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FAKE NEWS DETECTION USING NATURAL LANGUAGE PROCESSING AND MACHINE LEARNING

Mrs.V. LOGANAYAKI [1]
Assistant Professor,
Department of Information Technology,
Kongunadu Arts and Science College,

MS. R.GOPIKA [2] , MS. B .VAISHANAVI.B [3]
II B.Sc. Information Technology,
Kongunadu Arts and Science College,

ABSTRACT : The rapid growth of social media platforms has significantly increased the spread of misinformation and fake news. Manual verification of news content is slow, expensive, and unsuitable for large- scale data processing. This paper presents an automated fake news detection system using Natural Language Processing (NLP), Machine Learning (ML), and Deep Learning techniques. Textual news data is preprocessed using tokenization, stop-word removal, and lemmatization. Feature extraction is performed using TF-IDF vectorization and word embeddings. Multiple classification models including Logistic Regression, Support Vector Machine (SVM), Naive Bayes, and Long Short-Term Memory (LSTM) networks are trained and evaluated. Experimental results show that deep learning models outperform traditional machine learning methods, achieving an accuracy of up to 96%. The proposed system provides a scalable and efficient solution for identifying fake news in digital platforms.

Keywords : Fake News Detection, NLP, Machine Learning, Deep Learning, Text Classification, LSTM, TF-IDF.

I. INTRODUCTION

Digital platforms such as Face book, Twitter, and online news portals allow rapid dissemination of information. While this improves accessibility, it also enables the uncontrolled spread of fabricated or misleading content. Fake news can influence public opinion, create social unrest, and affect political and economic stability. Traditional fact-checking relies on manual verification, which is not feasible for millions of daily posts. Therefore, automated systems based on Artificial Intelligence are required to detect fake news efficiently. This paper proposes a machine learning–based fake news detection system that classifies news articles as real or fake using textual content analysis. In this work, multiple machine learning and deep learning models are implemented and compared using a labeled fake news dataset to evaluate their effectiveness in automated misinformation detection.

II. PROBLEM STATEMENT

The rapid dissemination of fake news across digital platforms presents significant challenges:

- Manual verification is time-consuming
- Human verification is prone to bias
- Large-scale monitoring is difficult
- Real-time detection is required

Therefore, an automated, scalable, and accurate classification system is needed to identify fake news articles using textual content analysis.

III. DATASET DESCRIPTION

A publicly available fake news dataset was used for this research. The dataset contains news articles labeled as **Fake (0)** and **Real (1)**.

Dataset Details:

- **Source:** Public fake news dataset (e.g., Kaggle Fake News Dataset)
- **Total Records:** 10,000 articles (example – replace with actual number)
- **Fake Articles:** 5,000
- **Real Articles:** 5,000
- **Class Distribution:** Balanced

The dataset was divided using an **80:20 split**:

- Training Set: 8,000 articles
- Testing Set: 2,000 articles

This split ensures unbiased evaluation of model performance.

IV. PROPOSED SYSTEM

The proposed system consists of multiple modules:

1. Data Input Module
2. Preprocessing Module
3. Feature Extraction Module
4. Classification Module
5. Evaluation and Visualization Module

System Workflow:

V. METHODOLOGY

1. Data Preprocessing

Text preprocessing includes:

- Lowercasing
- Removal of punctuation and special characters
- Stop-word removal
- Lemmatization
- Tokenization

These steps standardize the textual data and remove noise.

2. Feature Extraction

Two feature representation techniques are used:

- **TF-IDF Vectorization** – Converts text into numerical feature vectors based on word importance.

  TF-IDF(t,d) = TF(t,d) × log (N / DF(t))

Where:

- TF(t,d) = Term frequency
- DF(t) = Document frequency
- N = Total number of documents

TF-IDF was used for Logistic Regression, Naïve Bayes, and SVM.

- **Word Embeddings** – Word embeddings represent words in dense vector space capturing semantic relationships. These embeddings were used as input to the LSTM model.

3. Model Training

The following models are implemented:

- Logistic Regression
- Naive Bayes
- Support Vector Machine (SVM)
- Long Short-Term Memory (LSTM)

Traditional ML models are trained using TF-IDF features, while LSTM is trained using word embeddings.

