. This will make their investment decisions easier.

Market maker and structure

Market participants, which include brokers, mutual funds, and banks with substantial market shares, are the main factors influencing changes in stock prices. Allegations of market manipulation are frequently made against market makers in particular (Miśkiewicz et al., 2019; Stockhus, 2011; H. Wang et al., 2019). Important indications for trading behavior, patterns and structures are common in the forex exchange market (H. Wang et al., 2019). Market makers may use these trends to their advantage to defraud investors and individual traders. Realizing that forex is a zero-sum game in which some people's gains come at the price of others is crucial (H. Wang et al., 2019). Instead, then engaging in direct competition with retail traders, market makers frequently seek to trap as many of them as possible to profit from their losses.

A market framework is often constructed at the start of each week, usually on Mondays, although it can happen at any time when a pattern exists (Amirdhavasani et al., 2020). This framework begins with distinct trading patterns that emerge at the beginning of the week. Market makers employ these patterns to urge ordinary traders to follow current trends. Market makers can manipulate stock prices at the start of the sales week by placing purchase orders at opportune low points, causing regular traders to place stop-loss orders (Amirdhavasani et al., 2020; H. Wang et al., 2019). This strategy enables them to manipulate market dynamics and profit from fluctuations in stock prices.

Forex methods used commonly on forex expert adviser

The most prevalent approach used by forex expert advisers is a layering strategy without stop losses. This layering technique may be classed as martingale or non-martingale. According to Cohen (2022) a mathematician, invented the martingale approach, which dates to the 18th century. It is found in the betting system initially. It uses a duplicate definition. If the bet is a loss, the second bet is made. If the first bet is a loss. However, contrary to the first bet, the second bet would be doubled. It is a layering strategy as used in forex dealing, in which the second position is started with double in batches when the first entrance into the market did not go our way (Cohen, 2022; Torre et al., 2023). There is a statistical calculation whereby the dealer will still have a break-even position if the price jumped just half of the change from the first position. Martingale is typically used in forex to optimize the returns as far as possible. In many financial expert advisers, it is also famously used (martingale trading machine its 2013).

Another package, which is just a layer technique, is non -martingale. This strategy ensures that any time the price goes against our way, another place of the same lots will be opened way (Cohen, 2022; Torre et al., 2023). This is something like an ambition tactic that the price will finally go through the first entry location. Some investors disagree over whether the layering strategy is a necessity. This is because it can offend take months for the price to finally change to the first place. The is layering approach is then used to increase the equity and optimize profits to make up the time value of cash way (Cohen, 2022; Torre et al., 2023).. The price will often have its ups and downs to make room for the layered post to have benefit. It would compensate for the money’s time worth as well as increase the account equity. Increases in the equity of the account will continue to raise the danger of losing out an account.

Related work of Forex Expert Adviser

Technological developments have allowed economists and traders to better anticipate financial markets. Numerous techniques and models have been created to forecast economic trends, with artificial neural networks (ANNs) serving as one example for FX market forecasting. However, the intricacy of financial markets makes it difficult to put ANNs into reality (Cohen, 2022; Simon & Köln, 2015). Market swings are driven by a variety of factors, including political events and unforeseen economic news, making it difficult to develop a reliable forecasting model (Cohen, 2022; Stockhus, 2011). These dynamic dynamics restrict the ability of neural networks to provide accurate market forecasts.

Cavdar and Aydin (2020) uses genetic programming (GP) to offer a self-adapting architecture to improve algorithmic trading. GP aims to develop and optimize fundamental predictors. These predictions can be used by human traders as well as the system (Cavdar & Aydin, 2020; Slaný, 2009). One drawback of GP, meanwhile, is its propensity to predict erroneous turning points, which may result in poor choices (Slaný, 2009; H. Wang et al., 2019). In the forex market, an inaccurate signalling a trend reversal is referred to as a false turning point. A tipping point is the point at which a negative stock could start to exhibit bullish potential.

In addition to variants employing a Rolling Average model (ARMA), the third model examined is the Radial Basis Function (RBF) and Autoregression network. Using these models for possible enhancements, this thesis highlights the simple implementation of algorithmic trading (Wang & Li, 2019). However, no forex financial expert adviser will be developed using either platform. Rather, simple MQL4 scripting that complies with accepted technical standards will be used.

The use of moving averages in stock projections is well-documented, and because stocks and currencies have analytical parallels, traders frequently utilize the same approaches in both markets. The evolving average approach is increasingly used to forecast price movements in stock and currency markets (Cavdar & Aydin, 2020; Wang & Li, 2019). Furthermore, artificial intelligence technologies like fuzzy logic, genetic algorithms, and neural networks provide alternate forecasting strategies. While these strategies attempt to forecast stock or currency market movements, little thought has been given to whether price manipulation affects actual market prices. This study focuses on the developing average approach for detecting trends and determining the presence of probable market abuse.

Summary of the Literature review

The literature review covers the knowledge about expert advisor, how the expert advisor operators on the forex market. EAs are automatic trading systems that help investors and traders by executing transactions according to specified instructions (Bolloju & Sugumaran, 2012; Osunbor & Egwali, 2016). Their market success varies depending on a variety of circumstances. Here, we cover the benefits and drawbacks of utilizing EAs, the significance of backtesting procedures, the advantages of using a Virtual Private Server (VPS), and the difficulties that developers experience throughout the construction and testing phases (Bolloju & Sugumaran, 2012; Torre et al., 2023). The platform and programming languages to develop and host the expert advert to be able to run on one of the brokers. How online trading changed when introducing automated trading on the market. The market maker and structure how the manipulate the market they are operating.

Research Design Science Methodology

The study is based on the Research Design Science Methodology (RSDM) framework, which is a structured technique that allows for systematic exploration and creation of solutions that address challenging issues. RSDM stresses the integration of academic knowledge and practical application to provide actionable insights that address real-world problems (Venable et al., 2017). It includes a thorough technique for building and assessing artifacts (such as tools, financial expert adviser, systems, or processes) within a certain domain.

According to Geerts (2011) and Venable et al (2017) explained that RSDM not only provides a clear framework for research, but it also encourages thorough analysis and iterative development. This method is especially useful in domains where technological innovation and practical application are crucial. Using RSDM, researchers may efficiently negotiate the intricacies of their investigations, ensuring that each phase, from issue identification to solution evaluation, contributes significantly to the overall study objectives (Bolloju & Sugumaran, 2012). Using RSDM, the study will systematically investigate the design and execution of an automated financial expert adviser, providing insights that not only enrich academic knowledge but also improve practical financial management for young investors.

This study investigates the difficulties that young people have in developing passive income streams through financial management, particularly in the complicated and volatile currency market. Many people lack access to financial knowledge, emphasizing the importance of automated solutions that simplify trading operations (Slaný, 2009; Stockhus, 2011). The suggested study intends to create an automated financial expert adviser particularly created for young investors, allowing them to efficiently navigate the currency market and accomplish their financial objectives.

The study will use a quantitative approach, including prototypes and backtesting to collect data. Prototyping is critical throughout the design process, since it allows for iterative creation and refining of the financial expert adviser. This strategy, based on the Evolutionary Prototyping lifecycle model, allows for continuous revisions in response to user feedback, guaranteeing that the final product is user-centered and meets the demands of young investors (Wahid & Ridzuan, 2013; Stockhus, 2011). BackTesting measuring customer happiness and experiences will be used to perform quantitative analysis to determine how effective the automated adviser is(Wahid & Ridzuan, 2013). Generalizable results and objective analysis are made possible using positivist research procedures (Cavdar & Aydin, 2020; Slaný, 2009; Stockhus, 2011). This study intends to provide young people with automated trading solutions that improve financial independence and offer significant insights to the financial technology area by incorporating technology into personal finance plans.

