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Design and Development of Fake News Detection System Using Machine Learning Techniques

Himanshu Singh[1], Diksha Singh[2], Atul Kumar[3], Harsh Panwar[4], Dr. Saumya Chaturvedi[5], Ms. Poonam Verma[6], Dr. Sureshwati[7]

[1, 2, 3, 4]*Department of Computer Applications, Greater Noida Institute of Technology (Engg. Institute), Greater Noida, India*
[5]*Professor, Department of computer Applications, Greater Noida Institute of Technology (Engg. Institute), Greater Noida, India*
[6, 7]*Assistant Professor, Department of computer Applications, Greater Noida Institute of Technology (Engg. Institute), Greater Noida, India*

Abstract: ***The rapid expansion of digital communication and social media, the spread of fake news has become a growing concern. Detecting and filtering out fake news is crucial, yet it remains a challenging task due to limited datasets and effective analysis techniques. This study presents a machine learning-based approach to detecting fake news. The system extracts textual features using Term Frequency-Inverse Document Frequency (T F- IDF) with bag-of-words and n-grams. A Support Vector Machine (SVM) classifier is then employed to differentiate between authentic and fake news. Additionally, a dataset containing both real and fake news articles is introduced for training the model. The results highlight the effectiveness of the proposed system in accurately identifying misinformation.***

Keywords: Fake news detection, Social media, Machine Learning, Support Vector Machine TF-IDF, Web Mining.

I. INTRODUCTION

In recent years, the spread of fake news has grown rapidly, mainly due to the rise of social media platforms. Misinformation is often created for various reasons—some to attract website traffic through sensational headlines, while others aim to manipulate public opinion on political or financial matters. Fake news can also damage the reputation of individuals, businesses, and institutions. Additionally, misinformation about health-related topics poses serious risks. For example, during the COVID-19 pandemic, the World Health Organization (WHO) warned about an " infodemic " where the excessive spread of both true and false information made it difficult for people to identify reliable sources. This overload of misleading content fueled fear, uncertainty, and misinformation on a global scale.

This paper introduces an advanced method for detecting fake news using machine learning techniques. The key steps in our approach include:

1) Text Prepossessing: Removing unnecessary elements such as stop words and special characters to clean the text.
2) Text Representation: Converting text into numerical data using bag-of-words, n-grams, and Term Frequency-Inverse Document Frequency (TF- IDF).
3) Feature Extraction: Analyzing key aspects of news articles, including the source, author, publication date, and sentiment.
4) Machine Learning Classification: Implementing a Support Vector Machine (SVM) model to categorize news as real or fake.

II. RELATED WORK

1) Numerous studies have been conducted on fake news detection, exploring various methods for assessing the truthfulness of information. These approaches generally fall into two categories: linguistic-based methods that rely on machine learning and network-based analysis that examines how news spreads.
2) One study utilized a Naive Bayes classifier to identify fake news from Facebook posts, achieving an accuracy of 74%. While effective, other classifiers have outperformed this model. Another research compared different feature extraction techniques and multiple classification methods, concluding that the TF-IDF method combined with a Linear Support Vector Machine (LSVM) provided the best accuracy of 92%. However, LSVM is limited to handling only linearly separable datasets, which may restrict its effectiveness in complex cases.

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3) Other researchers have examined ways for social media users to verify information and highlighted the role of journalists and institutions in combating misinformation. Some studies explored multi-modal strategies, integrating textual content, images, and social metadata to improve accuracy. Another research work analyzed fake news detection across multiple datasets, emphasizing textual content and sentiment analysis but neglecting factors like the news source, author, and publication date, which could influence detection results.
4) Additionally, a public data set of verified news articles was introduced, alongside a text-processing approach that achieved 87% accuracy in distinguishing real from fake news. Another study proposed the LIAR data set, which is widely used for misinformation detection, stance classification, and argument analysis. However, this data set primarily focuses on political news, limiting its application to broader contexts.
5) Despite significant progress, most existing models classify news as strictly real or fake, which may not reflect the true nature of misinformation. In reality, news articles should be evaluated based on a confidence score rather than a binary classification. Our research addresses this limitation by proposing a model that introduces confidence levels in fake news classification, improving the accuracy and reliability of detection systems.

III. PROPOSED SYSTEM

Our system is designed to detect fake news by leveraging machine learning techniques. It builds a classification model using a Support Vector Machine (SVM), which is then used to determine whether a news article is real or fake.