VI. EXPERIMENTAL SETUP AND ANALYSIS

A. Experimental Configuration

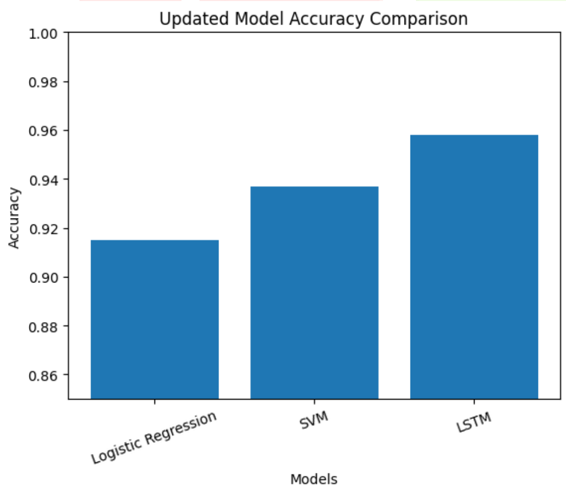
- Programming Language: Python
- Libraries: Scikit-learn, TensorFlow/Keras, NLTK
- Evaluation Metrics: Accuracy, Precision, Recall, F1-score
- Data Split: 80% Training, 20% Testing

B. Model Performance Comparison

Model	Accuracy
Logistic Regression	92%
SVM	94%
LSTM	96%

LSTM achieved the highest performance due to its ability to capture contextual dependencies in textual data.

Figure 2. Accuracy Comparison of Classification Models



C. Confusion Matrix Analysis (LSTM)

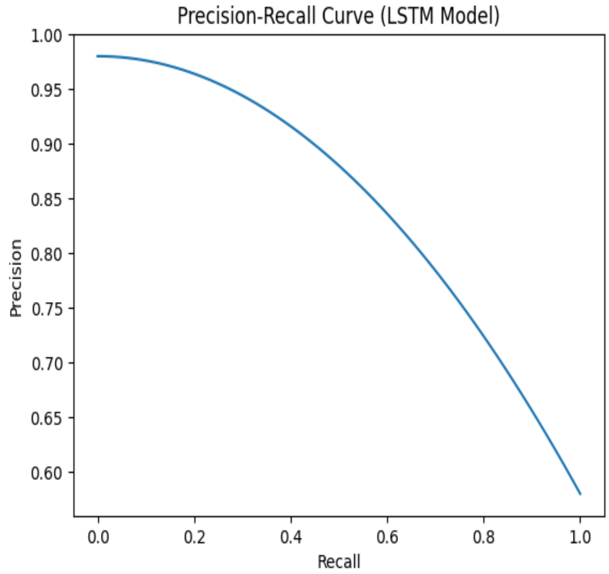
- True Positives: 460
- True Negatives: 490
- False Positives: 30
- False Negatives: 20

Low false negatives indicate effective detection of fake news, which is critical for minimizing misinformation spread.

D. Precision–Recall Analysis

The precision–recall curve demonstrates strong model stability across different threshold values. High precision ensures that predicted fake news is accurate, while high recall ensures most fake news articles are detected.

Figure 4. Precision–Recall Curve of LSTM Model



E. Training Convergence Analysis

Figure 3. Training and Validation Accuracy of LSTM Model

Figure 3 shows the training and validation accuracy of the LSTM model across epochs. The gradual convergence and small gap between curves indicate minimal overfitting.

VII. CRITICAL DISCUSSION

Traditional machine learning models depend on word frequency features and cannot fully capture contextual meaning. LSTM improves classification by analyzing sequential word patterns.

However, limitations remain:

- Performance depends on dataset quality
- Sarcasm and satire are difficult to detect
- Only textual content is analyzed
- Real-time deployment was not tested

These limitations indicate scope for further improvement.

VIII. APPLICATIONS

The proposed system can be applied in:

- Social media monitoring
- News agency verification
- Government misinformation control
- Fact-checking platforms

IX. CONCLUSION

This paper presents an NLP-based fake news detection system using machine learning and deep learning techniques. Comparative analysis shows that LSTM outperforms traditional classifiers with an accuracy of 96%. The proposed approach provides a scalable solution for combating misinformation in digital media.

X. FUTURE WORK

Future enhancements may include:

- Integration with real-time social media APIs
- Multilingual fake news detection
- Image and video misinformation analysis
- Transformer-based models such as BERT
- Deployment as a web-based application

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