In developing the prototype, the study describes the expert adviser on universal engine dealing. Trading strategies modes and functions that allow them to be applied have been discussed in depth using moving average and average directional index. Analyses have been carried out of a system of four universal specialist consultants, two or more of them opening new positions and two closing the other approaches (Cavdar & Aydin, 2020). A certain trading mode is described by various method call combinations. A professional specialist, for example, may only sell or purchase, oversee positions already opened or wait. Depending on the market time or the day of the week, a financial expert advisor may be set up flexibly in these modes.

Prototype

Introducing automated trading algorithms entails a variety of tasks, including assessing the market environment to understand market feedback signals and closing current positions. These mechanisms guarantee that trading decisions are consistent with market circumstances (Abbey & Doukas, 2020; Bolloju & Sugumaran, 2012). Furthermore, it is critical to closely monitor the operations of specialized consultants and precisely handle possible exchange problems (Osunbor & Egwali, 2016). Quick access to industry statistics and corporate data from these experts is also critical for making educated and fast choices.

The proposed article delves deeply into these issues and is divided into four sections. Part 1 of Strategy Trade Styles outlines major trade techniques, with an emphasis on the first trading method for position management depicted on Figure 1. It illustrates how an EA's trading logic may be efficiently classified into distinct trading modes, guaranteeing consistent strategy execution (Ciccozzi et al., 2019). Part 2, The Concept Case and Prototype Trade Approach, offers an event-driven model that integrates all event processing, including multi-currency scenarios, into the EA's fundamental logic (Ciccozzi et al., 2019).

Part 3, Customised Regulations and Auxiliary Trading Categories covers the method of creating bespoke Expert Consultants by defining trade input and exit criteria. It also looks at other algorithms that might make it easier to get key trade insights (Cohen, 2022). Part 4: Community Trade and Strategic Portfolio Management describes a method that combines different trading logics into a single ex5 executable module to improve portfolio management efficiency (Wahid & Ridzuan, 2013). These parts work together to give a comprehensive foundation for understanding and executing automated trading methods.

Figure 1: Chart with Expert advisor.

System tools

Virtual hosting combined with MetaTrader 4/5 is the best VPS option for Forex trading. It guarantees low server latency, has low expenses, and doesn't require any setup. Traders can expedite the process by creating a remote copy of their application straight from the platform (Cohen, 2022; Geerts, 2011). Many people believe that our hosting system is the best VPS option for unparalleled business productivity and quick server performance (Cavdar & Aydin, 2020; H. Wang et al., 2019). The use of databases greatly improves MetaTrader's usefulness. The ability to store and analyze market history, duplicate trades between platforms, provide real-time quotations and transactions, and carry out sophisticated analytical calculations are some of the main advantages (Torre et al., 2023; H. Wang et al., 2019). The VPS gives traders smooth control over their activities by supporting web-based calendars, account tracking, and remote management.

System architecture

The design model describing the configuration, behaviour and more views of the developer system, how it performs, or the functional tasks and non-functional task carried out by the financial expert advisor. A systematic definition and presentation of a system is an architectural description, structured in a manner that facilitates logic about system mechanisms and behaviours (Ciccozzi et al., 2019; Venable et al., 2017). Requirements of users and the financial expert advisor need to be analysed. Specify device usage cases. Processors / modules for the execution of the case applications are defined. Then, assign processor / modules specifications. Next, the study specify processor-level sequence diagrams implemented for the financial expert advisor shown on Figure 2.

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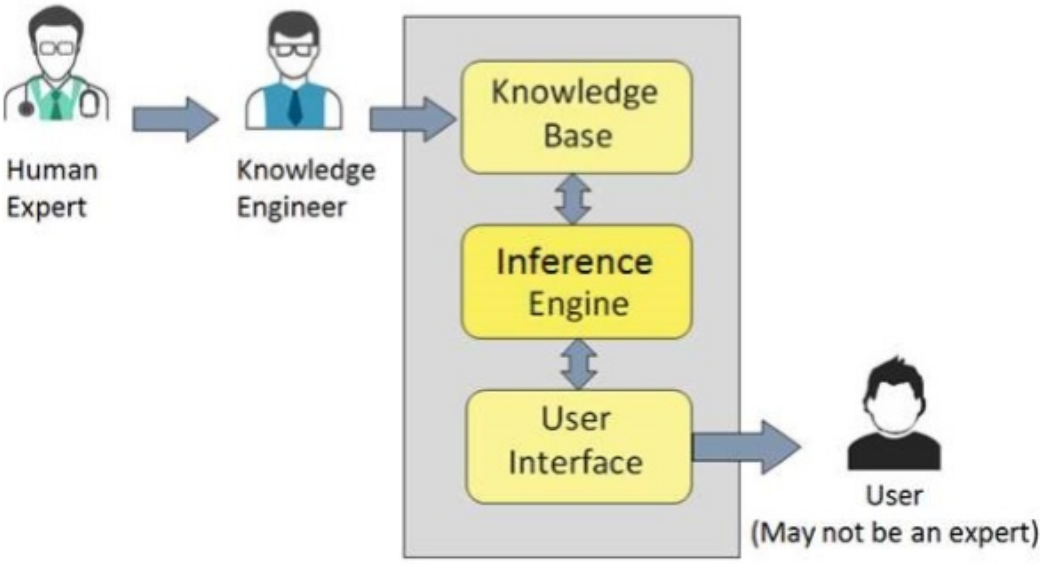

Figure 2: System design.

System flowchart or algorithms

The workflows are used to implement the market manipulation strategies in the workflow. A fully automatic framework is used to identify the working of trading operation after the trader has joined it. Investors or traders first determine the currency pair entry, how lots are risked, the rewards ratio, and the minimum candle size shown on Figure 3. Then, from the day before, this week and the previous week, the specialist consultant looks at the highest and lowest points which are placed as the possible market reversal zone (trap zone). If the price moves to the area, the expert advisor then places an order of purchasing and selling and adjusts the stop point to take advantage of the minimum input height (Ciccozzi et al., 2019; Geerts, 2011).

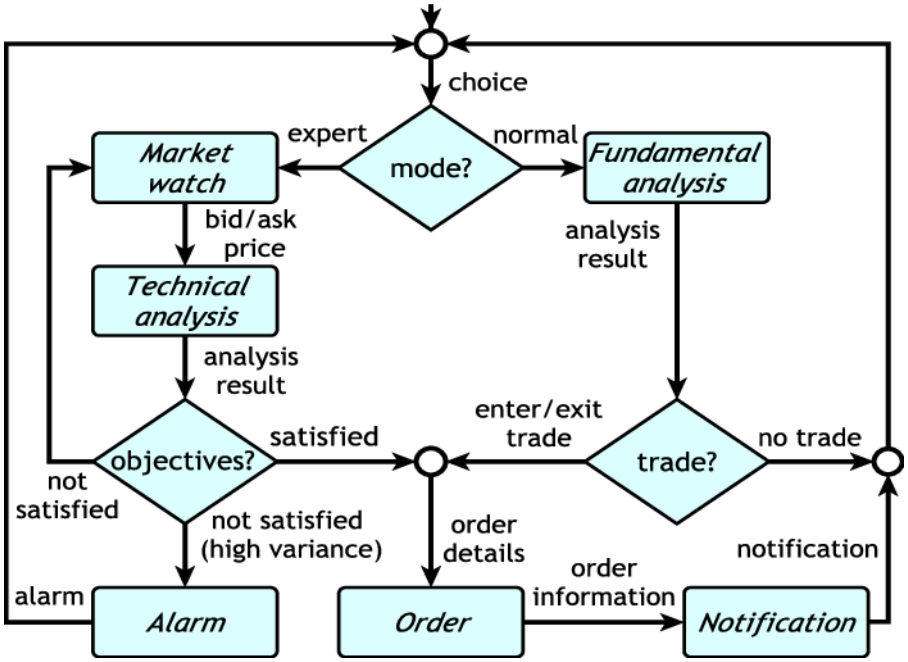

Figure 3: Flowchart.

