Utilizing Artificial Intelligence in Cryptocurrency Trading: a Literature Review

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***Abstract*—The rapid growth and unique advantages of cryptocurrencies have made them an attractive asset for investment portfolios. However, investing in cryptocurrencies comes with risks, especially market volatility. This paper explores the benefits of Bitcoin's market dominance, including liquidity, stability, and practical utility. It also reviews multiple previous articles about using Artificial Intelligence (AI) for cryptocurrency trading to enhance the feasibility and profitability of cryptocurrency investments, focusing specifically on Bitcoin. It further discusses the potential advantages of using AI in developing predictive models for market trends and managing grid trading strategies to stabilize returns and lower risks. While research on the application of grid trading strategy with AI in the cryptocurrency market is limited, existing studies in other asset classes demonstrate the effectiveness of AI-based methods. Finally, this paper outlines novel potential future research that aims to integrate AI with the Grid Trading Strategy. This integration seeks to enhance the sustainability of cryptocurrency investments while simultaneously amplifying their profitability.**

***Index Terms*—Cryptocurrency, Bitcoin, Grid trading strategy, Robotic Trading.**

I. Introduction

Cryptocurrency has become a highly interesting asset due to its various advantages, including potential high returns, decentralization, accessibility, security, and anonymity [1]–[4]. Furthermore, when surveying the extensive array of cryptocurrencies currently present in the market, it becomes evident that Bitcoin claims the spotlight as the leading and dominant player. This distinction is due to several key factors, including its impressive liquidity, the difficulty of manipulation by individuals seeking personal advantage, and the widespread acceptance it enjoys across various sectors and regions. As a result, Bitcoin emerges as a compelling option within the realm of alternative assets, offering potential investors a viable avenue for portfolio diversification [5]–[8].

Nonetheless, engaging in cryptocurrency investments carries inherent risks, encompassing factors such as market volatility and the uncertainties surrounding regulations. In response to these challenges, this study aims to strengthen the viability and potential profitability of ventures into cryptocurrency, by conducting a comprehensive review of prior research concerning cryptocurrency trading enriched by the application of Artificial Intelligence (AI). Capitalizing on AI's ability to recognize

patterns, predict trends, and analyze data, traders can construct predictive models that anticipate market trajectories and consequently fine-tune trading strategies for optimal returns [9]–[21].

Nonetheless, traders' objectives extend beyond merely maximizing predictive accuracy; they also emphasize optimal returns, stability, and appropriate risk management. The inherent volatility of cryptocurrency prices renders exclusive reliance on AI for predicting such prices ineffective in generating consistent and low-risk returns. Single-order trading strategies may fall short in effectiveness. Introducing a grid trading strategy, involving multiple orders to span various price levels, could offer advantages. Nevertheless, research into applying AI-enhanced grid trading within the cryptocurrency area remains limited. This paper addresses this gap by examining earlier investigations into AI-driven grid trading within different asset classesspecifically, Forex and Stock Trading [22], [23]. It sheds light on the underexplored territory of grid strategies paired with AI. Furthermore, in the discussion section, a novel framework is proposed for integrating AI into grid trading strategies tailored to cryptocurrencies.

The remainder of this article is organized as follows: Section II presents the Literature Survey. Section III provides the conclusions derived from the review of the research papers. Section IV contains a discussion on the shortcomings observed in earlier studies. Finally, Section V introduces proposals for future work.

II. Related works

After the early 21st century of economic crises across multiple countries, investors are actively seeking alternative investment options beyond traditional assets and fiat currencies. This research paper explores the potential of investing in cryptocurrencies, particularly focusing on Bitcoin, a prominent digital currency. It aims to identify strategies that can optimize returns and manage risks effectively, making cryptocurrency investments more suitable for investors. This section is divided into four parts. The initial part involves a literature review emphasizing the rationale behind the suitability of cryptocurrency, notably. Bitcoin, as an effective diversification tool in investors portfolios for potential investment-optimized returns. The second part reviews various studies that have employed different AI and forecasting methods to predict cryptocurrency trading and discuss their results. The third part examines the grid trading strategy, presenting it as a viable option for stable trading, and explores its application with AI on other asset classes. Lastly, the fourth part is a comparison of the research studies.

