**Title:** Project Registration & Progress Review **FF No. 180**

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| **Department:** Electronics and Telecommunication | **Academic Year:** 2024-25 |
| **Semester:** 7 | **Group No.:** 4 |
| **Project Title: Time Series Forecasting of Stock Prices using Neural Networks LSTM and GAN** | |
| **Project Area: Financial Technology (FinTech), Time Series Analysis** | |

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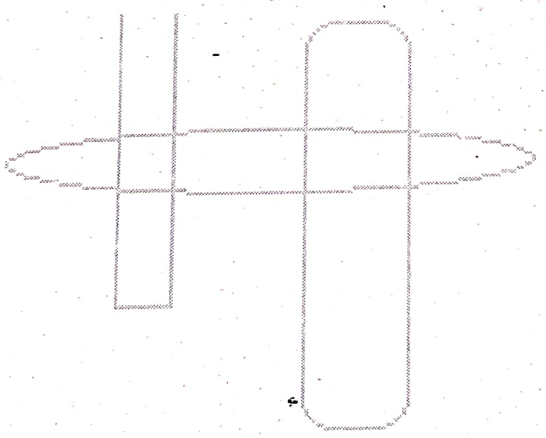
Project approved / ~~Not approved~~

**Guide** **Project Coordinator** **Head of Department**

**Project Synopsis**

The goal of the proposed project is to use advanced neural network techniques, namely Long Short-Term Memory (LSTM) and Generative Adversarial Networks (GAN), to construct a sophisticated stock price forecasting model. The research project attempts to increase stock price prediction accuracy by utilizing GAN's realistic data generation capabilities and LSTM's capacity to capture long-term dependencies in sequential data. Time series forecasting and stock price prediction are done using the OHLCV (Open, High, Low, Close, Volume) data. We explore a broad range of models, encompassing both conventional statistical methods and state-of-the-art deep learning techniques coupled with sentiment analysis, feature extraction, and hyperparameter adjustment. Since this has been demonstrated to yield more accurate results, our primary objective is to forecast fluctuations in stock prices.



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| Group No. | | | |
|---|---|---|---|
| Activity | Review Schedule | Progress Review Report submitted | Signature of Guide |
| Review 1 | Mid Sem. Semester | Yes / ~~No~~ | |
| Review 2 | End of Semester | Yes / ~~No~~ | |

Format of Progress Review Report:

**Review No.: 1** **Group No.: 4** **Date:** 23/08/24

**Progress Review Report**

In this project, we predicted stock prices using ARIMA, Fourier Transform, XGBoost, and LSTM models. We engineered 19 features, including moving averages, EMAs, and Bollinger Bands, to enhance prediction accuracy. The ARIMA model showed strong performance with low AIC/BIC values, while Fourier Transform provided accurate predictions aligned with actual prices.

XGBoost highlighted EMA as a key feature. However, LSTM models, despite being promising for long-term trend prediction, failed to deliver precise short-term price predictions.

In future, The hypertuning will be done on LSTM model.

**Signature of Guide:**

Review No.: 2 Group No.: 4 Date: 27/11/2024

**Progress Review Report**

The project focused on developing a robust stock price prediction model using Generative Adversarial Networks (GAN), incorporating Gated Recurrent Units (GRU) as the generator and Convolutional Neural Networks (CNN) as the discriminator. The GRU generator was designed to generate future stock prices based on historical data, while the CNN discriminator evaluated the authenticity of the generated prices against real data. Historical closing prices of Apple Inc., spanning from 2010 to 2020, formed the core of the dataset, with additional features such as S&P 500, NASDAQ, and U.S. Dollar indices, and sentiment scores derived from FinBert analysis of financial news. The GAN framework was enhanced by implementing the Wasserstein GAN with Gradient Penalty (WGAN-GP) to address stability and convergence issues in adversarial training.

The dataset was meticulously prepared through comprehensive feature engineering to enrich the model's predictive capacity. Technical indicators, including moving averages, momentum indicators, Bollinger Bands, and exponential moving averages, were computed to capture market trends. Sentiment analysis of Apple-related news was conducted using FinBert, assigning scores on a scale from -1 to 1 to quantify news sentiment. Additionally, Fourier transforms were applied to extract short- and long-term stock price trends. The data was restructured into a three-dimensional format suitable for the GAN model, with 30-day historical input windows used to predict stock prices for the following three days. This preprocessing step ensured that the model could effectively capture temporal dependencies and complex market dynamics.

The model was rigorously trained and evaluated, with datasets divided into training and testing subsets in a 70:30 ratio. The experimental design also included separate analyses for normal market conditions and volatile periods, such as the COVID-19 pandemic, to assess the model's adaptability. Results showed that the GAN-based models, particularly the WGAN-GP, significantly outperformed traditional models like LSTM and GRU in terms of Root Mean Square Error (RMSE). During normal conditions, the GAN demonstrated superior accuracy, while the WGAN-GP model excelled under volatile conditions, highlighting the efficacy of adversarial learning in adapting to market irregularities.

Extensive implementation efforts were undertaken to optimize the architecture and training process. The GAN model was designed with three GRU layers and three dense layers in the generator, complemented by three convolutional layers and dense layers in the discriminator. The model leveraged adaptive learning rates and batch sizes, with training conducted over multiple epochs to ensure convergence. The generator and discriminator losses were closely monitored to maintain a balanced adversarial process. By successfully integrating diverse features, addressing data complexity, and tailoring the architecture to the demands of financial forecasting, the project demonstrated a significant advancement in stock price prediction methodologies, providing a practical and scalable solution for real-world applications.

**Signature of Guide:**