This form of exchange mechanism runs at lightning-speed, with signals bought or sold and trades closed in milliseconds, as its name implies. This generally entails arbitration and scalping techniques focused on rapid market swings and high amounts of exchange (Cavdar & Aydin, 2020; Cohen, 2022). One of the best tactics is essentially to track price movements by purchasing or selling orders based on such technical metrics. In predicting whether patterns are likely to persist or reverse, this technique may also compare historical and current results (H. Wang et al., 2019).

System modules

Modular programming is the way that a task is broken into a variety of distinct sub-tasks (files). MQL5 language enables three types of programs to be developed, an EA, an indication or a script. The best EA for the key module is to handle all modules and with trade functions. As metrics, for example, other modules may be introduced. The indicators are ideal for module formation: Data can be stored in the indicator buffer calculation using the given algorithm and transferred, if necessary, through to multi-module EA. EA, on the other hand, will use or ignore certain data according to a work. In certain projects EAs are justified as external components, but at the same time, information about the process of data sharing must be considered.

System coding

Backtest the strategies with MQL5 or MQL4. These systems allow you to test algorithms using a variety of libraries, including the built-in Backtester and external tools like Zipline. Pandas libraries make data processing easier, especially when reading OHLC-V price data, whilst Matplotlib may be used to visualize market patterns and performance. The IDE (Integrated Development Environment) MQL4 depicted on Figure 4, another fundamental language for algorithmic trading, is the MetaTrader platform's native programming language, and brokers frequently support it. MQL4 is based on C++, thus developers acquainted with C, C++, or even Java will find it reasonably simple to learn (Cohen, 2022; Wahid & Ridzuan, 2013). Depending on the broker, the API utilized may differ in language (Cavdar & Aydin, 2020. Interactive Brokers, for example, has APIs in Python and C++, allowing traders to choose their programming environment.

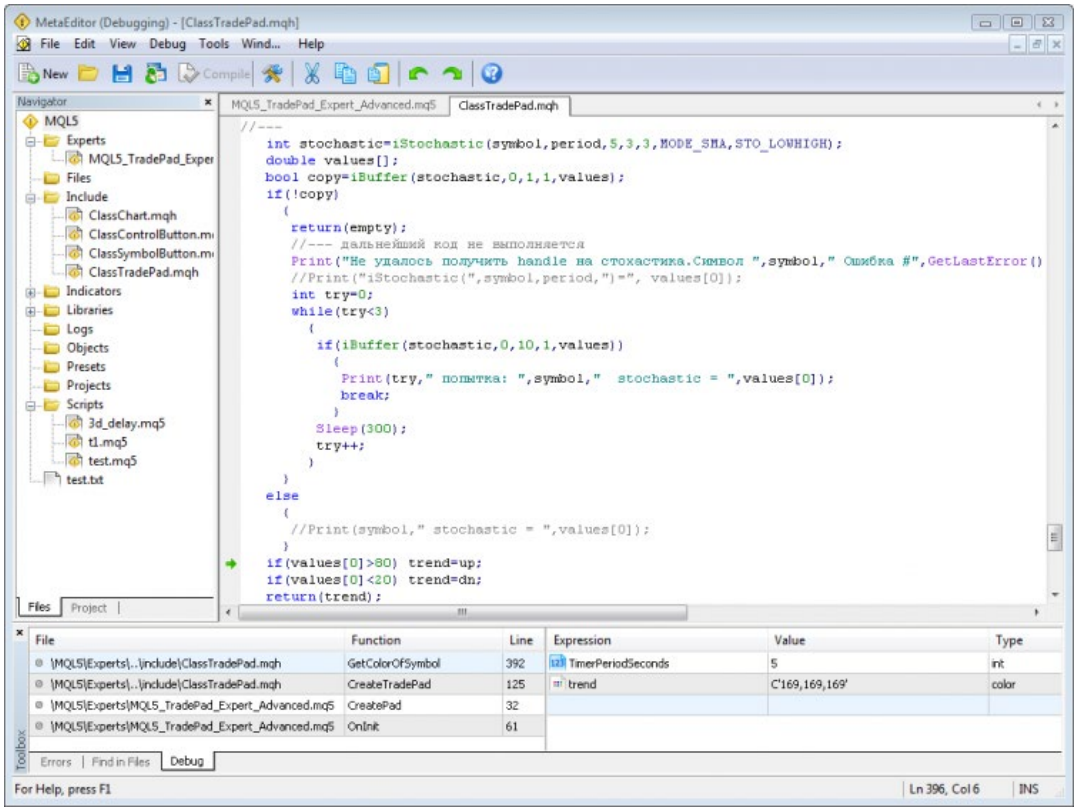

Figure 4: IDE programming

Beta testing of apps shall be conducted. Some traders are selected to use forex expert advisor and report any bugs or defects. Faults or glitches can be in several ways be it in terms of trading or app features. Figure 5 shows the business evaluations are performed by back testing and subsequent testing. Backtesting is a method in Metatrader that indicates that the forex expert advisor is tested based on historical data on the marketplace (Osunbor & Egwali, 2016). The brokers themselves supply the historical data they use. The forex expert advisor will test for at least 6 months with past knowledge on the market to provide a full result to ensure the maximum backtesting results and detailed statistics from history. This means that we will have to get the best possible historical evidence (Bolloju & Sugumaran, 2012; Osunbor & Egwali, 2016). This is a tool for detecting preliminary glitches. In this study, however the key outcome to see if this forex financial expert advisor has a backtesting outcome or not attainted its goal.

Figure 5: Strategy test, checking performance of the financial expert advisor.

Software Development

The Figure 6 below summarizes the five essential phases in establishing system requirements. These processes often include gathering and assessing user needs, developing functional and non-functional requirements, creating system specifications, confirming the financial expert advisor's requirements, and managing modifications throughout the development process (Ciccozzi et al., 2019; Geerts, 2011). Each phase guarantees that the finished system meets corporate objectives and user expectations while being responsive to changing demands.

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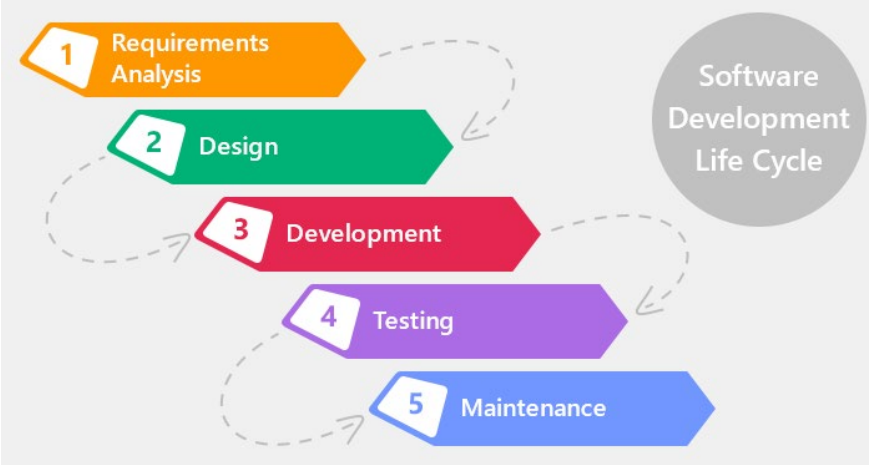

Figure 6: Software Development life cycle

Design and Development of Proposed Solution

This paper will examine the use of the UML (Unified Modeling Language) approach in the development of an expert consultancy. A popular tool for modeling object-oriented program structures, UML offers a graphical and visual method of system desig(Ciccozzi et al., 2019; Torre et al., 2023)n. It may also be used to create strong trading frameworks in addition to software modeling. Moreover, object-oriented programming languages facilitate the development process, improving modularity and reusability (Torre et al., 2023).

