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Financial Distress Prediction Using a Network-Informed Machine Learning Framework

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ABSTRACT

The Financial Distress Prediction web application is a Django-based platform designed to assess the likelihood of financial instability in companies using machine learning. This system enables both users and administrators to interact through a secure registration and login interface, offering real-time predictions based on eleven critical financial ratios. Utilizing a dataset of 5,002 companies, the application employs a Random Forest Classifier with 100 estimators to perform binary classification, identifying whether a company is financially distressed (1) or stable (0). The model is trained using an 80/20 train-test split and evaluates its performance with key metrics such as accuracy, confusion matrix, and classification report. The trained model is serialized using joblib and integrated into the system for fast and accurate online predictions. This predictive system supports decision-making by enabling users to input financial indicators and receive immediate insights on potential financial distress. Administrators have additional capabilities to manage user access and monitor application usage. The system features a user-friendly web interface for data entry and result display, as well as data visualization tools for reviewing the dataset's structure. By leveraging the power of machine learning and intuitive web design, this project bridges the gap between financial analytics and accessible decision-support systems, aiming to assist investors, auditors, and financial professionals in proactively identifying at-risk companies.

Keywords: Financial Distress Prediction, Network-Informed Machine Learning, Financial Risk Assessment, Corporate Bankruptcy Prediction, Graph-Based Learning, Financial Network Analysis, Predictive Analytics, Systemic Risk Modeling, Financial Stability Monitoring, Financial Data Mining.

INTRODUCTION

In today's complex financial landscape, early detection of corporate financial distress is essential for stakeholders such as investors, auditors, regulatory bodies, and company management. Financial distress, if left unaddressed, can lead to severe consequences including bankruptcy, loss of investor confidence, and economic instability. Traditional methods of distress prediction often rely on manual analysis of financial statements, which can be time-consuming and error-prone. With the growing availability of financial data and advancements in machine learning, automated systems have emerged as effective tools for predicting financial health based on historical and current financial indicators.

This project presents a Django-based

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Financial Distress Prediction web application that utilizes machine learning techniques to classify companies as either financially distressed or not. The system is built around the Random Forest Classifier algorithm from scikit-learn, trained on a dataset of 5,002 companies with 11 key financial ratios such as Current Ratio, Debt to Equity, ROA, and Operating Cash Flow. The model is trained using an 80/20 train-test split and evaluated using standard metrics including accuracy score, confusion matrix, and classification report. After training, the model is saved as a .pkl file and deployed within the web application to facilitate real-time predictions.

The application features a dual-role system with separate interfaces for users and administrators. Users can register, log in, and input financial values to receive predictions on the company's financial condition. Administrators, on the other hand, can manage users and view application usage. Additionally, the system includes dataset visualization capabilities to help users explore the structure of the underlying data. Through this integration of machine learning and web technology, the application provides a reliable, user-friendly platform to assist in timely financial risk assessment and decision-making.

I. LITERATURE SURVEY

1. Title: Bankruptcy Prediction Using Machine Learning Techniques
Authors: H. Chen, S. Huang, and Y. Lin

Abstract:
This study explores the application of machine learning techniques for predicting corporate bankruptcy using financial ratios and historical company data. The authors compare several algorithms including Logistic Regression, Decision Trees, and Support Vector Machines to determine their effectiveness in identifying financially distressed firms. Experimental results show that machine learning models outperform traditional statistical methods in terms of prediction accuracy and robustness. The study highlights the importance of feature selection and financial indicators in improving model performance.

2. Title: Financial Distress Prediction Based on Ensemble Learning
Authors: J. Sun, H. Li, Q. Huang, and K. He

Abstract:
The research proposes an ensemble learning framework for predicting financial distress in corporations. Multiple classifiers such as Random Forest, Gradient Boosting, and Support Vector Machines are integrated to improve prediction reliability. The model utilizes financial statement data and market indicators to classify firms into distressed and non-distressed categories. Experimental analysis demonstrates that ensemble models significantly enhance prediction accuracy and reduce classification errors compared to individual classifiers.

