

# Crypto Predict: AI-Powered Crypto currency Price Prediction & Sentiment Analysis

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**Abstract-***The rapid growth of cryptocurrency markets has introduced significant volatility, making accurate price prediction a challenging task. This paper presents Crypto Predict, an AI-powered system that integrates machine learning and natural language processing techniques to forecast crypto currency prices and analyse market sentiment. The proposed system utilizes historical price data along with technical indicators such as Simple Moving Averages (SMA) and Relative Strength Index (RSI) to predict short-term price movements using an autoregressive linear regression model. Additionally, sentiment analysis is performed on social media data using TextBlob to capture market psychology and investor behavior. The system combines quantitative price predictions with qualitative sentiment insights to generate intelligent trading signals such as Buy, Sell, or Hold. A full-stack architecture is implemented using Flask for backend processing, React for frontend visualization, and MongoDB for data storage. Real-time cryptocurrency data is fetched via API integration to ensure up-to-date predictions. Experimental results demonstrate high prediction accuracy and effective sentiment classification, improving decision-making reliability. The proposed approach highlights the importance of hybrid models that integrate financial indicators with behavioural analysis for enhanced cryptocurrency forecasting and trading strategies.*

**Keywords-**Crypto currency Prediction, Machine Learning, Sentiment Analysis, Linear Regression, Natural Language Processing, Financial Forecasting, Trading Signal Generation

## I. INTRODUCTION

Cryptocurrency markets have experienced exponential growth over the past decade, emerging as a significant component of the global financial ecosystem. Unlike traditional financial systems, cryptocurrencies operate on decentralized blockchain technology, eliminating the need for centralized authorities and enabling peer-to-peer transactions [1][2]. This decentralization, combined with the potential for high returns, has attracted investors, researchers, and institutions worldwide. However, despite their advantages, crypto currency markets are characterized by extreme volatility, rapid price fluctuations, and susceptibility to external influences such as regulatory changes, technological developments, macroeconomic trends, and investor

sentiment [3][4]. These factors make accurate prediction of cryptocurrency prices a highly challenging task. Traditional financial forecasting models, which rely heavily on statistical assumptions and linear relationships, often fail to capture the nonlinear and dynamic nature of cryptocurrency markets [5]. As a result, machine learning (ML) and artificial intelligence (AI) techniques have gained significant attention due to their ability to model complex patterns, learn from large datasets, and adapt to changing market conditions [6][7]. Various ML approaches, including regression models, decision trees, support vector machines, and deep learning architectures, have been applied to predict cryptocurrency price movements with improved accuracy [8][9].

In addition to quantitative price data, qualitative factors such as public sentiment and investor behavior play a crucial role in influencing cryptocurrency markets. Social media platforms, online forums, and news articles often drive market trends by shaping investor perceptions and decisions [10][11]. Consequently, sentiment analysis using Natural Language Processing (NLP) techniques has emerged as an essential tool for understanding market psychology. Methods such as TextBlob, VADER, and transformer-based models enable the extraction of sentiment polarity and emotional context from textual data [12][13].

Recent research has focused on hybrid approaches that combine machine learning-based price prediction with sentiment analysis to improve forecasting performance [14]. These integrated systems leverage both technical indicators (e.g., moving averages, RSI, MACD) and sentiment signals to provide a more comprehensive understanding of market dynamics [15]. However, many existing solutions lack real time data integration, scalability, and unified frameworks for generating actionable trading decisions.

To address these limitations, this paper proposes Crypto Predict, an AI-powered hybrid system that combines autoregressive machine learning models with sentiment analysis for cryptocurrency price prediction. The system incorporates historical price data, real-time API inputs, and social media sentiment to generate accurate forecasts and intelligent trading signals such as Buy, Sell, and Hold. By integrating quantitative and qualitative analysis within a full stack architecture, the proposed

approach aims to enhance prediction accuracy, improve decision-making, and provide a practical solution for modern cryptocurrency trading environments.

## II. LITERATURE SURVEY

Numerous studies have explored cryptocurrency price prediction using a wide range of machine learning, statistical, and deep learning approaches. Early research primarily focused on regression-based models due to their simplicity, interpretability, and effectiveness in short-term forecasting scenarios [1][2][3]. Linear regression and its variants have been widely applied to model the relationship between historical prices and future values, particularly in autoregressive frameworks where past observations are used as predictors. These models are computationally efficient and provide baseline performance; however, they often struggle to capture nonlinear patterns inherent in cryptocurrency markets.