Use case diagrams

Typically theoretical analysis starts with case diagrams, but not necessarily. The device is defined from the users' viewpoint. It involves identifying financial expert advisor actors, defining the connection between actors and the iterations of the financial expert advisor. Generally, use case is a list of acts, usually describing the interactions in order to accomplish an objective between a function (known in UML as a 'actor') and a method (Ciccozzi et al., 2019; Torre et al., 2023). An actor "specifies a role played by a user or some other interface mechanism in which human users, external hardware or other subjects may perform roles shown Figure 7.The relation with a single element in a model is a semantic connection.

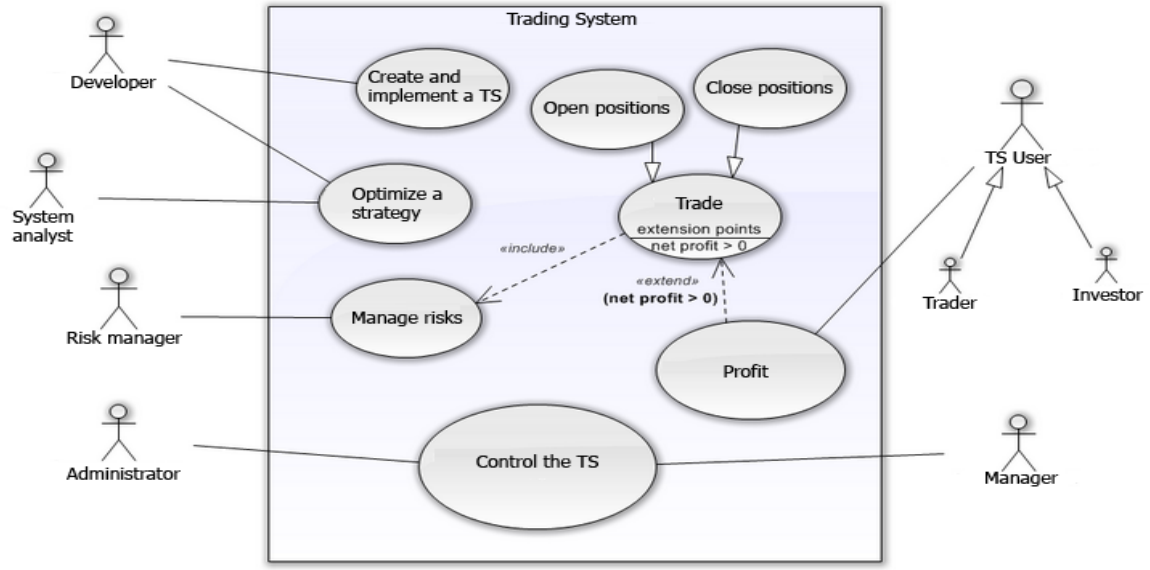

Figure 7: use case diagram

Class Diagram

The composition of the financial consultancy is defined using the class diagram. In specific, it provides an object-oriented programming class model of a static configuration of the trade mechanism shown on Figure 8. This represents the financial specialist consultant's programming reasoning.

Activity diagram

Activity diagrams reflect the workflows and control flow of incremental tasks and behaviour. The diagram of the operation differs from the flowchart, which only describes the algorithm steps. The notation of the operation diagram is broader.

