Bitcoin Price Prediction Using LSTM

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Abstract **-** Cryptocurrency stands as a digital representation of value, existing purely in the digital realm, free from any physical form or centralized control. All transactions are made electronically. Cryptocurrency is a valuable asset that transcends traditional notions of physical currency, existing solely in digital formats within decentralized connectivity. Here we highlight the difference between fiat currency, which is decentralized and free of third-party intervention, and the service offered to all virtual currency users. However, access to cryptocurrencies can disrupt international relations and markets due to their volatile prices. There are many virtual currencies such as Bitcoin, Ripple, Ethereum, Ethereum Classic, Litecoin and more. In our research, we focus specifically on Bitcoin, a popular cryptocurrency. Among various virtual currencies, Bitcoin is widely accepted by many organizations, including investors, scholars, traders and legislators. To the best of our capability, our aim is to make effective prediction models based on deep learning, especially Long Short Term Memory (LSTM) and Gated Recurrent Units (GRU), to control Bitcoin price change and achieve its accuracy. Our research involves comparing two real-time deep learning techniques and demonstrating their effectiveness in predicting Bitcoin price.

Keywords – Cryptocurrency , Bitcoin , Transactions , Decentralized , LSTM , Finance, Trading, Virtual currency, Forecasting.

I. INTRODUCTION

The digital cryptocurrency Bitcoin operates on an online decentralized network and does not rely on a government or legal system as it relies heavily on peer-to-peer network connectivity and cryptography to ensure integrity. This “trustless” system makes it easier to trade goods and services at lower costs [1]. Since the market is new, existing studies on forecasting this market are limited. A study shows that Google Trends data and the number of Bitcoin-related tweets on Twitter correlate well with the price of Bitcoin and can therefore predict the value of Bitcoin[19]. Another study used Bayesian regression (a binary distribution algorithm) to predict Bitcoin's price change, and when combined with trading strategies[17], the predictions were nearly 200% better in less than 2 months. In the ever-progressing principality of economics, cryptocurrency has emerged as a disruptive force, with Bitcoin leading the pack as the most prominent and widely traded digital asset. As Bitcoin continues to achieve grip among investors, traders, and mainstream adoption, the ability to forecast its price accurately becomes increasingly valuable. Predicting Bitcoin's price movements is not only a challenging task but also a highly lucrative opportunity for individuals and institutions seeking to capitalize on the volatility and potential returns of the cryptocurrency market[13].The project "Bitcoin Price Prediction using LSTM" aims to address this challenge by leveraging the power of data science and machine learning techniques to develop a robust model capable of forecasting Bitcoin's future price movements[5]. By examing past cost data, along with a myriad of relevant features such as trading volume, market sentiment, and technical indicators, this project seeks to offer meaningful perspective into the dynamics of the cryptocurrency market and assist stakeholders in making informed decisions[6]. The study concludes that there may be "information" in Bitcoin's historical data that can help predict future price changes. Finally, recent research on Bitcoin price formation shows that macroeconomic and financial indicators will have little effects on Bitcoin cost in the short term. Instead, market forces that affect Bitcoin availability and interest, particularly demand-side variables such as transaction volume, have a greater effect on Bitcoin price[7].

II. OBJECTIVE

To develop a model which can help to forecast the fourth-coming value of the cryptocurrency used (here : Bitcoin), with low error rate and a high accuracy. Given past records of Bitcoin prices along with relevant features such as trading amount, market view, and technical index, the task is to build a predictive model that can predict the fourth-coming value of Bitcoin with a high degree of accuracy.A prediction model that can effectively capture the highly erratic and uncertain identity of the virtual currency market, as well as accurately incorporate both quantitative and non quantitative factors that can influence the price of Bitcoin.