To address these limitations, time-series forecasting techniques such as Autoregressive Integrated Moving Average (ARIMA) and Seasonal ARIMA (SARIMA) have been extensively utilized [4][5][6]. These models are designed to handle temporal dependencies and trends in sequential data. While ARIMA-based models perform well under stable conditions, their predictive capability is limited when dealing with highly volatile and non-stationary financial data like cryptocurrencies.

In recent years, deep learning approaches have gained significant attention due to their ability to model complex nonlinear relationships. Long Short-Term Memory (LSTM) networks, a type of recurrent neural network (RNN), have been particularly effective in capturing long-term dependencies in time-series data [7][8][9]. LSTM models overcome the vanishing gradient problem and can learn intricate temporal patterns, making them suitable for cryptocurrency prediction tasks. Furthermore, hybrid deep learning architectures that combine LSTM with Convolutional Neural Networks (CNNs) have shown improved performance by extracting both spatial and temporal features from the data [10][11].

Apart from numerical data, sentiment analysis has emerged as a crucial component in financial forecasting. Research indicates that public sentiment expressed on social media platforms such as Twitter, Reddit, and news outlets significantly influences cryptocurrency price movements [12][13][14]. Positive sentiment often correlates with price increases, while negative sentiment can trigger market declines. To analyze such data, Natural Language Processing (NLP) techniques are employed. Tools like TextBlob and VADER are widely used for sentiment polarity classification due to their

simplicity and effectiveness in handling short textual data [15][16].

Several studies have proposed hybrid models that integrate sentiment analysis with machine learning algorithms to enhance prediction accuracy [17][18][19]. These models combine quantitative features (e.g., historical prices, technical indicators) with qualitative features (e.g., sentiment scores), providing a more comprehensive understanding of market behavior [20][21]. Such approaches have demonstrated improved performance compared to standalone models, as they capture both market trends and investor psychology.

Feature engineering plays a vital role in improving model performance. Technical indicators such as Relative Strength Index (RSI), Simple Moving Average (SMA), and Moving Average Convergence Divergence (MACD) are commonly used to extract meaningful patterns from raw price data [22][23][24]. These indicators help in identifying trends, momentum, and potential reversal points in the market. Additionally, data preprocessing techniques such as normalization and scaling, particularly MinMax normalization, are essential for ensuring stable model training and faster convergence [25].

Recent advancements in this domain include the development of real-time prediction systems that integrate live data streams through APIs and provide interactive visualization through web-based dashboards [26][27]. Full-stack implementations using modern technologies enable seamless interaction between backend prediction models and frontend user interfaces, enhancing usability and accessibility [28][29]. These systems allow users to monitor predictions, analyze trends, and make informed decisions in real time.

Despite significant progress, several challenges persist in cryptocurrency prediction, including extreme market volatility, data noise, and the influence of unpredictable external factors. Moreover, many existing systems lack robustness, scalability, and the ability to integrate multiple data sources effectively. To address these challenges, this paper proposes a hybrid approach that combines autoregressive machine learning models with sentiment analysis in a real-time framework, aiming to improve prediction accuracy and provide reliable trading insights [30].

### III. PROPOSED SYSTEM ARCHITECTURE

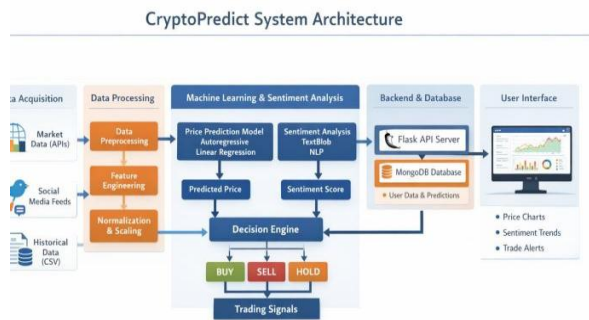


Fig.1. System Architecture

The proposed Crypto Predict system architecture represents a hybrid framework that integrates machine learning and sentiment analysis to predict cryptocurrency prices and generate intelligent trading signals. The architecture is divided into multiple layers, each responsible for a specific function in the overall pipeline.

#### A. Data Acquisition Layer

The system begins with collecting data from multiple sources:

- **Market Data (APIs):** Real-time cryptocurrency prices are fetched using APIs such as Alpha Vantage
- **Historical Data (CSV):** Past price data is used for training the model
- **Social Media Feeds:** Textual data (tweets/news) is collected for sentiment analysis

This multi-source data collection ensures both quantitative (price) and qualitative (sentiment) inputs.

#### B. Data Processing Layer

Once data is collected, it undergoes preprocessing:

- **Data Preprocessing:** Removes noise, missing values, and inconsistencies
- **Feature Engineering:** Generates technical indicators like SMA and RSI
- **Normalization & Scaling:** Uses MinMax scaling to normalize values

This step prepares clean and structured data for model training and prediction.