A. Cryptocurrency

Cryptocurrency has emerged as one of the most sought-after assets in investment portfolios owing to its numerous distinctive advantages. There are various potential benefits to investing in cryptocurrency, which include:

- High returns: Cryptocurrencies have shown a potential to generate high returns when held as a long-term investment [1].
- Decentralization: As cryptocurrencies are decentralized, they are not reliant on banks or governments, thus making them more resilient [2].
- Accessibility: Cryptocurrencies are easily accessible as they can be bought and sold online and are thus available to anyone with an internet connection.
- Security: Cryptocurrencies are secured by advanced cryptographic techniques which make them highly secure [3].
- Anonymity: Cryptocurrencies offer anonymity, thus potentially offering greater privacy to users [4].

Since the inception of Bitcoin in 2009, the world of cryptocurrencies has expanded dramatically, with thousands of alternative cryptocurrencies now in existence. However, Bitcoin's position as the pioneer and leader in the market presents traders with a distinctive set of benefits. Bitcoin's market dominance contributes to its liquidity and relative stability, providing a transparent price that is less susceptible to manipulation [5]. Its widespread acceptance among businesses and institutions enhances its practical utility. The robustness of Bitcoin's infrastructure, which includes an excess of trading platforms and wallets, offers convenience to traders. Furthermore, Bitcoin can serve as another asset class to help diversify investors portfolios [6]. Despite Bitcoins volatility, it generates substantially higher risk-adjusted returns [7]. Additionally, its longer performance history provides a rich source of data for analysis. Importantly, Bitcoin, like other cryptocurrencies, extends opportunities for financial inclusion, offering a financial tool for those excluded from traditional banking systems. Bitcoin's market dominance presents unique advantages, maintaining its preference in cryptocurrency trading despite high price volatility. The inclusion of Bitcoin into a diversified asset portfolio, with the correct allocation, can offer significant benefits to an investor [8]. To aid in this, leveraging the power of AI in recognizing patterns, forecasting trends, and analyzing data, predictive models for market tendencies will assist investors in making more informed decisions in cryptocurrency trading.

B. Utilizing Artificial Intelligence and forecasting methods in Cryptocurrency Trading

Numerous research papers have explored the utilization of AI-powered algorithmic investment strategies in forecasting and trading within the cryptocurrency market. Notable examples of these studies demonstrate the effectiveness of AI in this context.

In this literature review, we survey previous research on the application of AI in crypto trading to assist investors. Various methods using trading data at different time intervals, machine learning techniques, and trading strategies, with and without technical analysis, are presented. By analyzing these studies, we aim to identify the most promising algorithms for crypto trading and assess their potential for enhancing stability and reducing risk in this volatile market.

Leonardo Ranaldi (2022) [9] introduce CryptoNet, a system that utilizes artificial intelligence (AI) and machine learning (ML) techniques to analyze financial time series in the cryptocurrency market. They highlight the limitations of traditional approaches such as auto-regressive models and moving average models. By training an artificial neural network on Bitcoin and Ether data, CryptoNet, an Artificial Autoregressive Neural Network (ARNN) based model, achieves a significant improvement in mean absolute error (MAE) of up to 31% compared to linear regression models. The results demonstrate the potential of machine learning techniques for extracting time series trends and encourage their adoption in sectors traditionally hesitant to explore non-standard approaches.

Sudeep Tanwar (2021) [10] mentions that considerable research has been conducted on various cryptocurrencies to forecast accurate prices, but the majority of these approaches cannot be applied in real-time. This paper proposes a deep-learning-based hybrid model using Gated Recurrent Units (GRU) and Long Short-Term Memory (LSTM) to predict the prices of Litecoin and Zcash in the volatile cryptocurrency market in real-time scenarios. The model takes into account the inter-dependency of the parent coin, Bitcoin, and shows high accuracy in real-time price forecasting compared to existing models.