3. Title: Corporate Financial Distress Prediction Using Neural Networks
Authors: T. Olson, D. Delen, and Y. Meng

Abstract:
This paper investigates the use of artificial neural networks for predicting

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corporate financial distress. The model is trained on historical financial datasets consisting of liquidity ratios, profitability ratios, and leverage indicators. The neural network learns complex nonlinear relationships between financial variables and distress outcomes. The results reveal that neural network models achieve higher predictive accuracy compared to traditional statistical approaches such as discriminant analysis.

4. Title: A Comparative Study of Machine Learning Algorithms for Bankruptcy Prediction
Authors: M. Zięba, S. K. Tomczak, and J. Tomczak

Abstract:
This research presents a comparative analysis of several machine learning algorithms for bankruptcy prediction using corporate financial data. Algorithms such as Support Vector Machines, Random Forest, and Artificial Neural Networks are evaluated using multiple performance metrics including accuracy, precision, and recall. The findings indicate that ensemble-based methods perform better in handling complex financial datasets and provide more reliable predictions.

5. Title: Graph-Based Financial Risk Analysis for Corporate Networks
Authors: L. Huang and Y. Wang

Abstract:
The paper introduces a graph-based approach to analyze financial risk propagation within corporate networks. Firms are represented as nodes and financial relationships such as credit exposure and trade dependencies are modeled as edges. Graph analytics and machine learning techniques are applied to detect potential financial distress and systemic risk within the network. The results demonstrate that network-aware models provide deeper insights into interconnected financial risks compared to traditional isolated firm-level analysis.

II. EXISTING SYSTEM

The existing systems for predicting financial distress in companies primarily rely on traditional statistical models, such as logistic regression, Altman's Z-score, and other rule-based financial analysis techniques. These approaches often use a limited number of financial indicators and fixed threshold values to evaluate a company's financial health. While these models provide a foundation for risk assessment, they are largely static, less adaptive to complex patterns in data, and require expert interpretation. . These approaches often use a limited number of financial indicators and fixed threshold values to evaluate a company's financial health. . These approaches often use a limited number of financial indicators and fixed threshold values to evaluate a company's financial health. Additionally, many existing systems are implemented as standalone desktop tools or Excel-based solutions, which lack real-time accessibility and interactive web interfaces for broader user engagement.

III. PROPOSED SYSTEM

The proposed system is a web-based Financial Distress Prediction application developed using the Django framework, integrated with a machine learning model to predict the likelihood of a company experiencing financial distress. This system

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utilizes a Random Forest Classifier trained on a dataset of 5,002 companies with 11 critical financial ratios, allowing it to capture complex relationships among financial features. The application provides a secure and intuitive interface for users to register, log in, and input financial data to receive instant predictions. Administrators can manage users and monitor activity through a dedicated admin panel. The trained model is stored as a .pkl file and accessed for real-time prediction, ensuring fast and consistent results without retraining the model every time.

IV. SYSTEM ARCHITECTURE

The system architecture illustrates a web-based financial distress prediction framework built using a client–server model. On the client side, both users and administrators access the system through a web browser interface. Users submit financial data through the browser, which is then sent to the server-side Django web application for processing. The server side consists of multiple components including the User App, Admin App, Prediction Module, Database, Evaluation Module, and Model & Dataset module. The User App handles incoming financial inputs from users and forwards them to the Prediction Module, where a trained machine learning model (loaded from a .pkl file) analyzes the data and generates a financial distress prediction result. The Model & Dataset module provides the trained model and dataset required for prediction, while the Evaluation Module assesses the prediction performance. The Database stores user inputs, prediction history, and other system records. Meanwhile, the Admin App enables administrators to log in, manage user accounts, and maintain system data. Finally, the prediction results are returned to the user through the web interface, completing the interaction cycle.