#### C. Machine Learning & Sentiment Analysis Layer

This is the core intelligence layer of the system:

##### Price Prediction Model

- Uses Autoregressive Linear Regression
- Takes previous price and indicators as input
- Outputs predicted cryptocurrency price

##### Sentiment Analysis Module

- Uses TextBlob (NLP)
- Analyzes social media text
- Produces sentiment score (Positive/Negative)

**Decision Engine** The decision engine combines: Predicted price

- Current market price
- Sentiment score

Based on these inputs, it generates trading decisions:

- BUY → Price expected to increase + positive sentiment
- SELL → Price expected to decrease + negative sentiment
- HOLD → No strong signal

This is the key component that transforms predictions into actionable insights.

#### E. Backend & Database Layer

Backend (Flask API)

- Handles requests from frontend
- Loads trained ML models
- Performs prediction and sentiment analysis
- Sends results back to user

Database (MongoDB) Stores:

- User data
- Prediction history
- Generated alerts

This layer ensures data persistence and system functionality.

#### F. User Interface Layer

The frontend (React-based dashboard) provides:

- Price charts and trends

- Sentiment visualization
- Trading signals (BUY/SELL/HOLD)

Users interact with the system through this interface, making it user-friendly and interactive.

## IV. METHODOLOGY

The proposed system follows a structured methodology that integrates machine learning and sentiment analysis for cryptocurrency price prediction and trading signal generation. The methodology consists of multiple stages, including data collection, preprocessing, feature engineering, model training, sentiment analysis, and decision-making.

### A. Data Collection

The first step involves collecting both historical and real-time data:

- **Historical Data:** Cryptocurrency datasets (Bitcoin, Ethereum, Dogecoin) are collected in CSV format containing attributes such as date, closing price, and volume.
- **Real-Time Data:** Live market data is fetched using APIs (e.g., Alpha Vantage) to ensure up-to-date predictions.
- **Textual Data:** Social media data (tweets/news) is gathered to analyze public sentiment. This combination enables the system to use both structured and unstructured data sources.

### B. Data Preprocessing

The collected data undergoes preprocessing to ensure quality and consistency:

- Removal of missing or null values
- Noise filtering and data cleaning
- Conversion into structured time-series format
- Normalization using MinMax scaling

This step ensures that the data is suitable for machine learning models and reduces bias and inconsistencies.

### C. Feature Engineering

Feature engineering is performed to extract meaningful information from raw data:

Calculation of technical indicators:

- Simple Moving Average (SMA-7, SMA-30)
- Relative Strength Index (RSI-14)

Creation of lag features:

- Previous day closing price
- Previous SMA values these features help capture trends and temporal dependencies in crypto currency prices.

### D. Model Development

The system uses an autoregressive Linear Regression model for price prediction:

- **Input Features:** Previous day values (Close, SMA, RSI)
- **Output:** Predicted next-day closing price
- **Data Split:** 80% training and 20% testing (without shuffling to preserve time order) the model learns the relationship between past and future prices to generate accurate predictions.

### E. Model Evaluation

The performance of the model is evaluated using standard metrics:

- Mean Absolute Error (MAE)
- Root Mean Square Error (RMSE)
- $R^2$  Score (coefficient of determination) these metrics ensure the reliability and accuracy of the prediction model.

### F. Sentiment Analysis

To incorporate market psychology, sentiment analysis is performed:

- Text data is processed using TextBlob (NLP) Sentiment polarity is calculated
- Classified as:
  - o Positive
  - o Negative

This step helps capture investor behavior and market trends.

### G. Prediction and Decision Making

The system combines outputs from both modules:

- Predicted price (ML model)
- Current market price
- Sentiment score (NLP)

Based on these inputs, a decision engine generates trading signals:

- **BUY:** Predicted price increases with positive sentiment

- SELL: Predicted price decreases with negative sentiment
- HOLD: No strong indication

### H. System Implementation

The methodology is implemented using a full-stack architecture:

- Backend: Flask API for processing and prediction
- Frontend: React for visualization and user interaction
- Database: MongoDB for storing user data and predictions

### V. RESULT

The proposed system demonstrates strong performance in short-term cryptocurrency price prediction using an autoregressive linear regression model. By leveraging historical data and technical indicators such as SMA and RSI, the model effectively captures market trends and achieves high accuracy. The evaluation metrics, including Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and  $R^2$  score, indicate that the model performs reliably in predicting next-day prices. The integration of real-time data further enhances prediction relevance and ensures up-to-date analysis.