Patrick Jaquart (2012) [11] In this study, the authors analyze the predictability of the bitcoin market across different short time horizons ranging from 1 to 60 min, using various machine learning models. They find that recurrent neural networks (LSTM-RNN) and gradient boosting classifiers (GBC) perform well in predicting bitcoin prices compared to a random classifier. The comprehensive feature set used includes technical, blockchain-based, sentiment/interest-based, and asset-based features, with technical features proving to be the most relevant. The study also reveals that predictability increases for longer prediction horizons. While a long-short trading strategy generates significant returns before transaction costs, transaction costs result in negative returns due to short holding periods.

Francisco Orte (2022) [12] This study presents a price prediction model of crypto assets, using the Random Forest algorithm. The model compares three scenarios: utilizing technical indicators, candlestick patterns, and a combination of both. The study explores the model parameters, time intervals, and suitable investment horizons. Additionally, an out-of-sample prediction for the entire year of 2020 is simulated, considering different market scenarios. The results suggest that using candlestick patterns instead of technical indicators improves the efficiency of the price prediction model. The model is retrained after each new data collection to maximize information and simulate real operations.

Laura Alessandretti (2018) [13] This study tested three forecasting models on daily cryptocurrency prices: Method 1 used gradient boosting decision trees (XGBoost), Method 2 used a different XGBoost model for each currency, and Method 3 used long short-term memory (LSTM) recurrent neural networks. All three methods demonstrated better performance than the baseline strategy. Parameter optimization based on the Sharpe ratio resulted in larger returns. The LSTM-based method showed the best performance, leveraging the technique of LSTM for capturing long-term dependencies in the cryptocurrency price data.

Aisha Peng (2022) [14] This paper focuses on the application of Deep Reinforcement Learning (DRL) in predicting price fluctuations and identifying effective trading points in dynamic markets, contributing significantly to the finance sector. The study proposes the integration of the Proximal Policy Optimisation (PPO) algorithm into an automated trading system (ATS), which addresses behavioral biases often present in human decision-making. The aim is to develop a stable, accurate, and robust ATS that utilizes deep neural networks and reinforcement learning to maximize investment returns by predicting price movements and executing optimal trades. Experimental results demonstrate the superiority of the proposed model (Integrating LSTM with CNN) over baseline methods and other similar works in terms of performance and profitability.

Giorgio Lucarelli (2019) [15] In this study, different trading systems based on Deep Reinforcement Learning were assessed using hourly cryptocurrency (specifically Bitcoin) prices. The trading systems utilized Double and Dueling Double Deep Q-learning Networks, and were compared with a simpler Deep Q-learning Network. Each system was tested with two different reward functions: one based on the Sharpe ratio and the other on profitability. Six different Q-learning trading system settings were evaluated using bitcoin data from December 1, 2014, to June 27, 2018. The systems demonstrated positive average returns for shorter trading periods, with the SharpeD-DQN system, based on Double Q-learning and the Sharpe ratio reward function, achieving higher returns. When tested over the entire period, SharpeD-DQN generated a positive average percentage return of 8

Abhishek Kumar (2021) [16] This paper aims to utilize machine learning techniques to predict the intraday movements of cryptocurrencies and develop a corresponding trading strategy. Multiple algorithms including AdaBoost, RandomForest, XGBoost, and Neural Networks are employed and evaluated for their suitability in this task. The study incorporates various labels and unique features such as forecasts from econometric models like GARCH, volume and trade data, and their interaction with returns. While the MLP classifier and AdaBoost classifier demonstrate poor out-of-sample performance, potentially due to overfitting, Random Forests perform well despite underperforming in the training set. XGBoost emerges as the best-performing classifier, outperforming others in terms of accuracy and generating positive returns for all currencies along with RandomForest.

Erdinc Akyildirim (2021) [17] This study examines the predictability of twelve liquid cryptocurrencies using machine learning classification algorithms. The algorithms achieve average classification accuracy above 50% for all cryptocurrencies and timescales, indicating some predictability in cryptocurrency price trends. The machine learning algorithms

achieve an average predictive accuracy of about 55-65% at daily or minute frequencies, with support vector machines demonstrating the best and most consistent results compared to other classification algorithms.

Jifeng Sun (2019) [18] In this study, random forest is utilized to predict cryptocurrency prices by incorporating selected factors from Alpha101 as features based on historical market data from Binance and Bitfinex. The findings demonstrate the effectiveness of the proposed strategy in cryptocurrency trading. Random Forest models built using OHLCV data from different cryptocurrencies show that certain factors play a significant role in predicting price movements, and the models yield more accurate predictions over longer time intervals.