III. ALGORITHM

Long Short-Term Memory (LSTM) Network :

Long Short-Term Memory (LSTM) networks have achieved significant popularity in the field of time series forecasting, including Bitcoin price prediction, due to their capacity to capture long-range interconnections and handle sequential data

accurately[22]. In the circumstances of Bitcoin price prediction, LSTM networks offer a promising approach to model the complex and nonlinear relationships present in cryptocurrency markets[14]. LSTM networks are a type of recurrent neural network (RNN) architecture developed to address the vanishing gradient problem, which often obstructs the training of traditional RNNs on long sequences of data[21]. The LSTM architecture introduces dedicated storage units and gating mechanisms that enable the network's ability to choose what information to retain or discard information over time, making them perfectly-suited for modeling sequential facts with long-range dependencies[4].

LSTM is a sort of RNN that is developed to address the vanishing gradient issue that may arise in standard RNN[18]. It does this by presenting three gating components that control the stream of data through the input gate, forget gate and the output gate.

1. **Cell State:** The cell state serves as the "memory" of the LSTM network, permitting data to flow unalterd over time. It is controlled by three gates: the forget gate, input gate, and output gate.
2. **Forget Gate:** The forget gate decides which data from the past cell state should be discarded or forgotten. It takes as input the ongoing input and the preceding hidden state and generates a score between 0 and 1 for each component in the cell state, where 0 signifies "total forget" method and 1 "total recall."
3. **Input Gate:** The input equivalent decides which new data should be included to the memory state. It consists of two components: the input modulation gate and the candidate value computation. The input modulation gate controls the amount of input information that should be included to the cell state, while the candidate value computation generates new candidate values based on the current input and previous hidden state.
4. **Cell State Update:** The cell state undergoes updates by integrating retained information from prior iterations (determined by the forget gate) and the new information to be added (determined by the input gate).
5. **Output Gate:** The output gate regulates which data from the cell state should be revealed to the next hidden state. It influence the result of the LSTM cell based on the present input alongside the preceding hidden state.

For Bitcoin price forecasting, LSTM networks are trained using historical price data alongside pertinent factors like trading volume, investor sentiment, and technical analysis indicators. By learning patterns and relationships from past price movements, the LSTM model can then make predictions about future Bitcoin prices[9].

IV. MATHEMATICAL MODELS

Step 1: Choose How Much Previous Data It Should Remember
The first phase in the LSTM is to choose which data should be deleted from the cell in that specific time interval. The sigmoid function determines this. It presents at the past state (ht-1) parallel with the current work and computes the function ,refer Equation 1[12].
Deliberate the following two sentences:
Let the yield of h(t-1) be "Alia excels in Physics.David, on the contrary, excels in Chemistry."
Let the current input at x(t) be "David plays football good. "Recently during our phone conversation, he mentioned that he had been the captain of his college football team."The forget gate understand there can be a alter in environment after experiencing the first full halt . It compares with the current input sentence at x(t). The other sentence says about David, so the information on Alia is deleted. The perspective of the topic is deleted and assigned to David.

$$f_t = \sigma\left(W_f \cdot [h_{t-1}, x_t] \; + \; b_f\right)$$

f_t = forget gate
Decides which information to delete that is not important from previous time step

Equation 1

Step 2: Choose how much this unit includes to the current state in the subsequent tier, there are two elements . While the sigmoid function selectively allows values to pass through based on a binary decision (0 or 1), the tanh function amplifies the importance of the values it allows to be transmitted, choosing their level of significance (-1 to 1), refer Equation 2[12].

$$i_t = \sigma\left(W_i \cdot [h_{t-1}, x_t] \; + \; b_i\right)$$
$$\tilde{C}_t = \tanh(W_C \cdot [h_{t-1}, x_t] \; + \; b_C)$$

i_t = input gate
Determines which information to let through based on its significance in the current time step

Equation 2

Step 3: Choose which Portion of the Current Cell State produces it to the yield.
The third step is to choose what the yield will be. First, we run a sigmoid layer, which chooses which parts of memory state produces to the yield . Next, we utilize the hyperbolic tangent (tanh) function to adjust the memory state, restricting values between -1 and 1, and amplify it based on the output from the sigmoid gate, refer Equation 3[12].