In addition to price forecasting, sentiment analysis significantly improves the system’s decision-making capability. By analyzing social media data, the model incorporates market psychology into predictions, enabling better interpretation of price movements. The combined approach of quantitative prediction and qualitative sentiment analysis results in more accurate trading signals such as Buy, Sell, and Hold. Overall, the system provides a comprehensive framework for cryptocurrency forecasting and demonstrates the effectiveness of hybrid AI models.

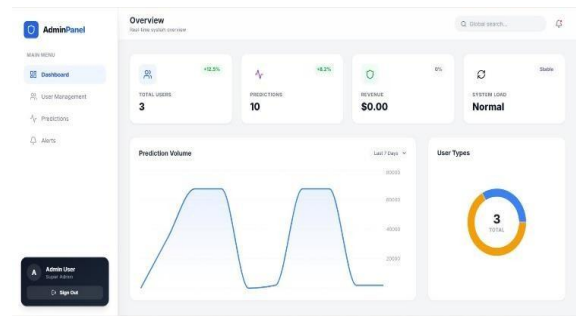


Fig. 2. Admin Panel Dashboard Showing System Overview, User Statistics, and Prediction Analytics

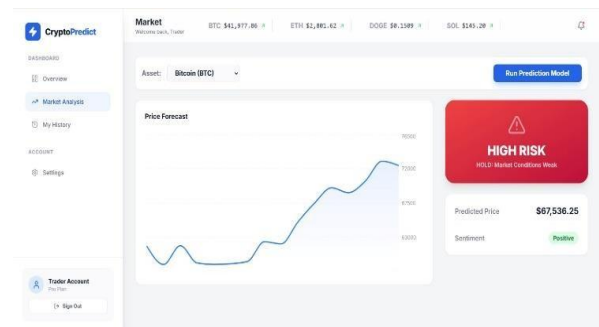


Fig. 3. Market Analysis Interface with Price Forecast Graph and Risk Alert System

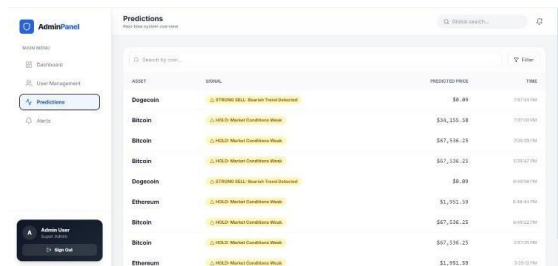


Fig. 4. Crypto currency Prediction Dashboard Displaying Sentiment and Predicted Price

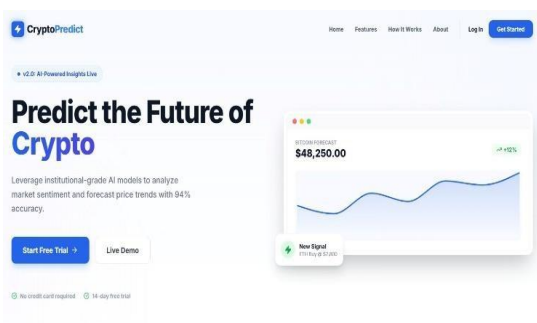


Fig. 1. Crypto Predict User Dashboard for Crypto Price Prediction and Market Analysis

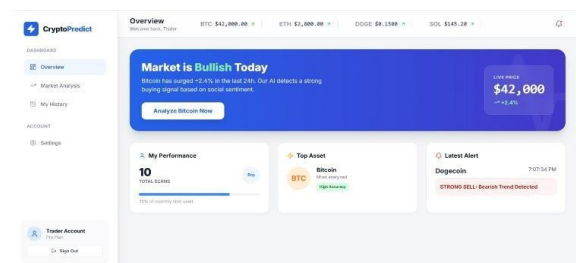


Fig. 5. System Overview Dashboard Showing Market Trends, Alerts, and User Performance Metrics

## VI. CONCLUSION

This paper presents Crypto Predict, an AI-powered system designed to predict crypto currency prices and analyse market sentiment using machine learning and natural language processing techniques. The system integrates historical price data, technical indicators, and real-time market information to generate accurate short-term predictions. By employing an autoregressive linear regression model, the system effectively captures temporal dependencies and achieves high prediction accuracy. One of the key contributions of this work is the integration of sentiment analysis with price prediction. By analysing social media data, the system incorporates investor behaviour and market psychology into the forecasting process. This hybrid approach enhances the reliability of predictions and provides more meaningful trading insights. The implementation of a smart alert system further improves usability by generating actionable signals such as Buy, Sell, and Hold. The full-stack architecture ensures scalability and user accessibility, with a React-based frontend, Flask backend, and MongoDB database. Real-time data integration enables continuous updates, making the system suitable for practical applications in financial decision-making.

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