Saad Ali Alahmari (2019) [19] This research demonstrated the application of the traditional Autoregressive Integrated Moving Average (ARIMA) model to forecast the prices of three significant cryptocurrencies - Bitcoin, XRP, and Ethereum - utilizing time series data on a daily, weekly, and monthly basis. The investigators discovered that the ARIMA model, when employed with weekly base re-sampling, yielded superior results in comparison to other models regarding mean absolute error (MAE), mean squared error (MSE), and root mean squared error (RMSE) for the price predictions of Bitcoin, XRP, and Ethereum.

Zheshi Chen (2019) [20] This paper showed Statistical methods like Logistic Regression and Linear Discriminant Analysis outperformed complex machine learning algorithms in daily Bitcoin price prediction, achieving 66% accuracy. However, for 5-minute interval price prediction, machine learning models, including Random Forest and LSTM, proved superior with a 67.2% accuracy rate. Essentially, statistical methods were more effective for low-frequency, high-dimensional data, while machine learning models were better for high-frequency data.

Jeffrey Chu (2020) [21] This study examined the momentum trading strategy and its applicability to cryptocurrency trading. By adapting the strategy to high-frequency cryptocurrency data, positive results were achieved in theory. The study demonstrated the potential for using the momentum strategy in cryptocurrency trading, with a cumulative return of approximately 0.4 over the test period. The results were robust when applied to another sample period, indicating the strategies' ability to generate positive returns. However, factors such as limited short-selling facilities, transaction costs, and confirmation times should be considered for further analysis to confirm profitability.

C. Utilizing Artificial Intelligence with Grid Trading on other asset class

Based on the above-reviewed papers, it is evident that AI can assist in forecasting cryptocurrencies. However, investors are also mindful of the potential for significant losses and risks, particularly in a volatile market. To address this, grid trading strategies offer a potential solution for stabilizing portfolios. Grid trading is a trading technique that involves placing multiple buy and sell orders at fixed intervals or price levels to profit from market volatility within a defined range. The main objective of the grid trading strategy is to profit from price fluctuations in both bullish and bearish market conditions [22]. While there is a lack of research on combining grid trading and AI specifically for crypto trading, we identified various grid trading strategies applied to other asset classes [22], [23]. Further exploration of these strategies could provide valuable insights for developing a grid trading approach integrated with AI in the cryptocurrency market.

Wei-Chang Yeh (2022) [22] In this study, a flexible grid trading model with AI is proposed, on S&P 500, Nasdaq100, and DowJones, EuroStoxx50, and ShanghaiCom asset classes, combine the Simplified Swarm Optimization (SSO) algorithm for parameter optimization in different market conditions. The model leverages the power of fully connected neural networks (FNN) and Long Short-Term Memory (LSTM) models to train a quantitative trading system capable of automatically calculating and adjusting optimal trading parameters based on prevailing market conditions. The proposed model aims to reduce investor effort, achieve superior investment returns, maintain model robustness, and effectively balance risk and returns in the trading market.

Francesco Rundo (2019) [23] proposed algorithmic trading with a grid trading strategy on the FOREX market. Grid algorithmic trading has gained popularity among traders due to its advantages in managing financial transactions and mitigating losses. It involves strategically positioning buy and sell orders with a time-spaced grid distance. This approach offers financial sustainability and is particularly suitable for high-frequency trading (HFT) strategies. To enhance the performance of HFT systems, the authors propose an automatic HFT grid trading system in the FOREX market that is combined with machine learning methods for financial time series forecasting. The proposed algorithm demonstrates effectiveness, robustness, and reduced drawdown, confirming its performance in real-world trading scenarios.

D. Comparing research papers

Table I summarizes earlier research that utilizes various forms of artificial intelligence for predicting cryptocurrency and other asset values. We show a comparison across distinct asset types including cryptocurrencies (BTC, ETC, ADA, BCH, BNB, XRP, etc.), stock indices, and the forex market. Our analysis encompasses a range of methodologies such as Linear Regression, ARNN, SSO, FNN, and LSTM, among others, employing a grid framework. We highlight the optimal outcomes achieved and show the focal points of the results, for example, whether they emphasize accuracy or trading returns. Additionally, our assessment incorporates a careful consideration of risk-related factors.