$$o_t = \sigma\left(W_o\ [h_{t-1}, x_t]\ +\ b_o\right)$$
$$h_t = o_t * \tanh\left(C_t\right)$$

o_t = output gate
Allows the passed in information to impact the output in the current time step

Equation 3

V. PROPOSED METHODOLOGY

1. User Registration and Login
   User will register with his/her personal information.
   Data will be saved in database.
   Once register user can login with emailed and password.
2. Realtime Price for Cryptocurrency
   After login user can select different cryptocurrency to get real-time price.
3. Future Price Prediction
   User can select different cryptocurrency to get the future price.
4. Basic Info of Cryptocurrency

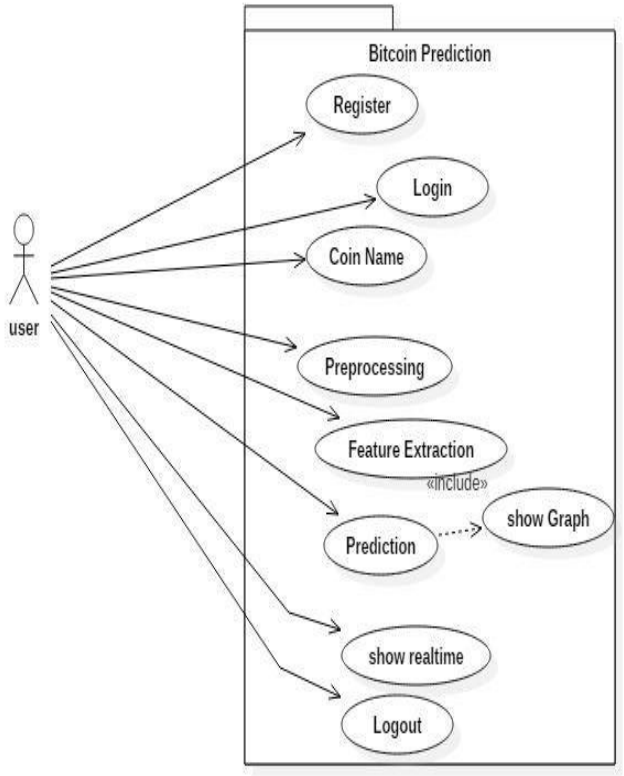

Fig 1. Use Case Diagram

Today Bitcoin is a safe and profitable investment. These are allowed as a limit to how much customers can access their computers to record and record Bitcoin transactions. Trading of Bitcoins in various currencies is carried out in other offices, where "buy" or "sell" requests are placed in the order e-book. “Buy” or “bid” indicates the intention to purchase a particular measure of Bitcoin at a low price, while “bid” or “ask” indicates the expectation to bid a particular measure of Bitcoin at a certain price[17]. This change is accomplished by coordinating the requested price, from the preparation of e-books to the effective exchange between client and providers.

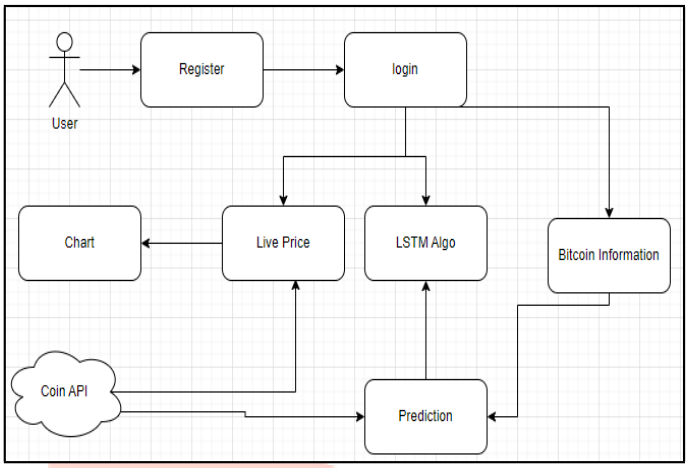

Fig 2. System Architecture

VI. IMPLEMENTATION MODEL

A) Lag Plots: After data cleaning, the next step involves generating lag plots for the time series data. Lag plots help identify patterns such as trends, randomness, and seasonality by visualizing the relationship between data points and their lagged values. These visualizations are created by plotting the time series data against its delayed values on the y-axis, while representing various lag intervals—such as minute, hour, day, week, and month on the x-axis.

