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WEB APPLICATION FOR STOCK PRICE FORECASTING: INTEGRATING FINANCIAL NEWS SENTIMENT AND ENSEMBLE DEEP LEARNING TECHNIQUES

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ABSTRACT

This paper presents a novel approach to stock price forecasting by integrating financial news sentiment analysis with ensemble deep learning techniques within a web application. The application leverages React.js for the user interface, Node.js for backend processing, and MongoDB for data management. By combining sentiment data from financial news with historical stock data, this tool aims to enhance prediction accuracy. We demonstrate the effectiveness of ensemble models, combining LSTM, GRU, and Transformer models, showing significant improvement in prediction stability and accuracy. Results indicate that sentiment-enhanced, ensemble-based predictions outperform traditional approaches, providing a robust tool for financial decision-making.

Keywords: Stock Price Prediction, Financial News Sentiment, Deep Learning, Ensemble Models, Web Application.

I. INTRODUCTION

The volatility and complexity of stock markets make accurate predictions challenging. Traditional forecasting models rely heavily on historical price data, but such approaches often overlook real-time factors like news sentiment, which can significantly influence investor decisions and market trends. Integrating financial news sentiment with stock price prediction models introduces a new dimension to forecasting, capturing shifts in market sentiment that historical data alone may miss. This research proposes a web application that leverages sentiment analysis from financial news alongside historical data, using ensemble deep learning techniques for improved accuracy. By combining LSTM, GRU, and Transformer models, the ensemble approach harnesses each model's strengths, enhancing the model's ability to handle complex data patterns. This project ultimately aims to offer a practical tool that empowers users with more reliable, sentiment-informed stock predictions, advancing financial decision-making and investment strategies.

II. METHODOLOGY

Data Collection

- **Stock Price Data**: Collected from financial APIs like Yahoo Finance, providing historical and real-time stock data.
- **Sentiment Data**: Financial news articles from reputable sources (e.g., Reuters, Bloomberg) are gathered and processed using Natural Language Processing (NLP) to assess sentiment.

Data Preprocessing

- **Historical Data Processing**: Stock data is cleaned, scaled, and normalized.
- **Sentiment Analysis**: News articles are processed using NLP techniques (e.g., VADER, BERT) to assign sentiment scores. Sentiment scores are then aligned with stock data timestamps.

Model Development

- **Individual Models**: LSTM, GRU, and Transformer models are trained individually on the combined dataset of historical prices and sentiment scores.
- **Ensemble Model**: An ensemble approach combines LSTM, GRU, and Transformer models using stacking. This method leverages the predictive strengths of each model, resulting in improved accuracy.

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System Architecture

- **Frontend (React.js)**: The user interface enables users to view stock trends, select stocks, and retrieve forecasts.
- **Backend (Node.js)**: Handles API requests, manages model predictions, and stores sentiment and stock data in MongoDB.
- **Database (MongoDB)**: Stores user information, stock price history, and sentiment scores.

III. MODELING AND ANALYSIS

Development Stack4

- **React.js** for frontend interactivity, using libraries like Chart.js for visualizations.
- **Node.js and Express** for backend server management.
- **MongoDB** for database storage, enabling persistent storage and quick retrieval of stock data and sentiment scores.

Machine Learning and Deep Learning:

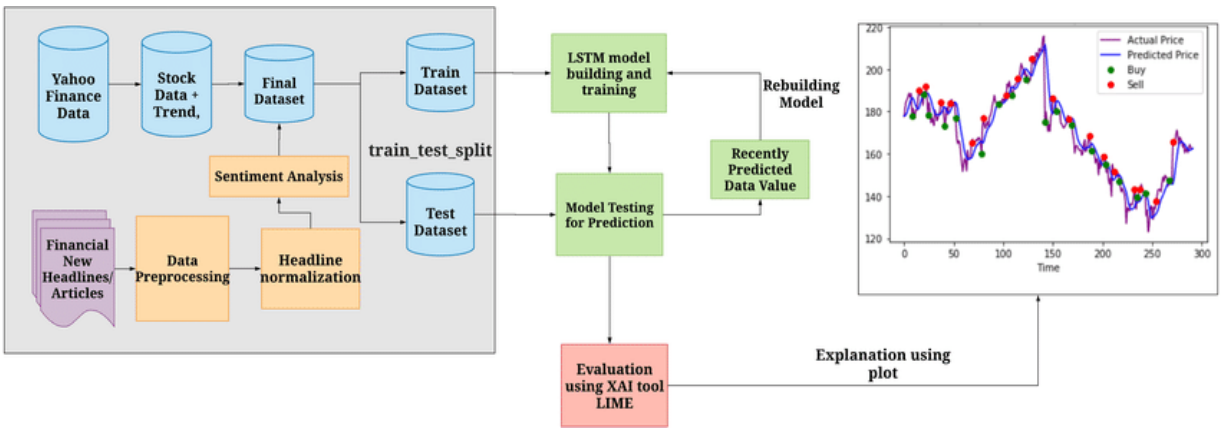
- **Python with TensorFlow and PyTorch**: Implements and trains machine learning models, including LSTM, GRU, and Transformers, for forecasting.
- **Scikit-learn**: Used for preprocessing tasks (e.g., scaling, feature engineering) and implementing ensemble techniques (e.g., stacking or voting).
- **Natural Language Processing**: Sentiment analysis is performed using libraries like **NLTK**, **spaCy**, or **Hugging Face Transformers**, incorporating pre-trained models like BERT for sentiment scoring

Prediction Workflow

1. Users select a stock through the interface.
2. The application retrieves historical price data and sentiment scores.
3. Data is processed and fed into the ensemble model for prediction.
4. Predicted stock price is displayed on the frontend with trend visualizations.

IV. RESULTS AND DISCUSSION

The results and discussion may be combined into a common section or obtainable separately. They may also be broken into subsets with short, revealing captions. An easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it. This section should be typed in character size 10pt Times New Roman.



V. MOTIVATION

The motivation for this project stems from the growing complexity and unpredictability of financial markets, coupled with the increasing availability of diverse data sources like financial news. Traditional stock price prediction models primarily use historical price data, which often fails to capture the immediate effects of real-world events and market sentiment. With the advent of natural language processing (NLP) and ensemble deep learning techniques, it has become feasible to incorporate real-time sentiment analysis into stock forecasting

systems. Financial news plays a crucial role in influencing investor behavior, and understanding its sentiment can provide deeper insights into market trends. Combining this sentiment data with historical price trends enhances prediction models, making them more dynamic and responsive. By using ensemble techniques like LSTM, GRU, and Transformers, the project addresses the limitations of single-model approaches, ensuring robustness and higher accuracy.

VI. CONCLUSION

This research demonstrates that incorporating sentiment analysis and ensemble learning into stock price forecasting enhances prediction accuracy. The developed web application provides an accessible platform for users, allowing real-time stock forecasting enriched by financial sentiment. Future work can focus on integrating social media sentiment and expanding to other asset classes, such as commodities and cryptocurrencies, to create a more comprehensive forecasting tool.

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