Our findings reveal a prevalent trend in these papers, where the primary emphasis is placed on predictive accuracy and the alignment of forecasts with actual prices. However, we have observed a notable gap in considering the genuine overall return and risk associated with the proposed models.

TABLE I: Comparison Research Works

Author	*Asset*	Methods	Best Result	Result	Risk
Leonardo Ranaldi (2022)	BTC, ETH	LR, ARNN	ARNN	Accuracy, MAE	N/A
Sudeep tanwar (2021)	Litecoin, Zcash	GRU, LSTM, Mix	Mix	Accuracy, MSE	N/A
Patrick Jaquart (2012)	BTC	GRU, LSTM, FNN, LR, GBC, RF	LSTM, GBC	Trading returns	High
Francisco Orte (2022)	BTC	RF, Candle Stick pattern, Technical analysis	RF and Candle Stick	Trading returns	N/A
Laura Alessandretti (2018)	Multi Crypto	XGBoost, LSTM	LSTM	Trading returns	N/A
Aisha Peng (2022)	ADA, BCH, BNB, BTC, ETC, LINK, LTC, XLM, XRP	PPO, CNN, LSTM	LSTM with CNN	Trading returns	Medium
Giorgio Lucarelli(2019)	BTC	RL: D-DQN, DD-DQN, DQN	SharpeD-DQN	Trading returns	Medium
Abhishek Kumar (2021)	BTC, ETH, XRP, LTC, BCH	AdaBoost, RandomForest, XGBoost and Neural Networks	XGBoost	Trading returns	N/A
Erdinc Akyildirim (2021)	BTC, LTC, ETH, ETC, BCH	SVM, LR ANN, and RS	support vector machines	Accuracy	N/A
Jifeng Sun (2019)	BTC	random forest	random forest	Accuracy	N/A
Saad Ali Alahmari (2019)	BTC	Machine Learning ARIMA	Weekly, ARIMA	Accuracy	N/A
Zheshi Chen (2019)	BTC	LR, LDA, QDA, SVM, RF,XGB, LSTM	Daliy Stat, 5 min, LSTM	Accuracy	N/A
Wei-Chang Yeh (2022)	S&P 500, Nasdaq100, DowJones, EuroStoxx50,ShanghaiCom	Grid with SSO, FNN, LSTM	Grid with SSO, FNN	Trading returns	Low
Francesco Rundo (2019)	EUR/USD	Grid with CNN, LSTM	Grid and LSTM	Trading returns	Low
Proposed Future Work	BTC	Grid with LSTM	N/A	Trading returns	Low

From an investor's standpoint, factors such as the total return on investment and the stability of their portfolio hold greater significance. Consequently, the assessment of losses and risks assumes a critical role.

III. Conclusion

Based on the literature review conducted, several AI methodologies and tools have been identified as useful for cryptocurrency trading. These include machine learning algorithms such as Random Forest, XGBoost, and neural networks, as well as techniques like deep reinforcement learning (DRL) and LSTM (Long Short-Term Memory), and recurrent neural networks (RNNs). These AI approaches can be applied to analyze historical data, predict price movements, and make informed trading decisions in the cryptocurrency market. By leveraging these methodologies and tools, investors can enhance their trading strategies and potentially achieve better results in the crypto market.

IV. Discussion

Based on the above literature review, it is evident that the LSTM method outperforms other techniques in cryptocurrency trading, especially in highly volatile markets. Furthermore, longer periods of analysis tend to yield more favorable outcomes. However, it is important to recognize that many research studies often focus on the precision of predictions, rather than on considering the total return, while also integrating risk as a vital component of the assessment. To address the high volatility and risk challenges associated with the cryptocurrency market, merely predicting price trends might not be sufficient to generate consistent returns. Another potential solution to stabilize portfolios could be the implementation of Grid Trading strategies to lower potential risk. This Grid Trading technique involves placing multiple buy and sell orders at fixed intervals or price levels to profit from market volatility within a defined range [22]. While research on the combination of grid trading and AI for crypto trading is limited, exploring existing grid strategies in other asset classes [22], [23] can provide valuable insights for integrating AI into cryptocurrency grid trading for potential future work.