B) Train-Test Split: Following lag plot analysis, the data is split into training and testing sets. Typically, a portion of the dataset (e.g., 60 data samples) is reserved for testing, while the leftover samples are employed to train the model. A graph illustrating the train-test split is generated to visualize the arrangement of data between the two sets.

C) Scaling: Prior to model training, it's essential to scale the data ensuring that all features maintain a comparable scale.However, scaling must be performed after the train-test split to prevent data seepage from the test set to the training set, which could adversely affect model performance. Scaling the

data helps normalize the input features and improve the convergence of the training process.

D) Data Generator: A data generator function is created to prepare the data for feeding into the LSTM model. This function frames the input data by defining a "lookback" period, which determines the window size for predicting the current day's data based on the previous days' observations[8]. The input sequence is split into windows of data suitable for training the LSTM model.

E) Restructuring Input into a 3D Tensor: For LSTM models, the input data should be restructured into a three-dimensional tensor comprising samples, timesteps, and features. Samples represent the number of data points, timesteps indicate the number of time steps used for running the RNN, and features denote the number of features in each timestep.

F) Generating Epochs: Callbacks from the Keras library, such as ModelCheckpoint and EarlyStopping, are imported to save the model at checkpoints and stop training when the monitored metric stops improving. These callbacks ensure model integrity and prevent overfitting by saving the best model parameters and terminating training when further optimization is unlikely to improve performance.

VII. RESULT

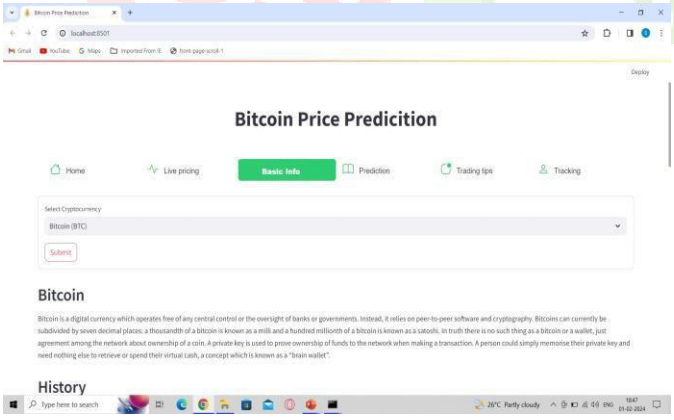

Fig 3 : Information of bitcoin

This figure represents the basic information about the bitcoin.

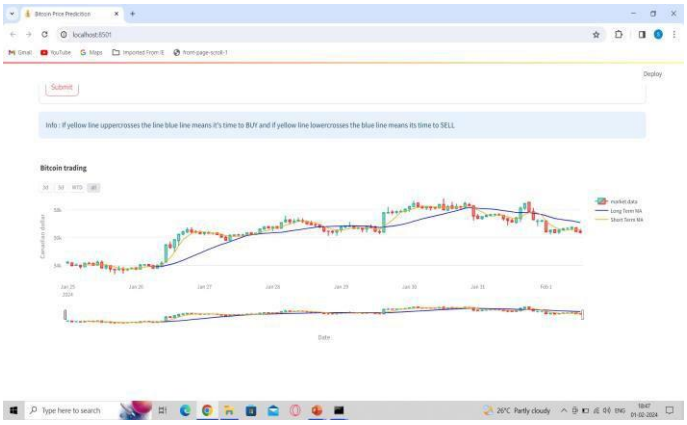

Fig 4: Live Pricing

This figure represents live pricing of the bitcoin.

