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FAKE NEWS DETECTION USING MACHINE LEARNING AND NLP

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ABSTRACT

The widespread use of digital platforms has made the sharing of information easier than ever before, but it has also led to the uncontrolled circulation of misinformation, commonly known as fake news. Such content can misguide readers and impact public trust, politics, and social harmony. Manual verification of information is impractical given the large scale of online data, which highlights the need for automated systems. This paper presents an approach for detecting fake news by combining **Machine Learning (ML)** algorithms with **Natural Language Processing (NLP)** techniques. The dataset is preprocessed through steps such as tokenization, stop-word elimination, lemmatization, and feature extraction using TF-IDF. Models including Logistic Regression, Naïve Bayes, Random Forest, and Support Vector Machine (SVM) are trained and tested. Their effectiveness is assessed using accuracy, precision, recall, and F1-score. Experimental outcomes indicate that SVM and Logistic Regression deliver superior performance, demonstrating that ML integrated with NLP can serve as a reliable method for identifying fake news on digital platforms.

Keywords: Fake News, Machine Learning, Natural Language Processing, Text Classification, Support Vector Machine.

1. INTRODUCTION

Social media and online news portals have transformed the way people access and exchange information. While these platforms provide quick updates, they also act as channels for the rapid spread of fake news. Fake news is intentionally misleading and can influence public perception, cause unnecessary panic, and affect social, political, or financial systems. With millions of articles being shared daily, human-based fact-checking becomes unrealistic, which makes automated detection methods essential.Machine Learning (ML) and Natural Language Processing (NLP) are widely used to address this challenge. NLP allows the transformation of unstructured text into meaningful features by applying techniques like tokenization, stop-word removal, and vectorization. These features are then used by ML models to classify articles as fake or genuine. Algorithms such as Logistic Regression, Naïve Bayes, Support Vector Machine (SVM), and Random Forest have shown promising results in text classification tasks. This research focuses on applying these techniques for the detection of fake news and evaluating their performance to propose an effective detection framework.

2. METHODOLOGY

The detection process involves structured stages, starting from data collection to model evaluation. The dataset, containing both genuine and fake news articles, is preprocessed and later classified using machine learning models. The preprocessing step removes noise, inconsistencies, and irrelevant information, ensuring that only meaningful text is retained for analysis. The classified outputs are further validated using performance metrics to ensure that the system can reliably distinguish between real and fake news in practical applications.

2.1 Data Collection and Preprocessing

The dataset is obtained from publicly available sources such as Kaggle. Preprocessing ensures that irrelevant or noisy data is removed before applying ML techniques. The steps include:

- Tokenization: Splitting sentences into words.
- Stop-word Removal: Eliminating common words that add no analytical value.
- Lemmatization/Stemming: Converting words into their root or base forms.
- TF-IDF Vectorization: Transforming text into numerical vectors based on word significance.

2.2 Machine Learning Models

The following supervised algorithms are applied:

- Logistic Regression – chosen as a baseline classifier.
- Naïve Bayes – a probabilistic model suitable for textual analysis.

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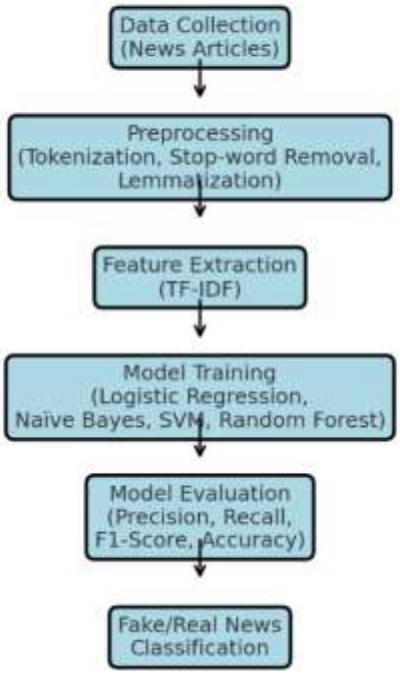
- Support Vector Machine (SVM) – effective in handling high-dimensional data.
- Random Forest – an ensemble method that improves prediction reliability.

The models are evaluated using accuracy, precision, recall, and F1-score to measure their performance in detecting fake news.