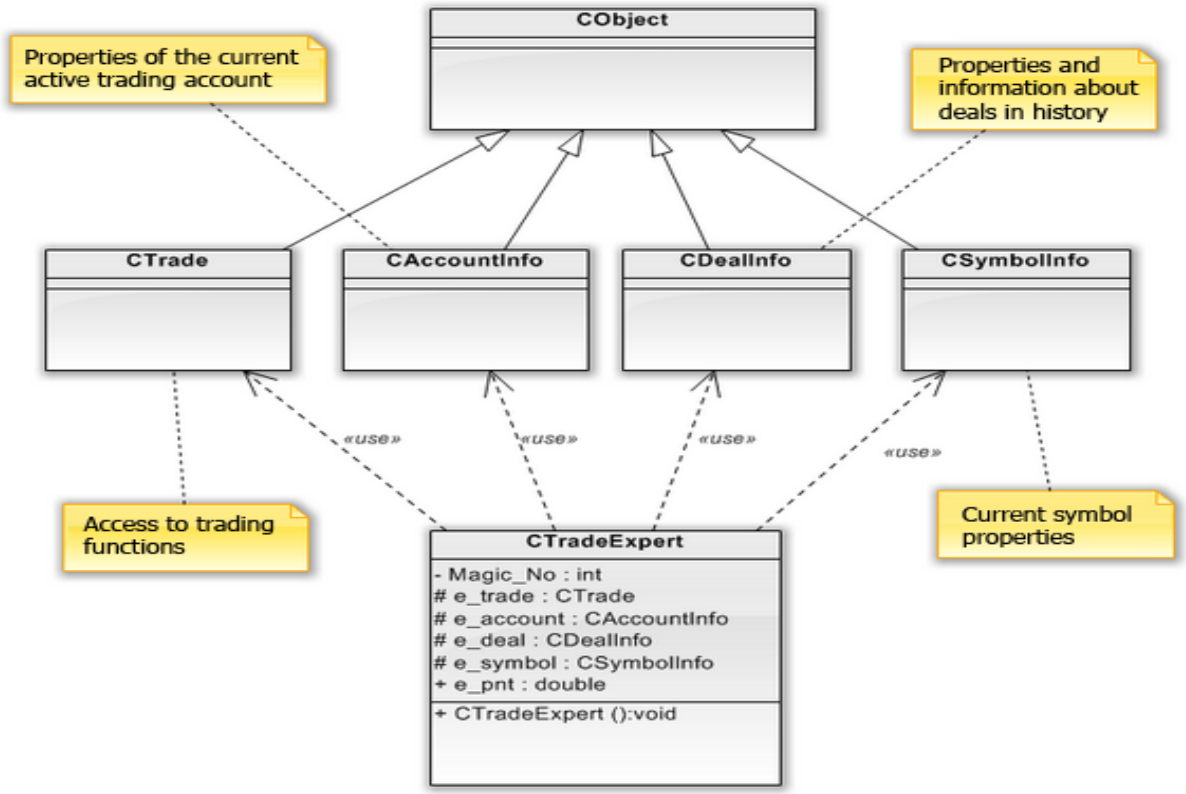

Figure 8: Class diagram

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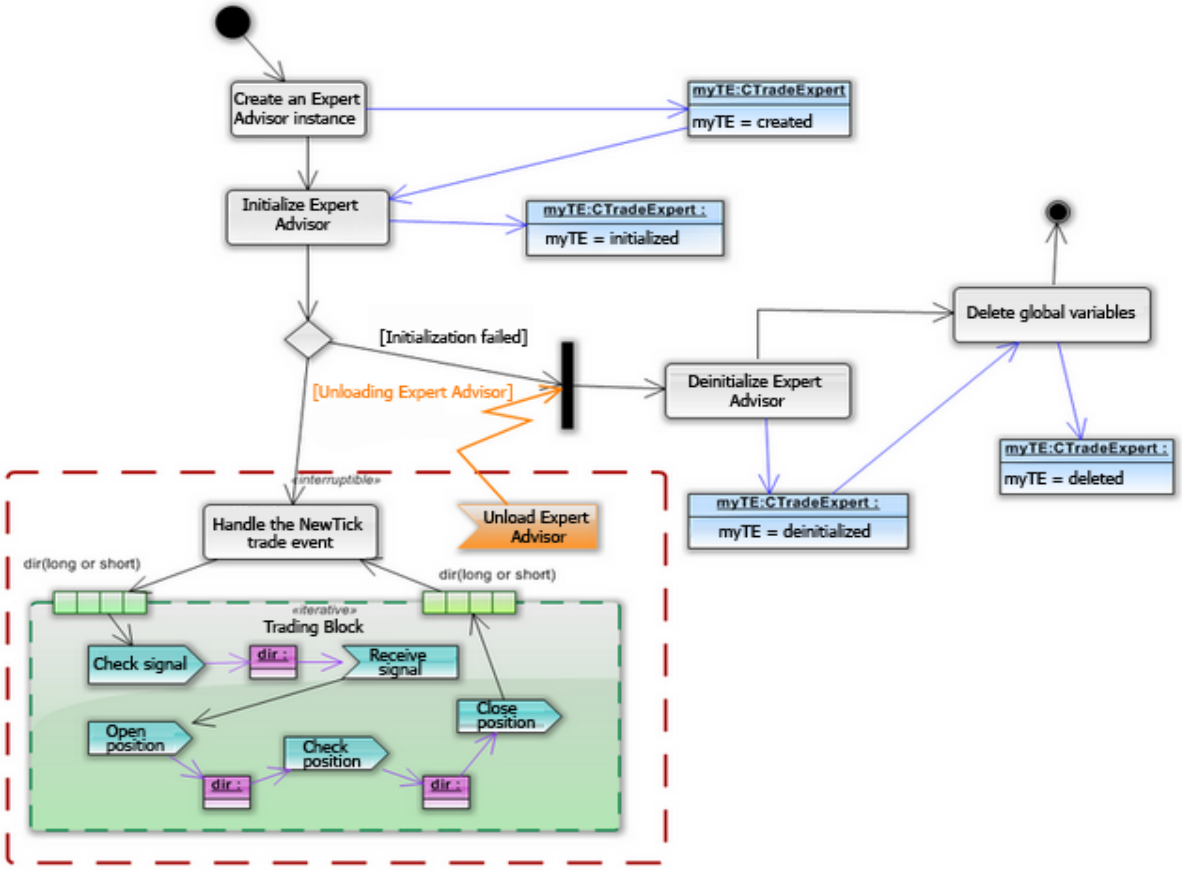


Figure 9: Activity diagram

The multiple dimensional design of the creation phase of the Expert Advisor using UML, a graphical language for the visual simulation of object-oriented software systems, is considered in this review (Ciccozzi et al., 2019; Torre et al., 2023). The primary value of this strategy is the designer's visualization.

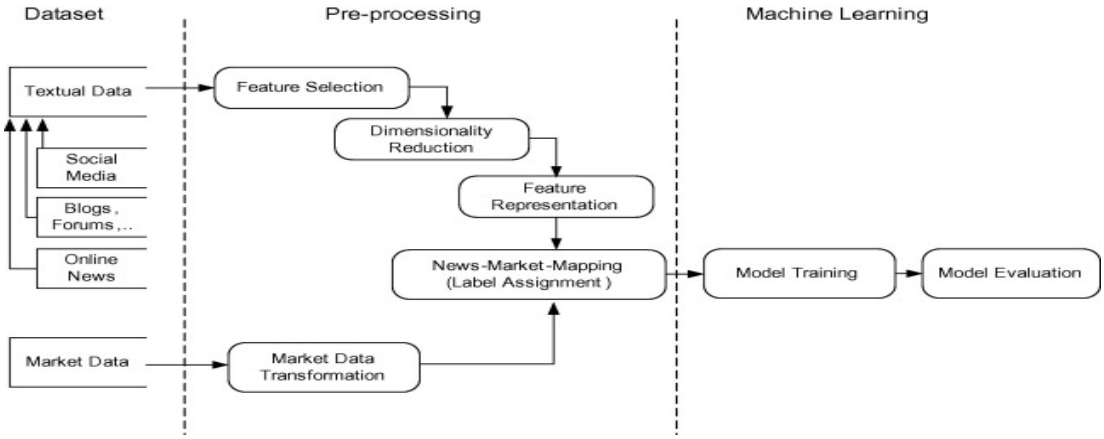


Figure 10: Sequence diagram

System Development Results

Prototyping is used as both a proof of concept for solution creation and a strategy for successful issue solving. The financial expert advisor (EA) is written in MetaQuotes Language (MQL) version 4 or 5 and runs on the MetaTrader 4 (MT4) platform, a popular electronic trading platform for retail foreign exchange (forex) traders (Cohen, 2022; Wahid & Ridzuan, 2013). The broker's server architecture hosts client apps that allow traders to watch live market prices and use real-time charting tools to make educated decisions (Cohen, 2022; Pokhrel & Chhetri, 2021). This initiative focuses on four basic approaches, and preliminary research has yielded encouraging findings. One important field is technical metrics, tools aimed to improve market evaluation when paired with technical analysis. These metrics are based on mathematical models and equations developed from specific market values or quantities (Cohen, 2022). The output of these computations is crucial for market research and prediction as it enables traders to see patterns, predict changes in price, and make informed choices.

Several backtests have shown that the Buy and Sell Trend Arrows indicator performs well shown on Figure 11. However, it should be noted that in some cases, this method may drain the account balance. Despite this danger, it is included in this study because of the potential rewards (Grable et al., 2020). The approach is based on basic tools and clear principles, with minimal restrictions controlling its implementation (Cavdar & Aydin, 2020). The effectiveness of this technique is strongly dependent on proper cash management. The basis of this strategy is the use of buy/sell arrows as critical markers. It compares the closing price of a currency pair to its price range over a certain time (H. Wang et al., 2019). Critical market turning points may be predicted using two important lines: oversold and overbought levels (Miśkiewicz et al., 2019; Simon & Köln, 2015). When the trend price reaches these levels, it indicates a possible market reversal. Oversold circumstances indicate that the price has been negative for a long time, implying the likelihood of a reversal or retracement. Overbought circumstances, on the other hand, indicate that the price has been optimistic for far too long, suggesting that a pullback or correction is imminent depicted on Figure 11.

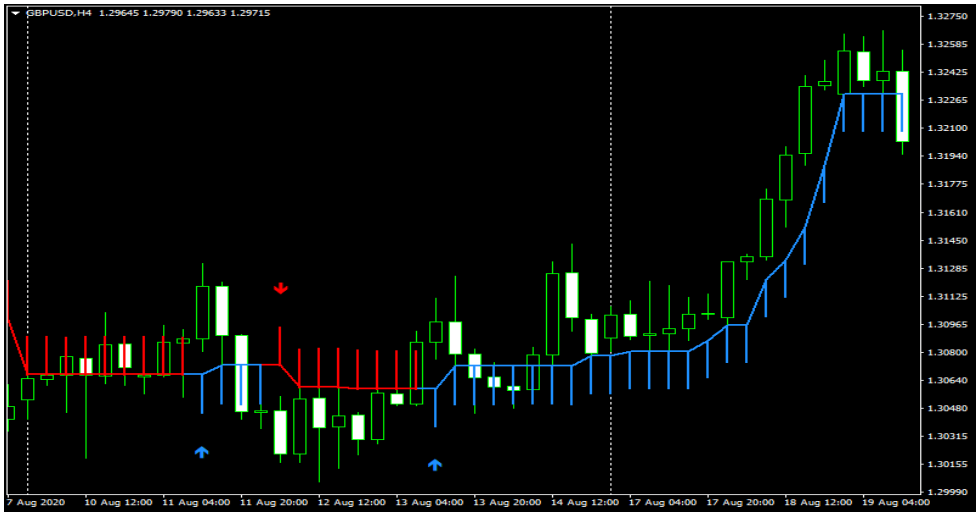


Figure 11: Buy and sell arrow trend

There are trade terms that must be respected. Briefly, the terms of trade are, 4 hours timeframe and major currencies. Buy and sell arrow: the pattern has shifted into overpurchased arrow or oversold arrow areas. Pip steps is 500 pips at this stage. This is price difference between the various tiers. The graph would have just the largest currency pairs in a period of four hours. Whenever buy and sell arrows trench enter overcrowded or overendowed areas, the financial expert advisor will be ready to start their original role within the current timeframe.