A. System Overview

The system processes a data set containing news articles along with related metadata, such as author, source, and publication date. This data undergoes prepossessing, which involves cleaning and structuring the text for machine learning. The data set is then split into training and testing sets. The SVM algorithm is used to train the model, which is then tested for accuracy. If performance is unsatisfactory, parameters are adjusted to enhance accuracy.

B. Data Pre-processing

The system categorizes news data into three main types: **textual, categorical, and numerical**. Each category undergoes specific pre processing steps:

1) Processing Textual Data

- Cleaning: Removing unnecessary elements like stop words, punctuation, and symbols.
- Stemming: Reducing words to their root forms to unify variations.
- Encoding: Converting text into numerical representations using Bag-of-Words, N-Grams, and TF -IDF techniques.
- TF-IDF Calculation: Assigns importance to words based on their frequency in a document compared to their occurrence across multiple documents.

2) Processing Categorical Data

- Source Encoding: Assigning numerical labels to different sources such as newspapers, TV channels, and online platforms.
- Author Encoding: Converting author names into numerical values while grouping those from the same source for better pattern recognition.

3) Processing Numerical Data

- Date Formatting: Splitting publication dates into day, month, and year for better analysis.
- Sentiment Analysis: Assigning a sentiment score based on the text:
    - Positive (>0) = More likely to be real news
    - Negative (<0) = More likely to be fake news
    - Neutral (0) = No clear bias

C. Model Training and Validation

The system consists of two main phases:

1) Training Phase

- The SVM algorithm is applied to develop the model.

- It calculates a confidence score to classify news as real or fake.
- A positive score indicates real news, while a negative score suggests fake news.
- The score helps assess the level of certainty in the classification.

2) Validation Phase

- A portion of the dataset is reserved for testing to ensure the model correctly classifies new data.
- Cross-validation is performed to prevent over-fitting and enhance reliability.

D. Optimizing Model Performance

To maximize accuracy, various SVM parameters are fine-tuned, such as:

- Cost function adjustments
- Kernel type selection
- Hyperparameter tuning (γ, ε, etc.)

E. Deployment and Usage

Once the model achieves an optimal accuracy level, it is deployed to analyze new and unseen news articles. The system assigns a confidence score, helping users assess the reliability of an article. This provides a more effective and scalable method for detecting fake news.

IV. EXPERIMENTS AND RESULTS

To assess the effectiveness of our fake news detection model, we created a datasets by combining real and fake news sources.

A. Dataset Description

We integrated two datasets to construct our training data:

1) Fake News Dataset – This dataset consists of articles flagged as false, sourced from 244 websites identified by the BS Detector Chrome extension. The data was gathered using the Webhose.io API and contains 12,999 social media posts categorized into different data types, including text, numerical values, and metadata.

2) Real News Dataset – This dataset includes news articles collected from well-known media outlets such as The New York Times, CNN, Reuters, NPR, and The Guardian. The data was extracted using web scraping techniques (Beautiful Soup) and stored in an SQLite database, later converted into CSV files for analysis.

After pre processing, our final data-set contained the following features:

- Top 5 most common words (extracted using the Bag-of-Words technique)
- Three-word combinations (generated using the N-Gram model)
- Publication date (day, month, and year)
- Sentiment score (to assess emotional tone)
- News source (publication name)
- Author (writer's identity)
- Label (Fake or Real classification)

B. Results and Analysis

To achieve the highest accuracy, we tested various **feature extraction methods and model parameters**.

1) Comparison of Bag-of-Words and N-Grams
  - The Bag-of-Words method performed best when using the 25 most frequent words. Adding more words led to overfitting, reducing accuracy.
  - The N-Gram technique performed optimally with 2-word sequences (bigrams). Larger N-values resulted in reduced accuracy due to the short length of news articles.

2) Effect of Features on Accuracy
  - Sentiment scores had little impact, as negative sentiment does not necessarily indicate fake news.
  - News source and publication date significantly improved accuracy, increasing it to 96%.
  - Encoding the author's name further boosted accuracy to 100%, proving its importance in detecting fake news.

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3) Optimizing the Model
- Among different SVM kernels, the linear and polynomial kernels produced the best results.
- The Gaussian (RBF) kernel performed well but required fine-tuning of parameters like Cost (C), Gamma (γ), and Epsilon (ε).

