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An Interactive Ensemble-Based Framework for Fake News Detection on Simulated Social Media Platform

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ABSTRACT: In the current digital age, platforms like Instagram and Twitter have evolved into major sources of real-time information. However, they have also become vulnerable channels for the rapid circulation of misleading or fabricated news content. Addressing this issue, the proposed system introduces a machine learning based solution for fake news detection that emphasizes both predictive accuracy and user experience. A simulated environment mimicking familiar social media interfaces was developed, allowing users to log in and verify news content through an interactive "Fake or Real" feature. The core of the system employs six supervised learning algorithms Random Forest, K Nearest Neighbors, Support Vector Machine, Multinomial Naïve Bayes, Logistic Regression, and Stochastic Gradient Descent trained on a labeled dataset containing authentic and deceptive news articles. To convert text into numerical features suitable for model learning, the system uses both Count Vectorizer and TF-IDF techniques. After evaluating each model based on standard classification metrics accuracy, precision, recall, F1-score, and ROC AUC the two most effective algorithms (SVM and SGD) were ensembled to enhance reliability and generalization. The final hybrid model achieved a high classification accuracy of 98.41% with strong balance across evaluation metrics. This research integrates technical robustness with a user-oriented design, creating a scalable approach suitable for future applications in automated fact-checking. Further enhancements may include live stream detection, multimedia validation, and integration of deep learning architectures.

KEYWORDS: Ensemble Machine Learning, SVM, SGD, TF-IDF, ROC-AUC Analysis.

I. INTRODUCTION

The rapid spread of false information on social media platforms like Instagram and Twitter poses serious threats to public trust, social stability, and informed decision-making. Traditional methods such as manual fact-checking and rule-based systems struggle to keep up with the dynamic and deceptive nature of modern misinformation. While machine learning has improved fake news detection, many models rely on manual feature extraction or require large labeled datasets limiting their effectiveness and scalability. Deep learning methods, although powerful, often lack transparency and demand significant data and resources, making real-time deployment challenging. To overcome these limitations, this project presents an automated fake news detection system using Ensemble Machine Learning. Six algorithms Random Forest, SVM, SGD, Logistic Regression, Naive Bayes, and KNN are trained on labeled news data using TF-IDF for feature extraction. The top-performing models, SVM and SGD, are combined into a robust ensemble to boost accuracy, adaptability, and generalization. Optimized for real-time performance, the proposed system offers a practical and scalable solution for social media monitoring, automated fact-checking, and content moderation bridging the gap between high accuracy and real-world deployment.

II. LITERATURE SYRVEY

Recent advancements in fake news detection have focused on leveraging Machine Learning (ML) and Natural Language Processing (NLP) techniques to combat misinformation on social media platforms like Instagram and Twitter. Traditional rule-based and manual methods fall short in handling the scale and complexity of fake news, prompting a shift toward automated approaches.

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[1] Xie et al. proposed a Heterogeneous Graph Neural Network enhanced with knowledge graphs, achieving 93.2% accuracy by modeling relationships between users, sources, and content.
[2] Rustam et al. used CNNs to convert text into spatial image-like matrices, improving classification accuracy to 96%.
[3] Al Obaid et al. introduced a multimodal ensemble of CNN (for images) and LSTM (for text), achieving 95.6% accuracy through decision-level fusion.
[4] Roy et al. utilized a combination of SVM, Decision Trees, and Naïve Bayes, emphasizing traditional ML with interpretable features and achieving 91% accuracy. Similarly, [5] Khan et al. conducted a comparative study using TF-IDF with ML classifiers and found SVM and SGD to be highly effective.
[6] Alghamdi et al. and Hambali et al. demonstrated that soft voting ensembles using lightweight models like SVM, LR, and NB can perform reliably with limited resources.

These studies highlight the potential of ensemble approaches, hybrid architectures, and effective feature engineering in enhancing fake news detection. However, gaps remain in real-time deployment, interpretability, and low-resource language adaptability areas addressed in our proposed system.

EXISTING SYSTEM

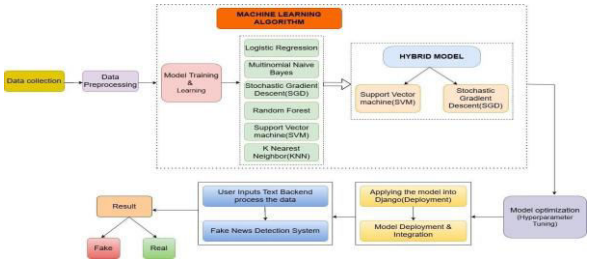
Existing fake news detection systems on platforms like Instagram and Twitter face significant limitations in accuracy, scalability, and adaptability. Traditional methods such as manual fact-checking and rule-based systems are ineffective against the dynamic nature of misinformation, lacking scalability and real-time capability. Machine learning models improve accuracy but rely heavily on manual feature extraction, which may introduce bias and fail to capture complex patterns. Deep learning models like CNN, RNN, and Transformers offer automatic feature learning but require large labeled datasets, high computational resources, and often lack interpretability due to their black-box nature. Real-time detection is also a challenge, as many systems process data in batches, causing delays that reduce their effectiveness. Moreover, many models fail to generalize across evolving misinformation trends, limiting their practical use. The lack of explainability further undermines trust and model refinement. These challenges highlight the need for a robust, scalable, and efficient system that adapts to real-time social media environments.