The figure 11 above shows an installation using the technique of the trend indicator. Whenever the trend hits the unsustainable selling, it is a sign of a turnaround of the pattern. This example indicates that the trend reaches the retail region after a sequence of downward acceleration (Amirdhavasani et al., 2020). Then the market is starting to reverse. Not all markets are going to respond this way, of course. The market is going towards an erratic and often

highly volatile movement (Amirdhavasani et al., 2020; Simon & Köln, 2015). A trading configuration is thus just an entry law. Profit taking, Stoploss and trailing Stop, For this approach there is no clear advantage. The easiest approach is to set daily range that is more likely to be received or to close all orders manually. Both are fine, anyway. It is coded to allow the consumer/investor/trader to set his own benefit goal on the financial expert advisor. This means the specialist experts remain agile.

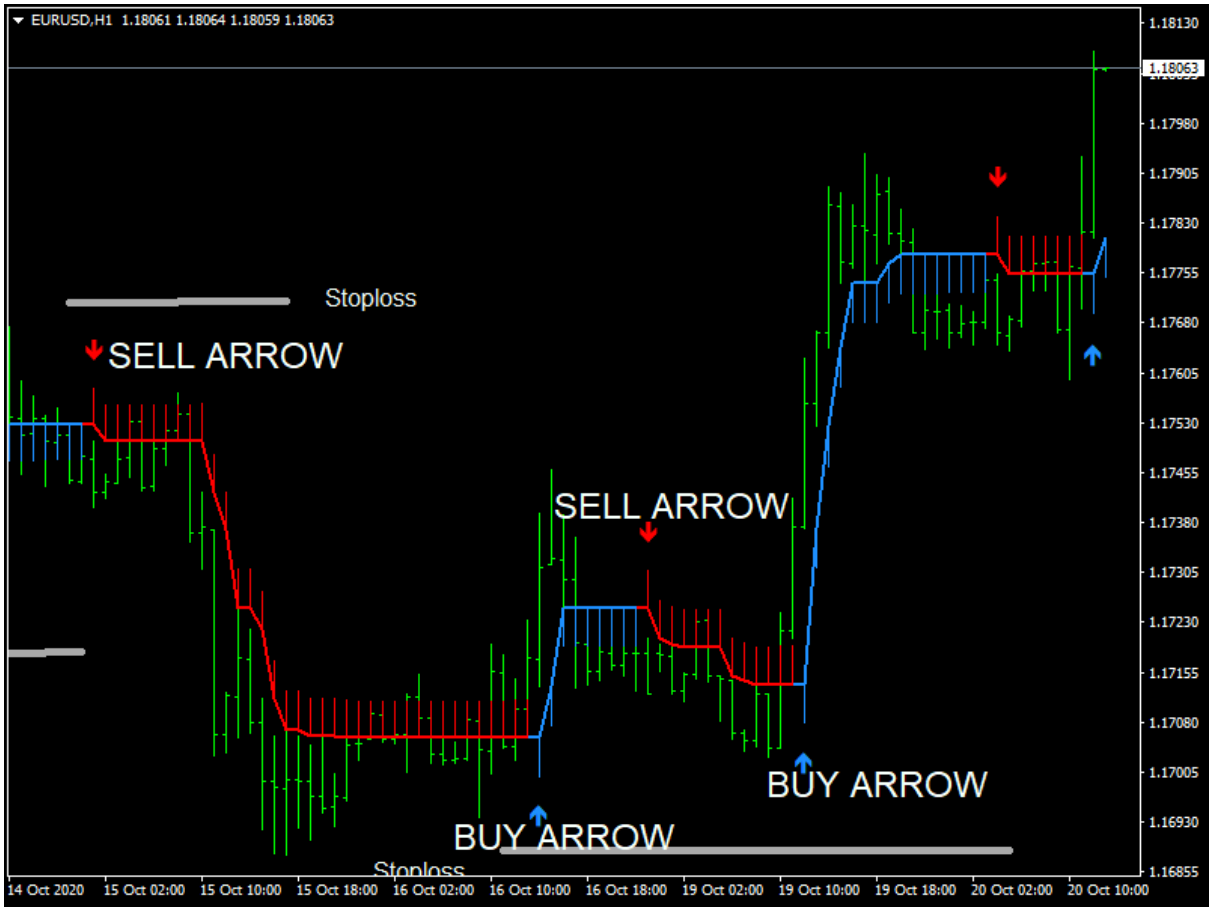


Figure 12: with take profit and stoploss

Final expert advisor Techniques Research

This approach has been developed as a private exchange technique. Trading facts could not be explained privately and confidentially. This commercial technique was, however, selected for analysis because:

- This technique has managed to help the practitioner make profit and gain their money back in a short-term Planning for future improvement shown on both figure 13 and 14.
- High proportion of the benefit ratio
- This technique is also able to be translated into codes for this Forex robot to work

Testing

The Strategy Tester helps you, before using them for live trade, to test and refine trading strategies (expert advisors). During the testing, the history data is once used as a consultant for initial criteria. A trading strategy with various sets of parameters is applied many times during optimization which allows the most suitable combination to be chosen. A multi-monetary tool enables you to analyze and refine techniques for trading various financial instruments (Amirdhavasani et al., 2020; Miśkiewicz et al., 2019; Slaný, 2009). To manually set the list of symbols for testing / optimization, the tester processes knowledge of all symbols used for the trading technique.

