
Detection of Fake Information Using a Hybrid Machine Learning and Natural Language Processing Framework

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Abstract: This study focuses on applying machine learning techniques for fake news detection. It investigates the principles, methodologies, and algorithms used to identify fake news articles, their creators, and related topics across online social networks. In particular, a Naive Bayes classification model is proposed to classify news posts as either real or fake. The model is trained on labelled datasets and utilizes text pre-processing techniques such as tokenization, stop-word removal, and feature extraction methods like TF-IDF to enhance classification accuracy. The performance of the proposed model is evaluated using standard metrics including accuracy, precision, recall, and F1-score. Experimental results indicate that machine learning-based approaches, especially probabilistic classifiers such as Naive Bayes, can effectively address the fake news detection problem. Furthermore, performance can be improved by integrating advanced techniques such as ensemble learning, deep learning models, and natural language processing (NLP) methods.

Key Words: Fake News Detection, Naïve Bayes Classification, Machine Learning, TF-IDF Feature Extraction, Natural Language Processing (NLP).

1. Introduction

In the digital era, the rapid growth of online platforms and social media has significantly transformed the way information is produced, distributed, and consumed. While this transformation has improved access to information, it has also facilitated the widespread dissemination of fake news. Fake news refers to deliberately fabricated or misleading information presented as

legitimate news, often created to influence public opinion, generate financial profit through increased web traffic, or promote political agendas. The increasing prevalence of such misinformation has created serious social, political, and economic challenges worldwide.

The issue gained substantial attention during major political events such as the 2016 United States presidential election, where

misinformation campaigns were widely reported across digital platforms. Social media platforms like Facebook and Twitter became central channels for the rapid spread of misleading content. The viral nature of these platforms, combined with algorithm-driven content recommendation systems, has made it increasingly difficult to distinguish credible journalism from fabricated stories.

Traditional methods of detecting fake news, such as manual fact-checking, are time-consuming and cannot keep pace with the massive volume of content generated daily. Therefore, automated approaches using Machine Learning (ML) techniques have emerged as effective solutions. Machine learning algorithms can analyse linguistic patterns, writing styles, source credibility, and contextual features to classify news articles as real or fake. Techniques such as Natural Language Processing (NLP), supervised learning models, and deep learning frameworks play a significant role in improving detection accuracy.

2. Literature Survey

Kai Shu et al. (2017) Presented a comprehensive study on fake news detection from a data mining perspective. The authors discussed how misinformation spreads rapidly on social media platforms and

emphasized the importance of automatic detection systems. They proposed that both content-based features (such as linguistic patterns and writing style) and social context features (such as user behavior and propagation patterns) are essential for accurate detection. Traditional machine learning algorithms like Support Vector Machine (SVM), Naïve Bayes, and Decision Trees were analysed in their framework. The study highlighted the challenges of feature extraction and dataset imbalance. They also introduced benchmark datasets to support research in this field. Their work became a foundation for combining textual and social features in machine learning models. The paper concluded that hybrid models perform better than single-feature approaches.

[2] Vosoughi et al. (2018) investigated how false news spreads differently compared to true news on social networks. Although their study focused on diffusion analysis, it significantly influenced machine learning-based fake news detection research. They found that fake news spreads faster, deeper, and more broadly than real news. This insight helped researchers incorporate propagation-based features into classification models. Machine learning systems began using temporal and network-based attributes for

better prediction. The study demonstrated that human behaviour plays a critical role in misinformation spread. Their findings encouraged the development of models that combine content analysis with social engagement metrics. The research highlighted the need for early detection systems using predictive algorithms. It remains one of the most cited works in fake news research.

3. Proposed System

The proposed Fake News Detection System utilizes machine learning techniques to automatically classify news articles as genuine or fake. Initially, the collected news dataset undergoes pre-processing steps such as text cleaning, tokenization, stop-word removal, and stemming to improve data quality. Relevant textual features are then extracted using Natural Language Processing (NLP) methods such as TF-IDF or word embedding's. The processed features are used to train machine learning classifiers to identify patterns associated with fake and real news. The trained model predicts the authenticity of unseen news articles with high accuracy. These features are then fed into the Machine Learning Model Layer, where algorithms such as Logistic Regression, Naïve Bayes, Support Vector Machine

(SVM), or deep learning models like LSTM are trained and validated. The trained model is stored for deployment.

This system helps combat misinformation by providing fast, reliable, and automated fake news verification.

4. System Architecture

A Fake News Detection System using Machine Learning is designed with a modular architecture that enables efficient data processing, model training, and real-time prediction. The system begins with a Data Collection Layer, where news articles are gathered from reliable datasets such as Kaggle and social media platforms like Twitter. The collected data is stored in a centralized database. Next, the Data Preprocessing Module performs text cleaning, tokenization, stop-word removal, stemming/lemmatization, and vectorization techniques such as TF-IDF or word embedding's. The processed data is passed to the Feature Extraction and Selection Module, which identifies important textual features that help distinguish fake from real news.