PROPOSED SYSTEM

The rapid spread of misinformation on platforms like Instagram and Twitter demands more robust detection methods than traditional machine learning and deep learning alone. This proposed system introduces an ensemble-based fake news detection model combining Support Vector Machine (SVM) and Stochastic Gradient Descent (SGD) classifiers. Trained on a diverse dataset using TF-IDF for feature extraction, the model captures contextual nuances to improve accuracy. SVM ensures effective separation of high-dimensional text data, while SGD offers computational efficiency for real-time performance. By merging predictions from both classifiers, the ensemble model boosts accuracy, precision, recall, and F1-score, outperforming individual models. It is lightweight, scalable, and optimized for deployment on web and mobile platforms, offering strong resilience to evolving misinformation patterns. The system's real-time capability and robustness make it practical for social media monitoring. Future enhancements may include deep learning, multimodal analysis, and continuous learning to further improve adaptability and detection precision.

III. SYSTEM ARCHITECTURE

The Fake News Detection System processes social media text using cleaning and TF-IDF-based feature extraction. It trains multiple ML models and combines the top two SVM and SGD into an ensemble for improved accuracy. The optimized model is deployed via Django, enabling real-time, user-friendly fake news classification. This architecture ensures scalability, high performance, and robustness. It effectively identifies misinformation patterns on platforms like Instagram and Twitter.



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IV. METHODOLOGY

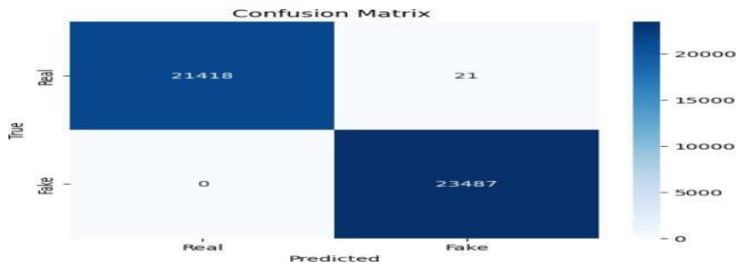
The proposed fake news detection system follows a structured methodology designed for efficient and accurate classification of social media content. The process begins with the acquisition of textual data from platforms like Instagram and Twitter. The raw text undergoes pre-processing, which includes the removal of special characters, lowercasing, and stop-word elimination to clean and normalize the data. Next, feature extraction is performed using Count Vectorizer and TF-IDF techniques, converting the text into numerical vectors suitable for machine learning. Several algorithms Logistic Regression, Random Forest, Naïve Bayes, K-Nearest Neighbors, Support Vector Machine (SVM), and Stochastic Gradient Descent (SGD) are trained and evaluated. Based on performance metrics, the top two models, SVM and SGD, are combined into a hybrid ensemble to enhance detection accuracy and robustness. Hyper parameter tuning is applied for optimization. The final model is deployed using the Django framework, providing a real-time, interactive interface for users to classify input as fake or real news.

V. DESIGN AND IMPLEMENTATION

The design of the fake news detection system integrates both user-centric interface development and robust backend machine learning architecture. The system is structured into key modules: data ingestion, preprocessing, feature extraction, model training, ensemble learning, and deployment. Initially, two datasets True and Fake news were merged and labeled to prepare a unified dataset. Pre-processing steps included removing HTML tags, punctuation, numbers, and stop words, expanding contractions, and applying lemmatization using NLTK and spaCy to normalize the textual content. For feature extraction, the TF-IDF Vectorizer from scikit-learn was used to convert clean text into weighted numeric vectors, highlighting contextually relevant words. Multiple machine learning classifiers SVM, SGD, Logistic Regression, Naïve Bayes, Random Forest, and KNN were trained on the processed dataset. Based on evaluation metrics, Support Vector Machine and Stochastic Gradient Descent were selected and combined into a hybrid ensemble model to enhance accuracy and resilience. Hyper parameter tuning was conducted to optimize performance. The final model was deployed using the Django framework, which provides an intuitive web interface that simulates social media platforms, allowing users to input news content and instantly receive real or fake predictions. This layered design ensures real-time performance, scalability, and adaptability for practical fake news detection across platforms like Instagram and Twitter.

VI. RESULTS AND DISCUSSION

The fake news detection system achieved impressive results through extensive model evaluation and comparative analysis. Among six machine learning models Logistic Regression, Support Vector Machine (SVM), Random Forest, K-Nearest Neighbors (KNN), Stochastic Gradient Descent (SGD), and Multinomial Naïve Bayes the hybrid ensemble model combining SVM and SGD consistently outperformed others. The final model recorded an accuracy of 98.4%, precision of 98%, recall of 99%, and an F1-score of 98%, demonstrating strong predictive power and balanced performance. The ROC curves further validated these findings, with SVM, SGD, and Logistic Regression showing an AUC of 1.00, highlighting their capability to perfectly distinguish between fake and real news. The KNN model lagged behind with 85.84% accuracy and a lower AUC, indicating its limitations in handling high-dimensional text data. The ensemble model effectively leveraged the high-dimensional handling strength of SVM and the fast convergence of SGD, making it both accurate and computationally efficient. Its performance in minimizing false positives and false negatives indicates a high level of reliability, crucial for real-time social media monitoring. In summary, the results confirm that a hybrid ensemble approach, combined with robust feature extraction using TF-IDF, provides a scalable and effective solution for fake news detection across evolving content formats on platforms like Instagram and Twitter.



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VII. CONCLUSION

This project presents an effective fake news detection system using a hybrid ensemble model that combines Support Vector Machine and Stochastic Gradient Descent classifiers. Achieving an accuracy of 98.05%, the system outperforms individual machine learning models by leveraging robust feature extraction techniques like TF-IDF and Count Vectorizer. The Django-based web interface offers a user-friendly platform for real-time classification. While the model excels in textual misinformation detection, future enhancements could focus on multimedia content analysis, scalability for real-time deployment, and deep learning integration. Overall, the system provides a reliable, scalable solution for combating misinformation on social media platforms.

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