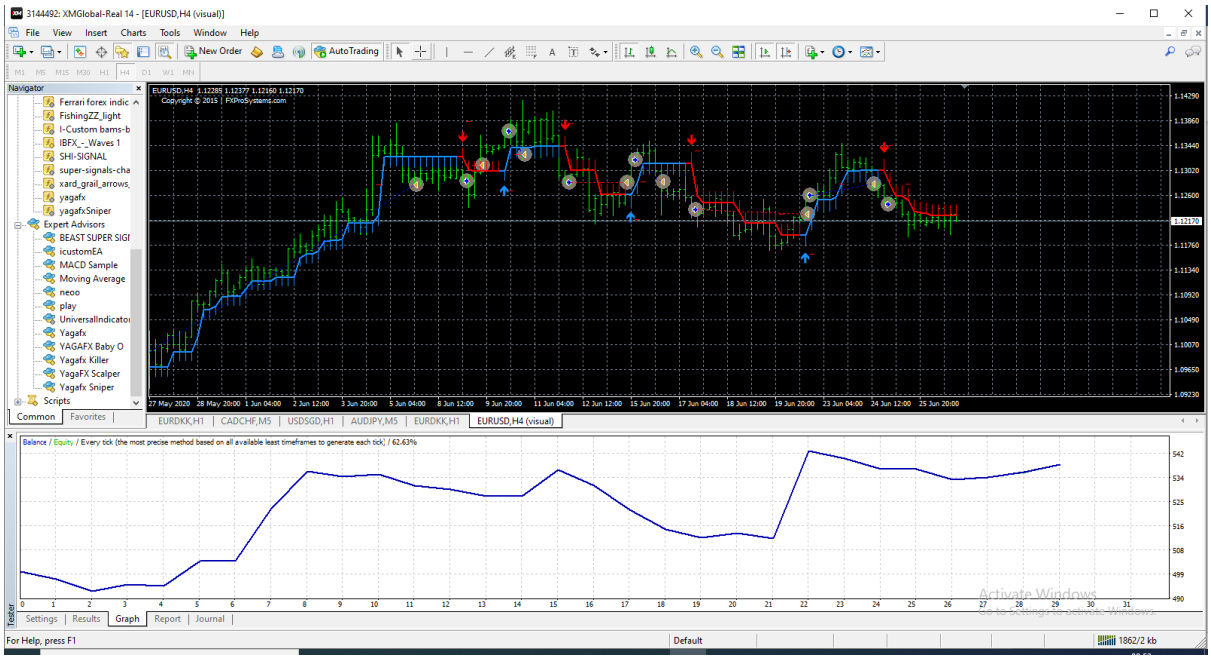
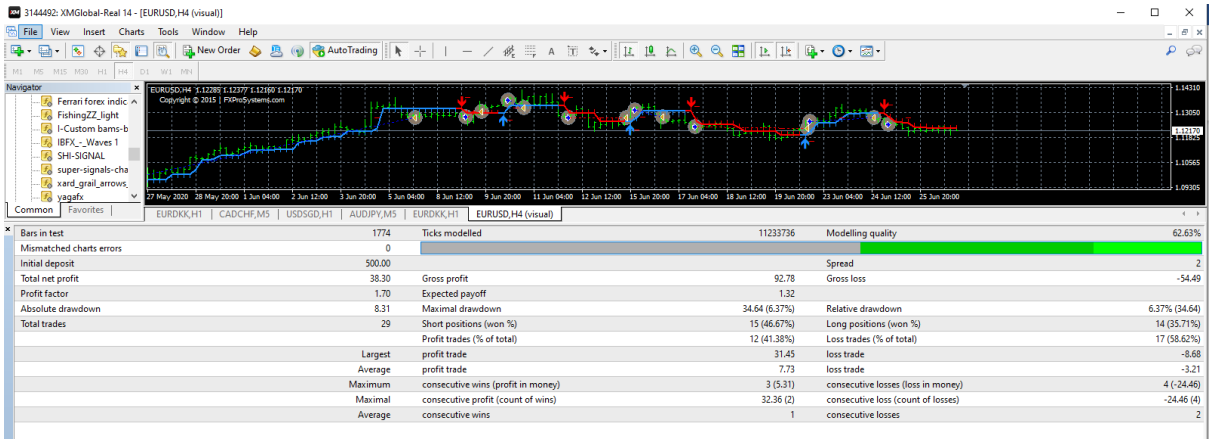


Figure 13: testing the financial expert advisor with a line graph



Bars in test	1774	Ticks modelled	11233736	Modelling quality	62.63%
Mismatched charts errors	0				
Initial deposit	500.00			Spread	2
Total net profit	38.30	Gross profit	92.78	Gross loss	-54.49
Profit factor	1.70	Expected payoff	1.32		
Absolute drawdown	8.31	Maximal drawdown	34.64 (6.37%)	Relative drawdown	6.37% (34.64)
Total trades	29	Short positions (won %)	15 (46.67%)	Long positions (won %)	14 (35.71%)
		Profit trades (% of total)	12 (41.38%)	Loss trades (% of total)	17 (58.62%)
	Largest	profit trade	31.45	loss trade	-8.68
	Average	profit trade	7.73	loss trade	-3.21
	Maximum	consecutive wins (profit in money)	3 (5.31)	consecutive losses (loss in money)	4 (-24.46)
	Maximal	consecutive profit (count of wins)	32.36 (2)	consecutive loss (count of losses)	-24.46 (4)
	Average	consecutive wins	1	consecutive losses	2

Figure 14: Performance of financial expert advisor

System Evaluation

This study attempts to automatically maximize the benefit for foreign trade through EA, while accuracy and downside standards are also considered to decide the correct EA to be used in such business sessions, the assessment systems shall rate EA results according to trade meetings (Sydney, Tokyo, London and New York) (Amirdhavasani et al., 2020). This measurement framework is an ELECTRE Network-based technique that communicates with desktop application resources in real time and can show the performance of real-time diagrams using the desktop application connections protocol (Amirdhavasani et al., 2020; Simon & Köln, 2015; Slaný, 2009; Torre et al., 2023). all EAs were simulated 24 hours a day in all market sessions, and its gain, accuracy and drawdown parameters, measured using an ELECTRE desktop application -based methodology, are rated by the best EAs. The ideas behind this study was to compare the best EA in testing times with the outcomes of each best EA by business sessions.

Table 3: Function of the system

Name of Activity	Non-functional	functional	database	Security	Performance rate
Open trades	No	Yes, open buy and sell trades	Yes, saves on the file	Check the signal correct	7
Set stoploss and take profit	no	Yes, it protects your initial amount, gain or loses	Yes, saves on the file		8
Trailing stop	no	Yes, protects profit gain from a trade	Yes, saves on the file		8
Breakeven	no	Yes, no gain or lose	Yes, saves on the file		8
Risk management	no	Yes, the amount you will lose.	Yes, saves on the file		6
Money management	no	Yes, how to increase the slot size base on capital	Yes, saves on the file		6
Currency pairs	no	Yes, which pair are you trading	Yes, saves on the file		9
Internet connection	Yes, need data to operate	no	Yes, the time you log in		Depends on internet connection
Interfaces	Yes	no	no		9
Privacy	Yes, only person who can access the plateform	no	no		10
Visibility	Yes, view the charts	no	no		10
encryption	No, only you can use the expert advisor	yes	no		5

Conclusions

Researchers have long been involved in algorithmic trading and statistical modelling in foreign exchange trading. In this sense, individual and commercial investors occupied themselves with the creation of predictive consultants (Cohen, 2022). In this document, a topological model was created with the objective of developing high-quality predictive professional consultants. Definition of the informal sector to build the topological model, a predictive professional advisor was used (Cohen, 2022; Slaný, 2009). Expert advisor and trading robots are programs which automate and execute a trade strategy on the financial markets. The software predicts the buy / sell signals for traders' plans, and the consultant or computer immediately opens positions. The trade escape is also included with price targets programmed. This means the traders no longer must physically interfere. Obviously, the purpose of these specialist consultants and trade robots is to make profit.

Regarding suggestions for further studies, this study would continue to build more automation possibilities and simultaneously discover new ways of benefiting from forex financial robots and implementing and upgrading the features of the financial expert advisor (Mehta et al., 2020.; Muhamad Syahir Bin Wahid & Darul Ridzuan, 2013). Further aspect of this project study would be to define the challenges and works on addressing them. It is advisable to advance works forex financial expert advisors as continuous monitoring is often necessary (Geerts, 2011). One

will make the investment decision more easily and that too helps brokers minimize payroll expenses. It is often most always in alignment with the path taken, and is hybrid business information system, innovations and technology. This would be a valuable study to inspire people to build passive income in the foreign exchange and technology market thereby contributing towards future sustenance of interested people in the society.

In concluding, a financial expert advisor specialist consultant designs and trades in the swap market. For financial institutions financial expert advisor is highly important and Individuals that have a stock market stake. The traders' trading strategy is coded into financial expert advisor to assess the demand on this plan to make a separate buying and selling order. This is a step in the direction of sustainable development enabled with the use of information systems.