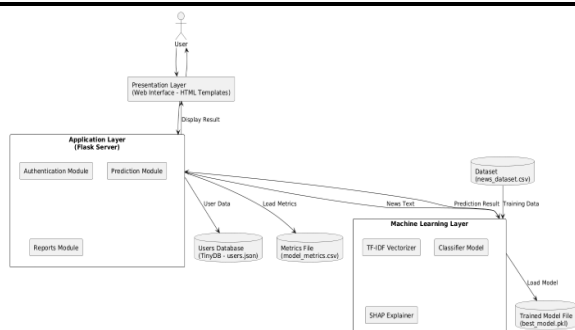


Fig. 1: System Architecture

5. Methodology

The proposed Fake News Detection System follows a structured machine learning methodology to accurately classify news articles as real or fake. Initially, a news dataset is collected from reliable sources and undergoes pre-processing, including text cleaning, tokenization, stop-word removal, and stemming to improve data quality.

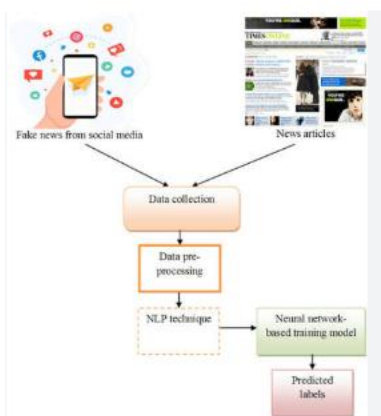


Fig: NB Architecture

The processed text is transformed into numerical representations using Natural Language Processing (NLP) techniques such as TF-IDF for effective feature extraction.

These features are then used to train machine learning classifiers, including Naïve Bayes to identify patterns associated with fake and genuine news.

6. Design and Construction

The design of the Fake News Detection System follows a modular and scalable architecture to ensure efficient processing, accurate classification, and easy deployment. The system is structured into multiple layers, including data input, preprocessing, feature extraction, classification, and user interface modules. This layered design ensures smooth data flow from raw news articles to final prediction output.

I. Data Collection: The first module in fake news detection is data collection. A labeled dataset containing both real and fake news articles is gathered from reliable sources. These datasets usually include headlines, article content, and corresponding labels (real or fake). The data is commonly stored in CSV format for easy processing. Ensuring a balanced dataset improves classification reliability and reduces bias during training.

II. Data Preprocessing: After collection, the dataset undergoes preprocessing to remove noise and standardize text. This includes converting text to lowercase, removing punctuation, special characters, and stop

words, and performing tokenization.

Stemming or lemmatization reduces words to their root forms. Proper preprocessing enhances text clarity and model efficiency.

III. Feature Extraction: Since machine learning models require numerical input, textual data is transformed into vectors using techniques like TF-IDF.

(i) Term Frequency (TF):

$$TF(t, d) = \frac{f(t, d)}{\sum_k f(k, d)}$$

where $f(t, d)$ represents the frequency of term t in document d .

(ii) TF-IDF Formula:

$$TFIDF(t, d) = TF(t, d) \times \log\left(\frac{N}{df(t)}\right)$$

where N is the total number of documents and $df(t)$ is the document frequency of term t .

These numerical representations help models identify important words in fake or real news.

IV. Model Selection and Training

Machine learning algorithms such as Naïve Bayes, Logistic Regression, SVM, and Random Forest are applied. For example, Naïve Bayes calculates the probability of a class given features using Bayes' theorem:

(iii) Naïve Bayes Formula:

$$P(C | X) = \frac{P(X | C) \cdot P(C)}{P(X)}$$

where $P(C | X)$ is the probability of class C (real or fake) given feature set X .

The dataset is split (80:20) into training and testing sets for learning and validation.

V. Model Evaluation

Performance is evaluated using accuracy, precision, recall, F1-score, and confusion matrix analysis to ensure reliable predictions.

VI. Model Deployment

Finally, the trained model is deployed using frameworks like Flask or Django to enable real-time fake news detection and reduce misinformation spread.

7. Results and Discussion

The experimental results demonstrate that the applied machine learning models for fake news detection achieve strong performance in distinguishing between real and fake news. Ensemble methods such as Random Forest and Gradient Boosting consistently outperform individual classifiers by achieving higher precision and recall. Support Vector Machine (SVM) shows high precision but relatively lower recall, indicating a conservative classification approach. Proposed provides faster computation with competitive accuracy but is

less effective in capturing complex textual patterns.

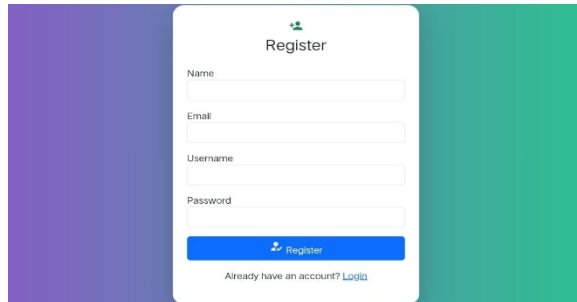


Fig 2: Registration Page

The system interface and user interaction begin with Figure 2 (User Registration Page), where new users create accounts to securely access the platform. This ensures controlled usage and data security. After registration, users log in through the system and access the dashboard.