4) Final Model Parameters
- Optimal Cost (C): 300
- Best Epsilon (ε): 0.0001
- Best Gamma (γ): 0.001

After tuning these parameters, our model successfully achieved 100% accuracy in detecting fake news.

V. CONCLUSION

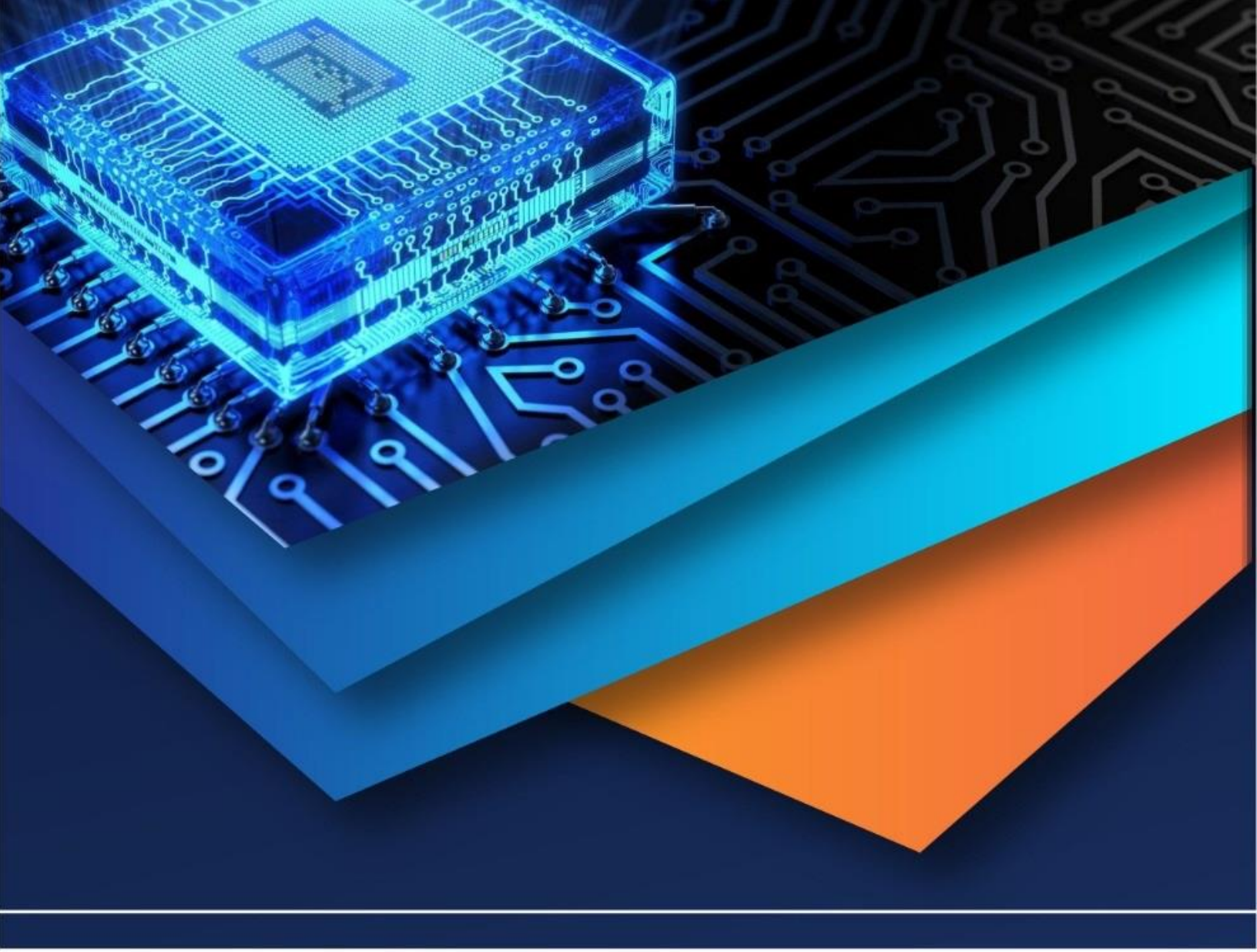
Our study confirms that Support Vector Machine (SVM) is highly effective in identifying fake news. Key takeaways include:

1) The most crucial features for detection are text, author, source, and date.
2) N-Gram models outperform Bag-of-Words when analyzing larger datasets.
3) SVM provides superior accuracy while also assigning confidence scores to its classifications.
4) Future enhancements could involve expanding the dataset and implementing real-time updates for continuous learning.

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