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Fake News Detection Using Machine Learning

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Abstract

The rapid spread of fake news on social media and online platforms has become a major challenge to information credibility. This paper proposes a machine learning-based approach for detecting fake news using textual features. A real-world dataset containing 44,942 news articles (21,418 true and 23,524 fake news) is utilized for training and testing. Multiple classifiers, including Logistic Regression, Decision Tree, Random Forest, and Gradient Boosting, are implemented to enhance prediction reliability. The system preprocesses the data, converts text into numerical feature vectors, and evaluates model performance using standard metrics such as accuracy, precision, recall, and F1-score. Experimental results indicate that the proposed system effectively distinguishes between true and fake news, providing a scalable solution for real-world applications. A comparative analysis of different machine learning models is conducted to identify the most effective classifier for fake news detection. The results demonstrate that ensemble-based models achieve superior performance compared to individual classifiers. The proposed approach can be effectively integrated into online news platforms and social media systems to reduce the spread of misinformation and improve information authenticity

Keywords- Fake News Detection, Machine Learning, Logistic Regression, Random Forest, Gradient Boosting, Text Classification.

I. Introduction

The rapid growth of digital media and social networking platforms has significantly changed the way information is created and shared. While online news sources provide quick access to information, they have also facilitated the widespread dissemination of fake news. Fake news refers to false or misleading information presented as legitimate news, often created to manipulate public opinion, influence political decisions, or generate financial profit. The uncontrolled spread of such misinformation poses serious threats to social stability, public trust, and democratic processes. To address the challenge, automated fake news detection systems are required. Machine learning techniques, combined with natural language processing, offer effective solutions by analysing textual patterns and classifying news articles based on learned features. Automated systems can process large datasets efficiently and provide faster and more consistent detection compared to manual methods.

The objective of this research is to develop an effective fake news detection system using machine learning algorithms. The proposed system utilises TF-IDF feature extraction and multiple classifiers, including Logistic Regression, Decision Tree, Random Forest, and Gradient Boosting, to accurately classify news articles as real or fake. By comparing the performance of different models, this study aims to identify the most reliable approach for fake news detection and contribute toward reducing the impact of misinformation in digital media.

II. Literature Review

Several studies have explored automated fake news detection using machine learning and natural language processing techniques. Early approaches relied on rule-based systems that used predefined linguistic patterns and keywords; however, these methods lacked scalability and adaptability. Supervised machine learning algorithms such as Naive Bayes, Support Vector Machines (SVM), and Decision Trees have been widely applied due to their simplicity and effectiveness in text classification tasks.[13]

Ensemble learning techniques, including Random Forest and Gradient Boosting, have demonstrated improved performance by combining multiple classifiers to reduce overfitting and enhance generalization. In recent years, deep learning models such as Long Short-Term Memory (LSTM) networks and Convolutional Neural Networks (CNN) have gained attention for their ability to capture complex semantic relationships in text data.[11]

TF-IDF vectorization remains one of the most commonly used feature extraction techniques for transforming textual data into numerical form. Despite significant progress, existing methods still face challenges related to handling large-scale datasets, computational complexity, and achieving robust real-time prediction accuracy.[8]

III. Technology Used

The proposed fake news detection system is developed using modern machine learning and natural language processing technologies. The following tools, libraries, and platforms are utilized in the implementation:

A. Programming Language:

Python is used as the primary programming language due to its simplicity, extensive library support, and suitability for data analysis and machine learning applications.

B. Machine Learning Libraries:

The Scikit-learn (sklearn) library is used to implement machine learning algorithms such as Logistic Regression, Decision Tree, Random Forest, and Gradient Boosting. It also provides utilities for model evaluation, train-test splitting, and performance metrics.

C. Natural Language Processing (NLP):

Text preprocessing and feature extraction are performed using NLP techniques. TF-IDF (Term Frequency–Inverse Document Frequency) vectorization is applied to convert textual data into numerical features suitable for machine learning models.

D. Data Processing Libraries:

Pandas and NumPy are used for data manipulation, cleaning, and numerical computations. These libraries facilitate efficient handling of large CSV datasets.

E. Model Persistence:

The Joblib library is used to save and load trained machine learning models and the TFIDF vectorizer, enabling model reuse and deployment without retraining.

F. Development Environment:

The system is developed and tested using Jupyter Notebook and Python IDEs, which provide an interactive environment for data analysis and experimentation.

IV. Dataset Description

The dataset used for this research is obtained from a publicly available fake news dataset commonly used for machine learning–based news classification tasks. The dataset contains news articles collected from various online news sources and is designed to support supervised learning for fake news detection. The dataset is stored in Comma-Separated Values (CSV) format, which allows easy data handling and preprocessing using Python libraries such as Pandas. It consists of two separate files representing true and fake news articles, which are later merged for training and evaluation. Each record in the dataset includes the following attributes:

- **Title:** The headline of the news article
- **Text:** The main content of the news article
- **Subject:** The category or topic of the news
- **Date:** The publication date of the article

The combined dataset contains a total of 44,942 news articles. Out of these, 21,418 samples are labelled as true news, and 23,524 samples are labelled as fake news. A binary class label is assigned, where 1 represents true news and 0 represents fake news. This balanced distribution of classes helps improve the reliability and performance of the machine learning models used in this study.