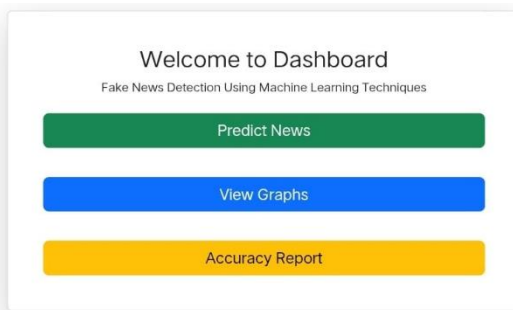


Fig 3: Classification Dashboard

The main functionality is presented in Figure 3, where users upload news text for analysis. The system processes the input using text segmentation, TF-IDF features, n-grams, and sentiment analysis to extract meaningful patterns for classification.

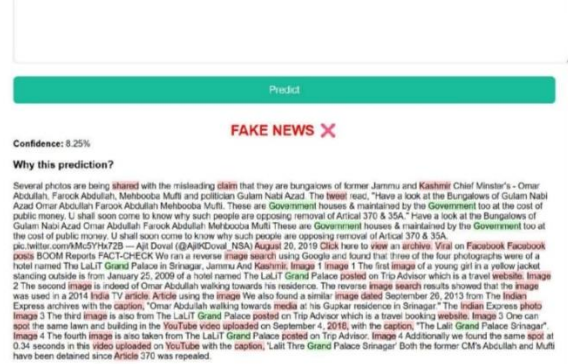


Fig 4: Predict News

The prediction results are illustrated in Figure 4, where the system accurately classifies news as real or fake. It also highlights fake content in red and real content in green, improving interpretability and user understanding.

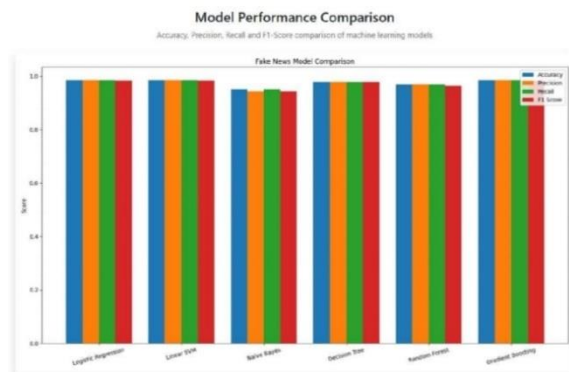


Fig 5: Algorithms Performance Graph

The comparative analysis of different algorithms is shown in Figure 5. The results indicate that Logistic Regression achieves the highest accuracy of 99.46%, followed by Linear SVM and Gradient Boosting at approximately 98.46%, Decision Tree at 97.95%, Random Forest at 96.93%, and

Naïve Bayes at 95.14%. This demonstrates that ensemble and hybrid approaches provide better robustness and classification performance.

Overall, the system achieves high accuracy, with performance nearing 99%, demonstrating its effectiveness in fake news detection. The integration of text segmentation and advanced feature extraction significantly improves classification results. These findings confirm that machine learning, particularly ensemble techniques, is highly effective for automated fake news detection, although continuous updates are necessary to adapt to evolving misinformation patterns.

8. Conclusion and Future Scope

In conclusion, the proposed SVM-based machine learning model for fake news detection demonstrates a robust and efficient approach to identifying misleading or false information on social media and online platforms. By leveraging textual analysis through TF-IDF feature extraction and using a high-dimensional classifier like SVM, the system can distinguish between fake and real news articles with high accuracy. The inclusion of pre-processing steps such as null value handling, label normalization, and filtering biased content ensures that the

model is trained on clean and representative data, which improves reliability. Compared to traditional manual verification or simpler models like Naive Bayes, the SVM-based system is better at capturing complex patterns, subtle language nuances, and non-linear relationships in text. The trained model can process large volumes of news content in real-time, enabling timely detection of fake news and reducing the potential spread of misinformation. Additionally, the system's integration with a user-friendly interface allows users to submit news articles and receive predictions along with confidence scores, making it practical and accessible. Overall, the proposed model provides an effective, scalable, and automated solution to address the challenges posed by fake news in the digital era.

Future Scope: The fake news detection system can be enhanced by incorporating advanced deep learning models such as BERT and RoBERTa, along with multimodal analysis of text, images, and videos to improve detection accuracy. Future developments may include real-time fake news monitoring, multilingual support, explainable AI techniques, and integration with fact-checking platforms to provide

transparent and reliable news verification across various digital platforms.

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