

BITCOIN PRICE PREDICTION

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ABSTRACT

This work aims to assess the ability of machine learning to predict Bitcoin price direction based on time series. Although many studies look at time series forecasting with machine learning, only a few are dedicated to Bitcoin. Due to the fact that Bitcoin is going through a key stage and majorly fluctuates when compared to the US dollar, its prediction is not easy. Because Bitcoin has led the way in four of the last five years, predicting its future has become very valuable to people. Previously, researchers have found that models run on GPUs are much faster than those run on CPUs. This research studies this area by comparing the training performance of RNNs and LSTMs using GPUs and CPUs. The research uses a Random Forest model to see how different independent variables help predict where Bitcoin's price will move. A reliable forecast of Bitcoin's movement may assist traders in finding positive trading chances.

Keywords: A brief review of Bitcoin Prediction, Time complexity, Machine Learning, Database Architecture, RNN (Recurrent Neural Network), LSTM, Cryptocurrency Forecasting, Deep Learning, Comparison of GPU vs CPU, Feature Selection, Random Forest Algorithm.

1. INTRODUCTION

1.1 Domain-Specific Introduction

The purpose of this research is to determine how accurate Bitcoin price prediction is with machine learning.

Predicting time series is important for financial markets, yet Bitcoin introduces new issues because its market is just starting out, prices fluctuate greatly, and it runs without a central authority. Because Bitcoin's Blockchain is open, strategies for predicting its future are not simple.

Standard forecasting models using Holt-Winters exponential smoothing cannot catch forecast errors well, as they both depend on linear assumptions and seasonality. That's because deep learning methods such as RNNs and LSTM networks can efficiently identify the time-based changes in Bitcoin's prices.

This study aims to summarise Bitcoin, machine learning, and time series analysis. The second part goes over the background of Bitcoin price prediction and other financial forecasting, showing that not much work has been done using machine learning for Bitcoin.

1.2 Problem Definition

In 2017, cryptocurrencies gained a lot of popularity, with capitalization reaching a height of over \$800 billion in January 2018. Today, more than 1,500 cryptocurrencies are being traded, and millions of people and organisations participate. Each day, the market trades over \$15 billion, and about 170 hedge funds are springing up to meet demand from institutions.

Bitcoin's changing price has led many to try using machine learning to forecast its future values. Among the studied techniques, neural networks were found to give the best results in terms of image classification. Forecasting cryptocurrency prices is easier and more accurate with Deep Reinforcement Learning than with traditional methods.

The price of Bitcoin is independent of stock market events or policies set by the government. The study is meant to help forecast Bitcoin's possible direction and price in USD by applying machine learning algorithms. Bayesian optimization of LSTM and RNN networks is used in this analysis to forecast Bitcoin's price, giving investors the information they need.

1.3 Project Purpose

This paper examines the accuracy of predicting the price direction of Bitcoin in machine learning approaches, more specifically the time series prediction. Even though there are many papers discussing machine learning methods applied to time series, they rarely focus on Bitcoin, despite being more volatile in comparison to other currencies as USD. The success of Bitcoin in recent period underscores the possibility of achievable prediction. Finally, the gain in performance of running machine learning algorithms on a GPU compared to a CPU is experimentally investigated, including a benchmark comparison of RNN and LSTM networks.

The study is purely about predicting the direction of Bitcoin's price, and could potentially be used as a signal for profitable trading strategies, like getting short or long based off of model forecasts. There are also factors affecting the Bitcoin price, which are internal (securities) and external (exchange shutdowns, market speculation, and investor size); however, the article is concerned with the model validity. The proposed prediction model will also be compared with state of the art cryptocurrency prediction models.

1.4 Problem Statement

Conventional jukebox apparatuses cannot sense users' feelings therein and then play back music in response to the users' feelings, so known jukebox players has used fixed playlists or required users' instructions. In this project, we propose a relatively simple recommendation system for jukebox in which the user's emotion is recognized by the Gemini-pro vision engine with the VideoDriver's image collection. The recommended songs will be based on the identified mood and will be in language that are preferred by the user (for example, songs in Telugu or Hindi), thus personalizing user's music experience. The objective is to develop an emotion-aware music recommendation system that enables a deeper connection with the user's music selection.