V. Implementation

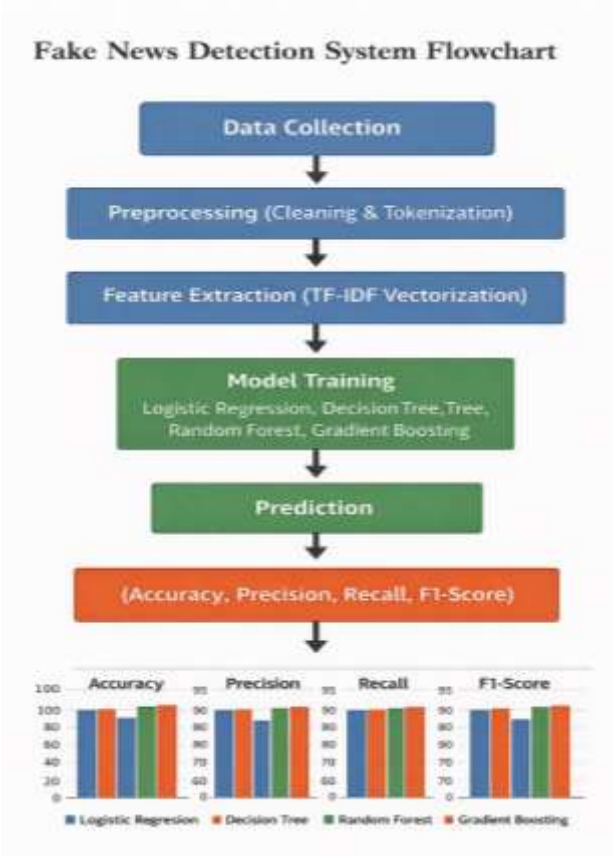

Figure 1: Flowchart

The proposed fake news detection system follows a structured machine learning pipeline consisting of data collection, preprocessing, feature extraction, model training, evaluation, and manual testing. . The overall workflow is illustrated in Figure 1.

A. Data Collection:

The dataset is collected in CSV format and consists of news articles labelled as true or fake. Each record includes attributes such as title, text, subject, and date. The dataset contains 21,418 true news samples and 23,524 fake news samples, providing a balanced distribution for training machine learning models.

B. Data Preprocessing:

Text preprocessing is performed to improve data quality and reduce noise. The preprocessing steps include converting text to lowercase, removing punctuation, special characters, URLs, HTML tags, numbers, and extra whitespace. This process ensures that only meaningful textual information is retained for feature extraction.

C. Feature Extraction:

After preprocessing, the textual data is transformed into numerical features using Term Frequency–Inverse Document

Frequency (TF-IDF) vectorization. TF-IDF assigns importance to words based on their frequency in a document relative to the entire dataset, enabling effective representation of textual patterns.

D. Model Training:

Four supervised machine learning classifiers are trained using the extracted TF-IDF features: Logistic Regression, Decision Tree, Random Forest, and Gradient Boosting. These models are selected to compare linear, tree-based, and ensemble learning approaches for fake news detection.

E. Model Evaluation:

The dataset is divided into training and testing sets using a train-test split strategy. Model performance is evaluated using standard metrics such as accuracy, precision, recall, and F1-score. These metrics provide a comprehensive evaluation of the classifiers' ability to distinguish between fake and true news articles.

F. Manual Testing:

A manual testing function is implemented to classify user-provided news text. The input text undergoes the same preprocessing and TF-IDF transformation before being passed to the trained models. The predictions from all four classifiers are displayed, allowing comparative analysis of model outputs.

VI. Results and Discussion

All four classifiers achieved high accuracy on the test dataset. Ensemble methods (Random Forest and Gradient Boosting) outperformed single models. Precision, recall, and F1-score metrics indicate that models reliably distinguish between fake and true news.

VII. Future Scope

The proposed fake news detection system can be further enhanced by incorporating image-based analysis to detect fake news in multimedia content. Advanced deep learning models such as BERT and LSTM can be employed to improve contextual understanding of news articles. Additionally, expanding the dataset to include multilingual news sources will increase the system's applicability and effectiveness across diverse regions.

VIII. Conclusion

The proposed fake news detection system effectively classifies news articles using machine learning classifiers based on TF-IDF features. The experimental results demonstrate that ensemble models such as Random Forest and Gradient Boosting outperform individual classifiers in terms of accuracy and reliability. The system provides an efficient and scalable solution for automated fake news detection.

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