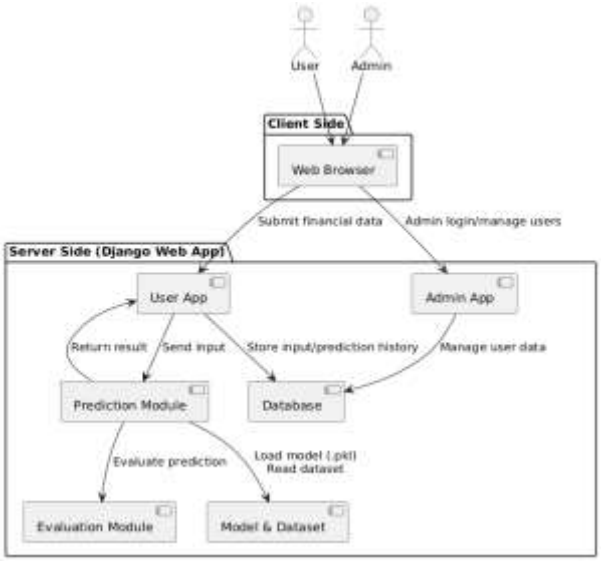

Fig 5.1: Structure of the Proposed System

V. IMPLEMENTATION

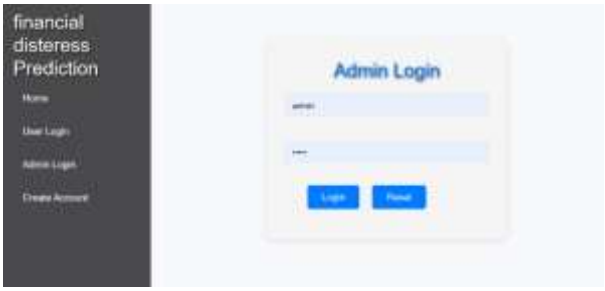

Fig 6.1: Admin Login Page

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Fig 6.2: Admin Dashboard

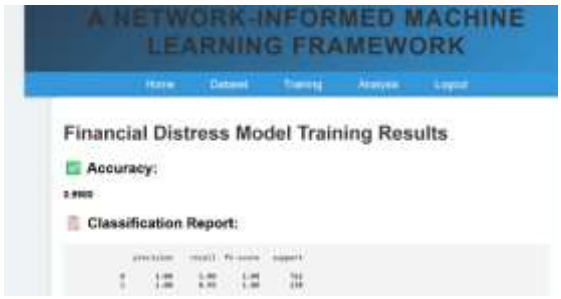

Fig 6.3: Model Training Page

Fig 6.4: Analysis Page

Fig 6.5: Registered Users

VI. CONCLUSION

The Financial Distress Prediction System successfully integrates machine learning with a Django-based web application to provide an efficient and accurate tool for predicting the financial health of companies. By leveraging a Random Forest Classifier and using 11 vital financial ratios, the system offers reliable binary classification of financial distress risk. The platform features real-time prediction capabilities, a clean and secure user interface, and role-based access for both users and administrators. It enhances decision-making processes for investors, auditors, and financial analysts by automating complex financial assessments with minimal user input. The application demonstrates how modern web technologies and data-driven models can be combined to provide actionable insights in the financial domain.

VII. FUTURE SCOPE

The future scope of the proposed financial distress prediction system includes several enhancements to improve its functionality and predictive capability. The current binary classification approach can be extended to a multi-class prediction model that identifies different levels of financial risk, such as low, medium, and high distress, providing more detailed insights into financial stability. Incorporating time series forecasting techniques can further improve the system by analyzing historical financial data to predict long-term distress trends. Additionally, integrating and comparing multiple machine learning models such as Support Vector Machines (SVM), XGBoost, and Neural Networks can help identify the most accurate model for financial prediction

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tasks. Expanding the dataset by including additional financial indicators and qualitative information, such as market news sentiment and economic trends, can enhance the reliability of predictions. The system can also be improved by developing an interactive dashboard that visualizes financial trends, analytics, and historical prediction records for better decision-making. Furthermore, implementing mobile support through a responsive interface or a dedicated mobile application will enable users to access the system conveniently from any device.

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