1.5 Project Features

Researchers are suggesting a system to predict Bitcoin prices by studying the patterns in the Bitcoin data using data mining. The organisation hopes to offer useful knowledge that helps investors avoid losing money. Unlike previous models, this system solves the problem in a complete way.

Key features include:

- **Increased Efficiency:** As a result, Bitcoin price prediction has seen a rise in accuracy.
- **Better Monitoring:** More accurate Bitcoin price tracking.
- **Cost Reduction:** Lets you pay less for storing, operating, and maintaining your systems.
- **Reduced Time Complexity:** Optimizes computational efficiency.
- **Simplified Architecture:** Easy-to-understand system design.
- **Handling Large Data:** Efficient processing of large datasets.

1.6 Modules Description

We provide a high-level introduction to the modules and what each one does in this section.

1. Data Gathering

The process of data collection comes first in the analysis. Completing this task accurately is necessary because the data used in data mining projects can determine their results. The amount and diversity of data needs to be sufficient to identify useful trends and to support future research. After that process, the dataset becomes available for analysis.

2. Data Preprocessing

Transforming basic data into something that can be analysed is a vital first task in data processing. This module takes multiple steps to clean and organise the data for analysis.

These steps include:

- ⇒ Data cleaning: Working to remove unneeded, unpaired and sparse data.
- ⇒ Integration (of Data) means merging different kinds of data to form a united collection.
- ⇒ Data Preparation: Producing data that is correctly arranged for analysis (i.e. brought to standard form or ranges).
- ⇒ Data Reduction: Transforming data so it requires fewer observations and/or a new scale of its features.

2. LITERATURE REVIEW

Extracting meaningful trends from large data collections is what data mining aims to do for organisations, allowing them to plan and decide better. [10], [11] Another name for it is Knowledge Discovery in Databases (KDD), which unites techniques from machine learning, statistics, and databases to produce useful insights from raw data. [12], [13]

2.1 Stages of Data Mining

1. **Data Sources:** We find data by accessing databases, websites, or checking social media. You should choose the proper dataset for your analysis to be meaningful.[14], [15]
2. **Data Exploration:** All incorrect data is corrected, and where information is empty, they are handled properly before analysis is performed.[16], [17]
3. **Data Modeling:** Associations and patterns are discovered by using methods such as clustering, classification and decision trees.[18]
4. **Deploying Models:** Patterns are implemented to address a range of issues, like to make predictions or enhance a decision.[19]



Fig 1: Data Mining; Stages

2.2 Techniques in Data Mining Stages of Data Mining

1. **Classification:** Organises data into groups based on what you determine in advance, much like email spam filters.
2. **Association:** Analyses connexions between different variables, and this is often used in retail to better understand customer purchases.
3. **Prediction:** Develop a guess about future trends by studying past facts, for instance, marketing forecasts.
4. **Clustering:** Combines comparable data points, a standard practise in customer segmentation.
5. **Sequential Patterns:** By studying the past, it can offer product suggestions in e-commerce.
6. **Decision Trees:** A model organised like a tree that makes decisions quickly and clearly.

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Fig 2: Data Mining; & Techniques

2.3 Benefits of Data Mining

- **Finance:** Models potential financial risks and recognises when fraud occurs.
- **Marketing:** Gauges what customers do and helps deliver personalised ads.
- **Retail:** Provides better service for customers while improving how we forecast sales.
- **Tax Authorities:** Detects fraud and ensures compliance.

2.4 Existing System

Many in the industry want to determine how Bitcoin, and other cryptocurrencies, might move because of its high volatility. [1] Much like the stock market, Bitcoin's price can change dramatically moment to moment, making predictions very hard. Changes in price are influenced by buyers and their requests for products.[2] Because cryptocurrencies act as investments, the

plan is to purchase them when they are cheap and sell them once they have increased in value. To a large degree, the thin data and fluctuations in the price of Bitcoin make it harder to conduct much research on predicting its movements.[2], [3]

2.5 Disadvantages

- **Lack of Effective Techniques:** Methods to analyse data accurately do not exist for investors and researchers, hurting their ability to predict prices.[4]
- **Data Storage Issues:** Working with extensive Bitcoin price data can be tough for many researchers and investors.[5]
- **Human Error:** When data is entered manually, there is a chance manual errors will occur in the analysis.[6]
- **Missing Data:** Noisy data often comes from incomplete or partial datasets.[7]

Related Research

Studies by Omkar S. Deorukhkar and others have used Feedforward Neural Networks (FNN) for Bitcoin price prediction, but they are less effective for time-series data. Unlike FNNs, Recurrent Neural Networks (RNNs) can learn from previous time steps, making them more suitable for sequential data like cryptocurrency prices.[1], [8], [9]

2.6 Proposed System

The method relies on using machine learning to make predictions about the daily value of Bitcoin.