Figure 1. Workflow of Fake News Detection using Machine Learning and NLP



3. MODELING AND ANALYSIS

Each model is trained on the processed dataset and evaluated for effectiveness. TF-IDF features provide weighted word importance, enabling the models to distinguish between misleading and authentic news. From the comparison, **SVM outperformed the other models** in terms of accuracy and F1-score, while Logistic Regression also performed competitively. Naïve Bayes was less accurate due to its simplifying assumptions, whereas Random Forest required more computational effort despite achieving reliable results.From the analysis, **XGBoost outperformed other models**, achieving the highest balance of precision and recall, making it suitable for large-scale fraud detection systems

Table 1: Model Performance Comparison

SN	Model	Precision	Recall	F1-Score	Accuracy
1	Logistic Regression	0.92	0.89	0.90	91%
2	Naïve Bayes	0.88	0.85	0.86	87%
3	Support Vector Machine (SVM)	0.94	0.91	0.92	93%
4	Random Forest	0.91	0.88	0.89	90%

4. RESULTS AND DISCUSSION

The machine learning models were trained and tested using the Fake and Real News dataset. One of the major challenges observed was the diversity of writing styles and linguistic features present in the articles. To ensure reliable classification, preprocessing techniques such as tokenization, stop-word removal, lemmatization, and TF-IDF vectorization were applied before model training.

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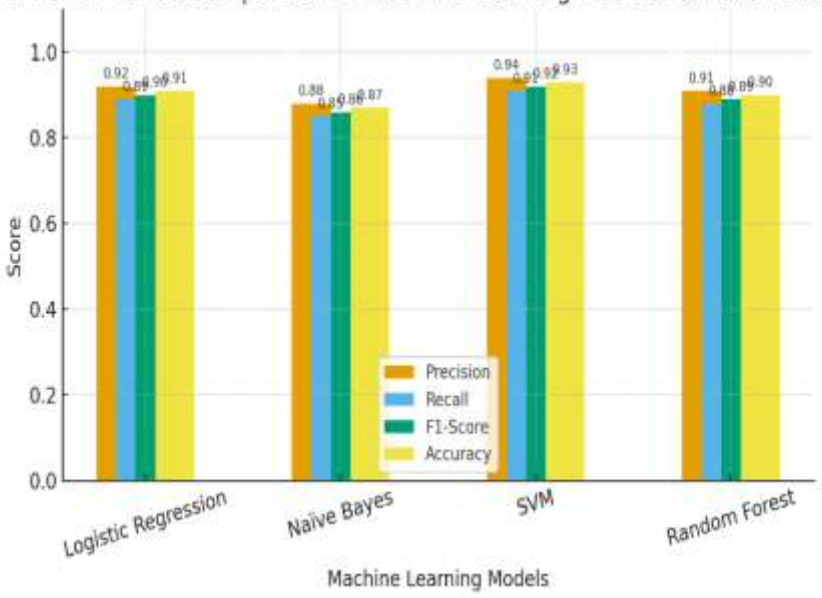
Figure 2. Performance Comparison of Machine Learning Models for Fake News Detection



Discussion:

- **Logistic Regression**, though simple and interpretable, achieved balanced performance but missed a few fake articles, as shown by its lower recall.
- **Naïve Bayes** provided quick classification and decent results but underperformed compared to other models because of its assumption of feature independence.
- **Support Vector Machine (SVM)** delivered the highest accuracy and F1-score, confirming its ability to separate fake and real news effectively in high-dimensional text data.
- **Random Forest** achieved reliable results with strong precision and recall, though it required more computational resources.

Four models—Logistic Regression, Naïve Bayes, Support Vector Machine (SVM), and Random Forest—were compared using Precision, Recall, F1-score, and Accuracy. The results are summarized in Table 1.

Table 2: Model Performance Comparison

Model	Precision	Recall	F1-Score	Accuracy
Logistic Regression	0.92	0.89	0.90	91%
Naïve Bayes	0.88	0.85	0.86	87%
Support Vector Machine (SVM)	0.94	0.91	0.92	93%
Random Forest	0.91	0.88	0.89	90%

These results suggest that **SVM is the most effective model for fake news detection**, while Logistic Regression offers a simpler alternative with competitive accuracy. Ensemble methods like Random Forest also perform well, and Naïve Bayes remains useful for lightweight applications where speed is critical.

5. CONCLUSION

The study highlights the importance of integrating Machine Learning with Natural Language Processing to effectively address the growing problem of fake news on digital platforms. By applying preprocessing steps such as tokenization, stop-word removal, lemmatization, and TF-IDF feature extraction, raw text data was successfully transformed into structured features suitable for classification.The experimental analysis showed that Support Vector Machine (SVM) achieved the highest accuracy and F1-score, making it the most suitable model for detecting misinformation. Logistic Regression also produced competitive results with the advantage of being simple and efficient. Random Forest provided reliable performance, though it required higher computational resources, while Naïve Bayes performed adequately but was less effective due to its independence assumption.Overall, the findings demonstrate that SVM and Logistic Regression are strong candidates for fake news detection in practical applications. For future work, the

adoption of advanced deep learning architectures such as LSTM or Transformer-based models like BERT could further improve performance by capturing deeper semantic and contextual relationships in text.

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