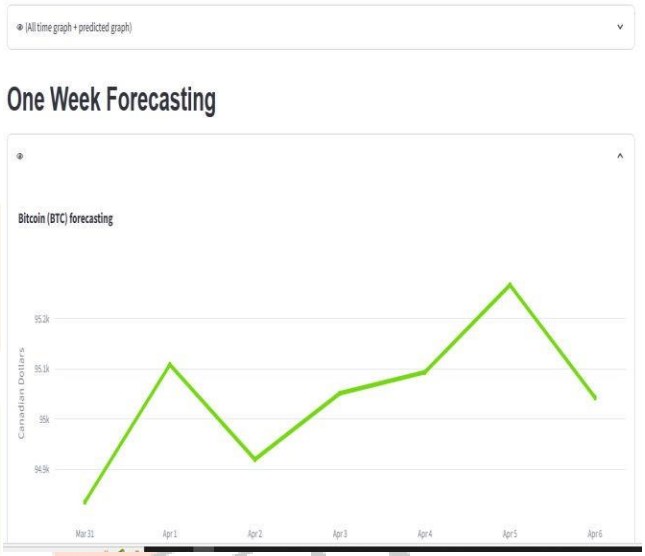

Fig 5: One week Forecasting

This figure represents the prediction of bitcoin for one week.

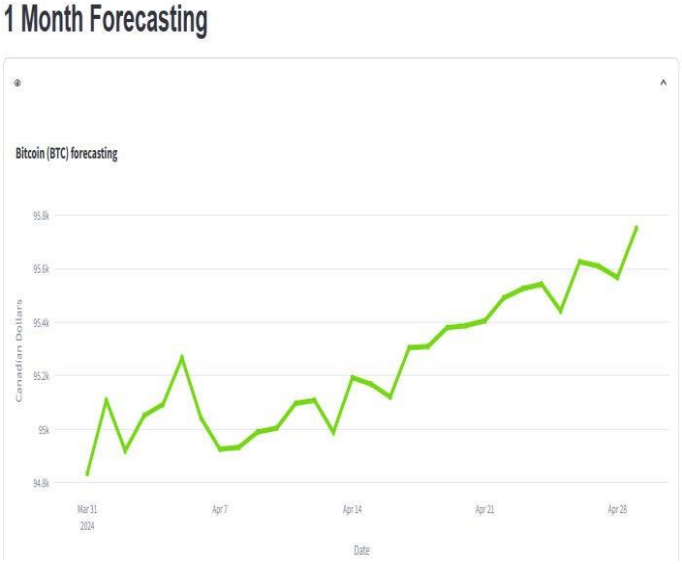

Fig 6: One Month Forecasting

This figure represents the prediction of bitcoin for one month.

VIII. CONCLUSIONS

In conclusion, the field of Bitcoin price prediction presents both challenges and chances for stakeholders in the cryptocurrency market. Through the application of machine learning techniques, particularly LSTM networks, this project endeavors to harness the power of data-driven insights to predict the forthcoming price fluctuations of Bitcoin . By analyzing historical price data, along with a plethora of relevant features such as trade volume, market outlook, and technical analyses, the LSTM model aims to capture the complex and nonlinear relationships inherent in cryptocurrency markets. Through its ability to learn from past recognizing patterns and adjusting to evolving market conditions dynamics, the LSTM network offers a promising approach to predicting Bitcoin prices with a high degree of accuracy .However, it is crucial to accept the inherent uncertainty and volatility of cryptocurrency markets, which pose significant challenges to the task of price prediction. Elements such as regulatory changes macroeconomic trends, technological innovations, and investor sentiment can all influence the orientation and scale of Bitcoin price movements, adding complexity to the forecasting process. Notwithstanding these challenges, the prospective advantages of accurate Bitcoin price prediction are substantial. For investors, traders, and financial institutions, reliable forecasts can inform investment decisions, mitigate risks, and optimize portfolio management strategies. Moreover, accurate price predictions can contribute to a deeper understanding of the underlying drivers of cryptocurrency markets, facilitating research and advancement in the realm of financial analysis.