- **Data Preprocessing:** We begin by making sure that all values in the dataset are present. It is important to carry out this step to remove noise and make sure the data is uniform, which helps the model be reliable.
- **Model Development:** Our next step involves constructing the model using LSTM, which is a type of recurrent neural network. Since LSTM is developed for working with sequential data, it is ideal for predicting Bitcoin prices.
- **Model Evaluation:** The RNN model's results are compared by testing it with a variety of configurations of the number of layers, after training. It ensures that the model uses the best architecture for the most accurate results.

3. REQUIREMENT ANALYSIS

3.1 Functional Requirements

The functions required by the software are defined by its functional requirements, along with the dataset it will use and the expected behaviour in each situation. These are duties such as analysing data, answering questions, and handling particular assignments for the software.[28]

These are the main requirements for the project:

- The system needs to have the ability to prep the crime data before further analysis.[28], [9]
- It should be possible for the system to examine the crime data.[28], [5]
- The system should be set up to detect hidden variations between the data.[28]
- It should be possible for the system to assign labels to groups of data.[28], [5]
- The system must have the ability to divide the data into training and testing parts.[28]
- The system must be capable of training the model by using the training data.[28], [9]
- It should be possible for the system to cheque the trained model using the test data.[28], [5]
- It should use its training to classify various crime incidences.[28]

3.2 Non-Functional Requirements

Non-functional requirements outline system behaviour based on factors like reliability, rather than on exactly what the system can do. Such details highlight how the system is performing and the experience for the user.[28],

Key non-functional requirements include:

- **Reliability:** The system must be stable and manage any errors in a smooth way.
- **Maintainability:** Making changes to the system should not be a difficult task.
- **Performance:** It is important for the system to handle loads and conditions effectively.
- **Portability:** The programme should run smoothly in various platforms or settings with only small adaptations.

- **Scalability:** The system should have the ability to manage bigger loads in the future.
- **Flexibility:** It should be simple to customise the software to serve different user purposes.

3.3 Hardware Requirements

Component	Specification
Processor	Any processor with a speed above 500 MHz
RAM	4 GB
Hard Disk	500 GB
System	Pentium IV with a minimum speed of 2.4 GHz

Table 1: Hard-Ware Requirements

3.4 Software Requirements

Component	Specification
Operating System	Windows 7/8/9/10
Programming Language	Python
IDE	Jupyter Notebook
Tools	Anaconda

Table 2: Soft-Ware Requirements

4. DESIGN

4.1 Design Goals

We aim to predict the maximum and ending prices of Bitcoin by analysing old data. The fact that prices in the cryptocurrency market change so erratically and there’s no predictable season, makes predictions very challenging. Artificial Neural Networks work well on non-linear data from the history in time series. For training and testing, the models utilised Bitcoin data from 2012 to the first quarter of 2018, using statistics of open price, high price, low price, close price, and trading volume. The models were built using information from the past eight quarters and tested with data from the following one.

The purpose is to offer an appropriate technique for forecasting Bitcoin prices with data mining, addressing issues in data quality and large-scale data. The main pluses of the suggested system are higher efficiency, a simpler structure, lower maintenance costs, and better data processing abilities. In addition, it guarantees data protection and only deals with data that is publicly accessible.