References

Abbey, B. S., & Doukas, J. A. (n.d.). *Is Technical Analysis Profitable for Individual Currency Traders?*

Amirdhavasani, S., Selvam, M., Sigo, M. O., Pavithran, A., & Kathiravan, C. (2020). Martingale Difference Hypothesis in Asia-Pacific Foreign Exchange Market. *International Journal of Management (IJM*, *11*(3), 633–641. http://www.iaeme.com/ijm/issues.asp?JType=IJM&VType=11&IType=3JournalImpactFactor

Ben Mrad Douagi, F. W., Chaouachi, O., & Sow, M. (2021). The portfolio management: Investigation of the fama-french five-and six-factor asset pricing models. *Polish Journal of Management Studies*, *23*(1), 106–118. https://doi.org/10.17512/pjms.2021.23.1.07

Bolloju, N., & Sugumaran, V. (2012). A knowledge-based object modeling advisor for developing quality object models. *Expert Systems with Applications*, *39*(3), 2893–2906. https://doi.org/10.1016/j.eswa.2011.08.151

Bozkurt, A., Jung, I., Xiao, J., Vladimirschi, V., Schuwer, R., Egorov, G., Lambert, S. R., Al-Freih, M., Pete, J., Olcott, D., Rodes, V., Aranciaga, I., Bali, M., Alvarez, A. V, Roberts, J., Pazurek, A., Raffaghelli, J. E., Panagiotou, N., De Coëtlogon, P., … Paskevicius, M. (n.d.). A global outlook to the interruption of education due to COVID-19 Pandemic: Navigating in a time of uncertainty and crisis. *Asian Journal of Distance Education*, *15*(1), 2020. http://www.asianjde.org

Caliskan Cavdar, S., & Dilek Aydin, A. (2020). Hybrid Model Approach to the Complexity of Stock Trading Decisions in Turkey. *Journal of Asian Finance, Economics and Business*, *7*(10), 9–21. https://doi.org/10.13106/jafeb.2020.vol7.no10.009

Carranza, E., Farole, T., Gentilini, U., Morgandi, M., Packard, T., Santos, I., & Weber, M. (2020). *Managing the Employment Impacts of the COVID-19 Crisis: Policy Options for Relief and Restructuring*. www.worldbank.org.

Ciccozzi, F., Malavolta, I., & Selic, B. (2019). Execution of UML models: a systematic review of research and practice. *Software and Systems Modeling*, *18*(3), 2313–2360. https://doi.org/10.1007/s10270-018-0675-4

Cohen, G. (2022). Algorithmic Trading and Financial Forecasting Using Advanced Artificial Intelligence Methodologies. In *Mathematics* (Vol. 10, Issue 18). MDPI. https://doi.org/10.3390/math10183302

Desai, N., Chopra, A. K., Arrott, M., Specht, B., & Singh, M. P. (2007). *Engineering Foreign Exchange Processes via Commitment Protocols *.*

Ellul, A., Erel, I., & Rajan, U. (2020). The COVID-19 pandemic crisis and corporate finance. In *Review of Corporate Finance Studies* (Vol. 9, Issue 3, pp. 421–429). Oxford University Press. https://doi.org/10.1093/rcfs/cfaa016

Geerts, G. L. (2011). A design science research methodology and its application to accounting information systems research. *International Journal of Accounting Information Systems*, *12*(2), 142–151. https://doi.org/10.1016/j.accinf.2011.02.004

Grable, J. E., Archuleta, K. L., Ford, M. R., Kruger, M., Gale, J., & Goetz, J. (2020). The Moderating Effect of Generalized Anxiety and Financial Knowledge on Financial Management Behavior. *Contemporary Family Therapy*, *42*(1), 15–24. https://doi.org/10.1007/s10591-019-09520-x

Lyons, A. C., Palmer, L., Jayaratne, K. S. U., & Scherpf, E. (2006). Are we making the grade? A national overview of financial education and program evaluation. In *Journal of Consumer Affairs* (Vol. 40, Issue 2, pp. 208–235). https://doi.org/10.1111/j.1745-6606.2006.00056.x

Mehta, J. R., Menghini, M. D., Engineering, R., & Sarafconn, D. A. (n.d.). *Automated Foreign Exchange Trading System An Interactive Qualifying Project Report*.

Miśkiewicz, J., Tadla, A., & Trela, Z. (2019). Does the monetary policy influenced cross-correlations on the main world stocks markets? Power Law Classification Scheme analysis. *Physica A: Statistical Mechanics and Its Applications*, *519*, 72–81. https://doi.org/10.1016/j.physa.2018.12.016

Muhamad Syahir Bin Wahid, B., & Darul Ridzuan, P. (2013). *Automated Forex Trading Robot with FBH Robot On Metatrader 4 Platform (Expert Advisor)*.

Osunbor, V. I., & Egwali, A. O. (2016). Development of OSEG: A FOREX Expert Advisor. In *The Pacific Journal of Science and Technology-206* (Vol. 17, Issue 2). http://www.akamaiuniversity.us/PJST.htm

Pokhrel, S., & Chhetri, R. (2021). A Literature Review on Impact of COVID-19 Pandemic on Teaching and Learning. *Higher Education for the Future*, *8*(1), 133–141. https://doi.org/10.1177/2347631120983481

Simon, L., & Köln, Z. A. (2015). *INFORMATION ASYMMETRIES: THREE ESSAYS IN MARKET MICROSTRUCTURE*.

Slaný, K. (2009). Towards the automatic evolutionary prediction of the FOREX market behaviour. *Proceedings of the 2009 International Conference on Adaptive and Intelligent Systems, ICAIS 2009*, 141–145. https://doi.org/10.1109/ICAIS.2009.31

Stockhus, S. (2011). *Saul Stockhus AUTOMATED TRADING SOFTWARE FOR FOREIGN EXCHANGE Information Technology Automated trading software for Foreign Exchange*. http://www.urn.fi/URN:NBN:f

Torre, D., Genero, M., Labiche, Y., & Elaasar, M. (2023). How consistency is handled in model-driven software engineering and UML: an expert opinion survey. *Software Quality Journal*, *31*(1), 1–54. https://doi.org/10.1007/s11219-022-09585-2

van Zanten, J. A., & van Tulder, R. (2021). Towards nexus-based governance: defining interactions between economic activities and Sustainable Development Goals (SDGs). *International Journal of Sustainable Development and World Ecology*, *28*(3), 210–226. https://doi.org/10.1080/13504509.2020.1768452

Venable, J. R., Pries-Heje, J., Baskerville, R. L., Venable, J. R. ;, Pries-Heje, J. ;, & Baskerville, R. (2017). Choosing a Design Science Research Methodology. In *Australia Choosing a Design Science Research Methodology* (Vol. 2). https://aisel.aisnet.org/acis2017/112

Wang, H., Lu, S., & Zhao, J. (2019). Aggregating multiple types of complex data in stock market prediction: A model-independent framework. *Knowledge-Based Systems*, *164*, 193–204. https://doi.org/10.1016/j.knosys.2018.10.035

Wang, S., & Li, S. G. (2019). A novel hybrid carbon price forecasting model based on radial basis function neural network. *Acta Physica Polonica A*, *135*(3), 368–374. https://doi.org/10.12693/APhysPolA.135.368

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He obtained B.Sc. degree in Computer Science & Statistics from Ogun State University, Ago-Iwoye, Nigeria in 1989, and B.Sc. Honours degree in Information Systems from University of South Africa (UNISA) in 2000. He then obtained two Masters' degree namely, an M.Sc. degree in Information Systems from UNISA in 2006 and also an M.Phil. Informatics degree from the University of Pretoria (UP) in 2011. He is currently busy with his doctoral studies.

His area of research interests includes Information systems and web-based application development, software engineering, e-learning, e-commerce and their impact on educational systems and on the society. He is currently lecturing the following courses or subjects such as: Web Applications development with ASP.NET using C# and VB; Web Applications development using PHP, Java servlet and Java Server Pages (JSP); Developing Client-Server Applications using Borland C++ Builder; Graphical User Interface Design, Development and Implementation; Research Methodology & Research Project 4; Client applications using HTML5, Cascading Style Sheets (CSS) and Javascript as well mathematical subjects like Discrete structures.

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