IX. APPLICATION

Bitcoin is one of the most popular Cryptocurrency today in financial market, where traders make investments. It is mostly used by the investors to predict the future prices and make the right investments. Investors use price predictions to formulate their investment strategies. Accurate predictions can help them decide when to buy or sell Bitcoin, optimize their portfolio allocations, and manage risk exposure effectively. Traders leverage price predictions to develop trading strategies that capitalize on short-term price movements. By anticipating price trends, traders can execute timely buy and sell orders to maximize profits and minimize losses in cryptocurrency markets[14]. Bitcoin price prediction aids in risk management by providing insights into the potential volatility and uncertainty of cryptocurrency markets. Investors and financial institutions can use these predictions to hedge against market risks, diversify their portfolios, and protect their investments. Predictions can be used in conjunction with sentiment analysis of news articles, social media posts, and market trends to know market sentiment. Comprehending market sentiment aids investors and traders in evaluating the prevailing mood and outlook of the market, factors that can significantly impact price fluctuations. Automated trading algorithms utilize price forecasts to autonomously execute trades, circumventing the need for human intervention [20]. These algorithms examine market data in real-time, identify trading opportunities based on predicted price fluctuations , and execute trades at a advantageous prices and times.Exchange platforms use price predictions to provide users with real-time price information, market analysis, and trading signals[12]. These platforms offer tools and features that empower users to make well-informed trading choices and manage their cryptocurrency assets effectively.Price predictions serve as inputs for the valuation and pricing of financial derivatives such as futures, options, and swaps based on Bitcoin. Derivative products allow investors to speculate on the future price of Bitcoin or hedge against price fluctuations, contributing to market liquidity and risk management.Wealth managers and institutional investors use price predictions to optimize their cryptocurrency investment portfolios. By incorporating predictions into their asset allocation strategies, they aim to achieve diversification, maximize returns, and minimize portfolio volatility. Researchers and scholars utilize price predictions to study the dynamics of cryptocurrency markets, develop predictive models, and advance the understanding of financial economics[10]. Academic research contributes to the advancement of different theories, methodologies, and insights into the behavior of Bitcoin prices. Regulatory bodies and policymakers may use price predictions to monitor and regulate cryptocurrency markets. Predictive analytics can help identify potential market manipulation, fraud, and compliance violations, contributing to market integrity and investor protection.

X. FUTURE SCOPE

The implemented LSTM model represents a foundational approach to Bitcoin price prediction, leveraging a limited set of features to achieve reasonable accuracy. However, to further enhance the model's efficiency and predictive power, it is recommended to incorporate additional Bitcoin price features. Kaggle is suggested as a trustworthy provider of datasets renowned for its hosting of credible and high-caliber data sources. Future endeavors will prioritize conducting a thorough investigation into LSTM and deep learning methodologies. This involves delving into advanced techniques, optimization strategies, and model architectures to improve prediction performance. By exploring the latest developments in LSTM and deep learning research, we aim to refine our understanding and implementation of these techniques for more effective Bitcoin price forecasting.Future research can focus on integrating progressive machine learning techniques, such as deep learning models to enhance the accuracy and robustness of Bitcoin price prediction. These models may better capture complex patterns and temporal dependencies in cryptocurrency markets.The incorporation of alternative data sources beyond historical price and trading volume, such as social media sentiment, blockchain analytics, macroeconomic indicators, and geopolitical events, can improve the predictive power of models. Exploration in this domain can delve into pioneering ways to collect, process, and integrate diverse data streams for more

holistic market analysis.Real-time prediction models that continuously ingest and analyze incoming data streams can enable adaptive and responsive decision-making in dynamic cryptocurrency markets. Future research can focus on developing models that adjust to evolving market dynamics in real-time and provide timely predictions and insights to users. Collaboration between experts from diverse disciplines, including finance, computer science, economics, and data science, can foster interdisciplinary research initiatives aimed at advancing the state-of-the-art in Bitcoin price prediction. Such collaborations can leverage expertise from different fields Addressing intricate challenges and formulating innovative solutions. The development of user-friendly prediction platforms and tools that exploit machine learning models to offer actionable insights and decision support for investors, traders, and analysts can enhance accessibility and usability..

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