4.2 System Architecture

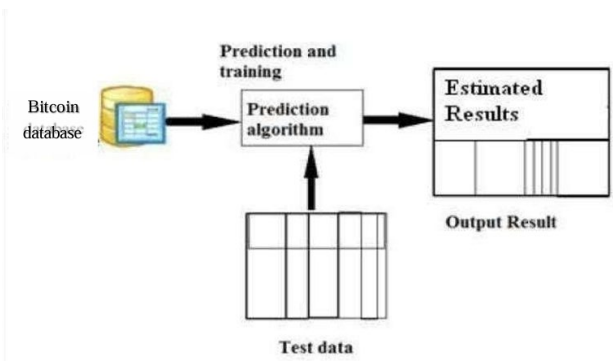


Fig 3: Sys Architecture

4.3 Data Flow Diagram

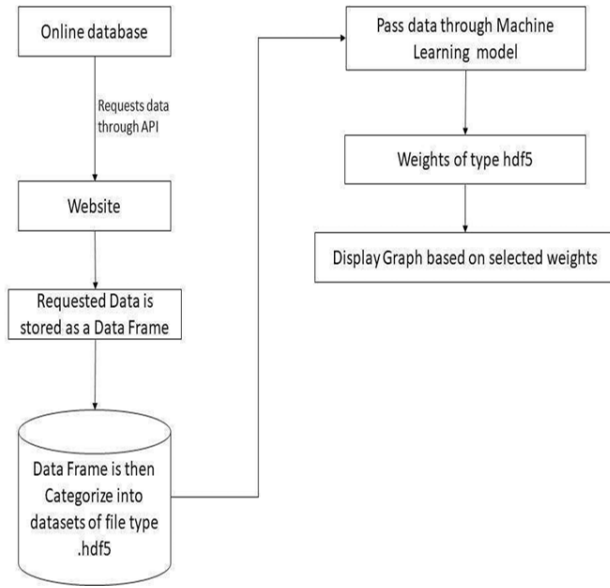


Fig 4: Data : Flow Diagram

5. IMPLEMENTATION

5.1 Dataset

You can find a lot of Bitcoin data online, often consisting of minute-by-minute price records. We are trying to use AI techniques to accurately predict the maximum and closing prices of Bitcoin in the next day.[31] This data is taken from Quandl API and ranges from Bitcoin prices since September 2011 to 2018. A set of 2,381 daily Bitcoin open, high, low, close, and volume records (in USD) is provided in the CSV form. The time from September to December 2011 was not used, and the remaining records are 2271, collected between January 2012 and March 2018.[32], [33], [34], [35], [36]

There are three subsets in the dataset.

Y_{12-13} : Experiments used 2012-2013 data, tested on Q1 2014

Y_{14-15} : Data was drawn from 2014 and 2015 to be used for study and then tested on Q1 2016

Y_{16-17} : The data has been trained and tested with Q1 2018 results

To forecast the next day's values, subsets use earlier closing and high prices from one day before. From January 1 to March 18, testing happens, and from March 19, predictions for the same year are made.

5.2 Data Preprocessing

Before analysing the data, it is essential to clean it since it has errors, different formats, and missing bits of information. The preprocessing steps include:

- **Data Gathering:** Four sources are used to get the data: CoinMarketCap, Blockchain, PyTrends, and Yahoo Finance. So, the data now consists of 12 different features.
- **Data Cleaning:** The table loses the 'Resolution' column, and values that are missing get replaced with the average value pertaining to that column. The data is put together based on time, ranging from 2014 to September 2018.
- **Data Normalization:** To make sure all features are equally important, training data is normalised before training the model. This reduces the problem of updates during training.

5.3 Classification

Common Classification Algorithms:

1. Linear Classifiers:

- ⇒ **Logistic Regression:** It is used to identify whether something is spam or not spam.
- ⇒ **Naive Bayes:** Bayes' theorem is commonly used with text classification.

2. **Support Vector Machines (SVMs):** Uses a hyperplane to split data for work with high-dimensional data.

3. **Decision Trees:** A model where the nodes show different decisions and the leaves are the classes.

4. **Boosted Trees:** Mixes weak decision trees to enhance the accuracy.

5. **Random Forest:** Using many decision trees together, making the classification results less biased.

6. **Neural Networks:** These models aim to work like the human brain with large and unorganised data.

6. CONCLUSION

This phase of the project was very important, as it helped us grasp the basics of data mining and explore them. The course introduced us to different concepts and approaches, which improved our understanding. We spent this phase understanding the important ideas and techniques in data mining, preparing for hands-on practise.

At this stage, the focus shifted from theory to practise. Now, we got closer to working within the system and implementing it step by step. The act of designing a system to predict Bitcoin was important due to the rapid changes in the market. Making such a system meant planning, studying the details, and practising machine learning techniques. We used classification practises and learned to deal with numerous difficulties that honed both our skill and approach. Following Phase 2, the system we developed successfully applied the ideas of data mining.

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