Stock Price Prediction: A Survey and GAN-based Implementation

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Overview

Introduction

AI in Stock Market Prediction

- Stock prices fluctuate due to economic trends, investor sentiment, and global events.
- Traditional models struggle with rapid market changes, while AI detects patterns and trends.

Why Predict Stock Prices?

- Helps investors make data-driven decisions and manage risks.
- Improves automated trading strategies for better market efficiency.

How AI Enhances Predictions

- Traditional models lack adaptability.
- Deep learning (LSTMs, GANs) captures complex market behaviors and improves accuracy.

Motivation

Why This Project?

- Stock prices fluctuate due to multiple factors, making accurate forecasting a challenge.
- Traditional models often fail to capture sudden market changes.
- AI and deep learning, particularly GANs, provide a powerful approach to understanding patterns and improving predictions.

Personal Motivation

- I've always been fascinated by the intersection of technology and finance.
- This project allows me to apply AI in a real-world scenario, exploring how machine learning can enhance stock predictions.
- Building a model that not only predicts stock prices but also explains its reasoning is both exciting and valuable for investors.

Problem Statement

Challenges in Stock Prediction

- High volatility due to economic and political factors.
- Traditional models struggle with **nonlinear dependencies** in stock price movements.
- Deep learning models often lack interpretability, making financial decision-making difficult.

Proposed Solution: Using GANs

- **GANs generate synthetic stock price data**, improving training and prediction accuracy.
- **WGAN-GP enhances stability**, reducing issues like mode collapse.
- **FinBERT sentiment analysis** incorporates market sentiment for more reliable predictions.

Literature Review - Part 1

Paper 1: AI-Based Stock Prediction [1]

- Reviews ML techniques for stock prediction.
- **Traditional Models:** ARIMA, GARCH, and regression methods struggle with volatility.
- **Machine Learning:** SVMs, Decision Trees, and Random Forests improve pattern recognition.
- **Deep Learning:** LSTMs and CNNs capture complex market trends.
- **Key Findings:** Hybrid models enhance accuracy; sentiment and technical indicators improve predictions.
- **Limitations:** ML models require large datasets and struggle with extreme market conditions.

Literature Review - Part 2

Paper 2: GANs for Stock Prediction [2]

- Explores Generative Adversarial Networks (GANs) for financial forecasting.
- **Why GANs?** Traditional models fail to generate realistic stock price distributions.
- **Findings:**
  - WGAN-GP stabilizes training, avoiding mode collapse.
  - Sentiment analysis (FinBERT) improves prediction reliability.
  - Synthetic stock data generated by GANs enhances model adaptability.
- **Challenges:** High computational cost, complex hyperparameter tuning, and evaluation difficulties.

Dataset and Features

Data Sources: [2]

- Stock prices from Yahoo Finance.
- News sentiment analysis using FinBERT.

Feature Engineering:

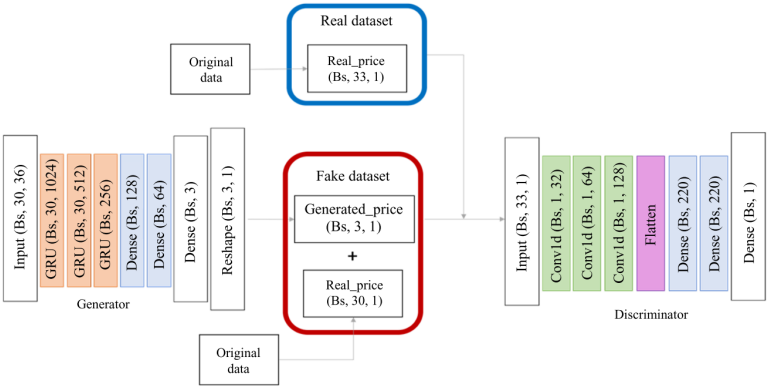
- Technical indicators: Moving Averages, MACD, Momentum.
- Fourier Transforms to extract market trends.

Prediction Task:

Input: 30-day historical stock data **Output:** Forecast next 3 days.

Proposed GAN Model

- **Generator:** 3 GRU layers + dense layers.
- **Discriminator:** 1D-CNN layers + fully connected layers.
- **Loss Function:** WGAN-GP for stability.



Source: [2]

Results Overview

Models Compared: LSTM, GRU, Basic GAN, WGAN-GP.
Evaluation Metric: RMSE.

- WGAN-GP performed best during high volatility (e.g., COVID-19).
- GRU showed better performance than LSTM across all cases.

	LSTM	GRU	Basic GAN	WGAN-GP
RMSE (Train)	1.52	1.00	1.64	1.74
RMSE (Test - 2020)	6.60	5.33	5.36	4.77
RMSE (Test - Excl. 2020)	9.45	4.08	3.09	3.88

Source: [2]

Results Visualization

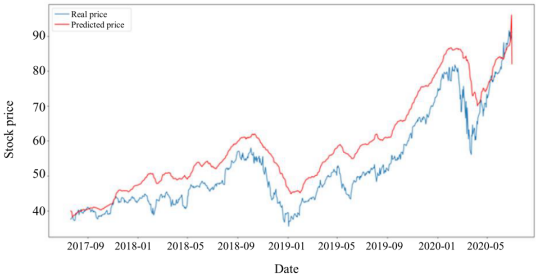


Fig. 4: LSTM test data plot

LSTM Performance [2]

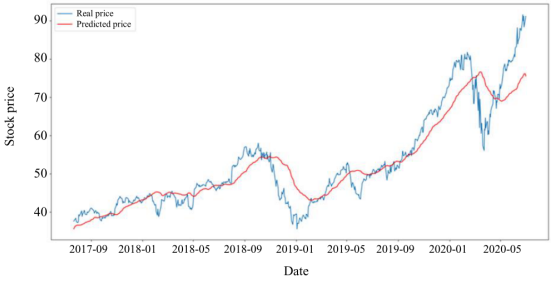


Fig. 9: WGAN-GP test data plot

WGAN-GP Performance [2]

Challenges and Limitations

- **Hyperparameter Tuning:** Fine-tuning GANs is complex and requires significant computing power.
- **Market Unpredictability:** AI models struggle with sudden events like financial crises.
- **Data Quality:** Incomplete or biased stock data can affect prediction accuracy.
- **Computational Cost:** GANs require high GPU resources, limiting large-scale use.
- **Overfitting Risk:** Models may generate overly specific predictions that don't generalize well.

Conclusion and Future Work

Key Takeaways:

- GANs improve stock price predictions compared to traditional methods.
- WGAN-GP stabilizes training, making forecasts more reliable.
- Sentiment analysis using FinBERT enhances prediction accuracy.

Future Work:

- Explore Transformer-based models (GPT, BERT) for financial data.
- Extend research to predict other assets like commodities and crypto.
- Optimize model efficiency for real-time trading applications.

References

Sources:

- *Stock Price Prediction Using Artificial Intelligence: A Survey* – Priyank Sonkiya, Vikas Bajpai, Anukriti Bansal [**1**]
- *Stock Price Prediction Using Generative Adversarial Networks* – Hsiang-Fu Lin, Yu-Chuan Huang, et al. [**2**]

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Thank You!

Questions and discussions are welcome.