V. Future Work

In view of the gaps shown in the previous review, we have identified promising avenues for future research in "AI-driven grid trading strategies for cryptocurrency trading". These areas of development hold the potential to enhance and revolutionize the efficiency and effectiveness of trading in the cryptocurrency market.

Implementing a grid strategy in trading can lead to stabilized returns. Nevertheless, the conventional grid trading approach comes with limitations. Its optimal performance relies on finding the right parameters and identifying suitable entry and exit points, making it most effective in sideways markets. Additionally, the traditional grid system involves placing buy and sell orders at predetermined price levels and fixed intervals [23].

Integrating AI to predict trends enables the grid system to determine precise entry and exit points for activation or termination. By leveraging forecasted pricing and employing a machine learning model that uses trading profits as rewards, AI can calculate optimal outcomes. This process allows AI to provide the right parameters for the grid, facilitating the setup of automatic trading orders and maximizing investment returns effectively.

Figure 1 shows a framework for our future work. This paper proposes an AI-empowered grid trading strategies framework which is a system that merges an AI-enabled algorithm with a grid trading system comprising two main components: AI-driven trend analysis and AI Robot Trading to manage a Grid trading system. The AI-driven trend analysis involves three key steps: firstly, gathering cryptocurrency market data from sources like crypto exchanges and including pricing details across different time intervals; secondly, creating indicators from this market data; and thirdly, employing AI to analyze these indicators, consequently identifying the cryptocurrencys trends and providing price estimations.

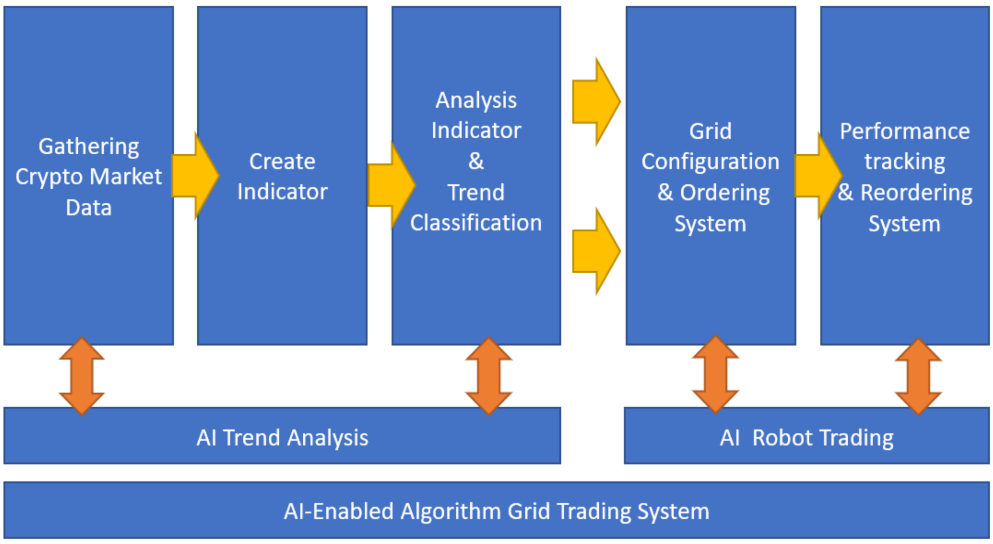

Fig. 1: Potential future work framework for AI-driven grid trading strategies for cryptocurrency trading.

AI Robot Trading operates through a two-step process: initially, involving grid configuration and the trading system, where trends and forecast prices are utilized to set grid parameters; secondly, in performance tracking and a reordering system, AI utilizes trading returns results to reconfigure grid trading for the purpose of optimizing overall returns.

With this suggested framework of the integration of AI's trend prediction capabilities with a grid trading system tailored for Bitcoin's volatility, and utilizing AI for optimal parameter determination, we anticipate that our future research will yield a novel algorithm system. Such a system could provide investors with lower risk and more stable returns, promoting Bitcoin as a viable investment alternative.

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