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ENHANCED FAKE NEWS DETECTION SYSTEM USING MULTIPLE MACHINE LEARNING ALGORITHMS

Umoh, Enoima Essien[1], and Ayim Livinus Abip [2*]

Department of Computer Science, University of Cross River State, Calabar, NIGERIA.

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***Corresponding Author**:
Umoh, Enoima Essien

Abstract **Original Research Article**

The purpose of this study is to develop a more accurate, reliable, and scalable fake news detection system by using an ensemble machine learning approach that overcomes the limitations of traditional single-model classifiers, particularly low accuracy, poor generalization, and high false-positive and false-negative rates. The study adopts an experimental research design using a benchmark Kaggle fake news dataset consisting of 20,800 labeled news articles. Text data were preprocessed through tokenization, stop-word removal, Bag-of-Words representation, TF-IDF transformation, and N-gram feature extraction. Five machine learning classifiers Support Vector Machine, Logistic Regression, Random Forest, Decision Tree, and Gradient Boosting were trained individually and then combined into an ensemble model using a majority-voting mechanism. The system's performance was evaluated using accuracy, precision, recall, and F1-score. The ensemble model significantly outperformed individual baseline models, achieving an accuracy of 97.86%. The results show that combining multiple classifiers reduces misclassification rates and enhances predictive reliability. The proposed system demonstrates strong robustness, adaptability, and effectiveness in detecting fake news across diverse textual inputs. The study relies on a single benchmark Kaggle dataset, which may not fully represent the complexity of real-world news across different platforms, languages, and evolving misinformation styles. The model focuses on textual content only and does not incorporate multimedia elements such as images, videos, or social context. This research contributes a novel ensemble-based framework that integrates multiple machine learning algorithms into a unified voting system for fake news detection. By combining diverse classifiers, the model significantly improves accuracy and robustness compared to traditional single-model approaches, offering a practical and scalable solution for real-world misinformation detection.

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1.0 INTRODUCTION

The spread of misinformation has become a major challenge in today's digital world. Although false information has existed for a long time, modern social media and online platforms allow it to spread faster and reach a much wider audience than ever before (Aldwairi & Alwahedi, 2018). Fake news is often designed to look like real news, making it difficult for readers to distinguish between true and false information (Lazer et al., 2018).

This problem has serious effects on society, including political manipulation, public confusion, and loss of trust in the media. Events such as the 2016 United States presidential election showed how fake news can influence public opinion on a large scale (Grinberg et al., 2019).

Researchers have developed machine learning techniques to detect fake news automatically. However, many existing systems still face problems such as low accuracy and poor adaptability to new forms of misinformation. This study proposes an improved fake news detection model using ensemble machine learning methods to provide more accurate and reliable results.

1.1 Conceptual Model Framework

The conceptual framework illustrates the overall structure and flow of the enhanced fake news detection system. It shows how raw news data is preprocessed, features are extracted, and multiple machine learning algorithms are applied. The individual classifier outputs are integrated using a majority-voting ensemble technique. Evaluation metrics assess the system's performance, and results are presented through the output module. This framework guides the systematic development and implementation of the detection model. See Figure 1

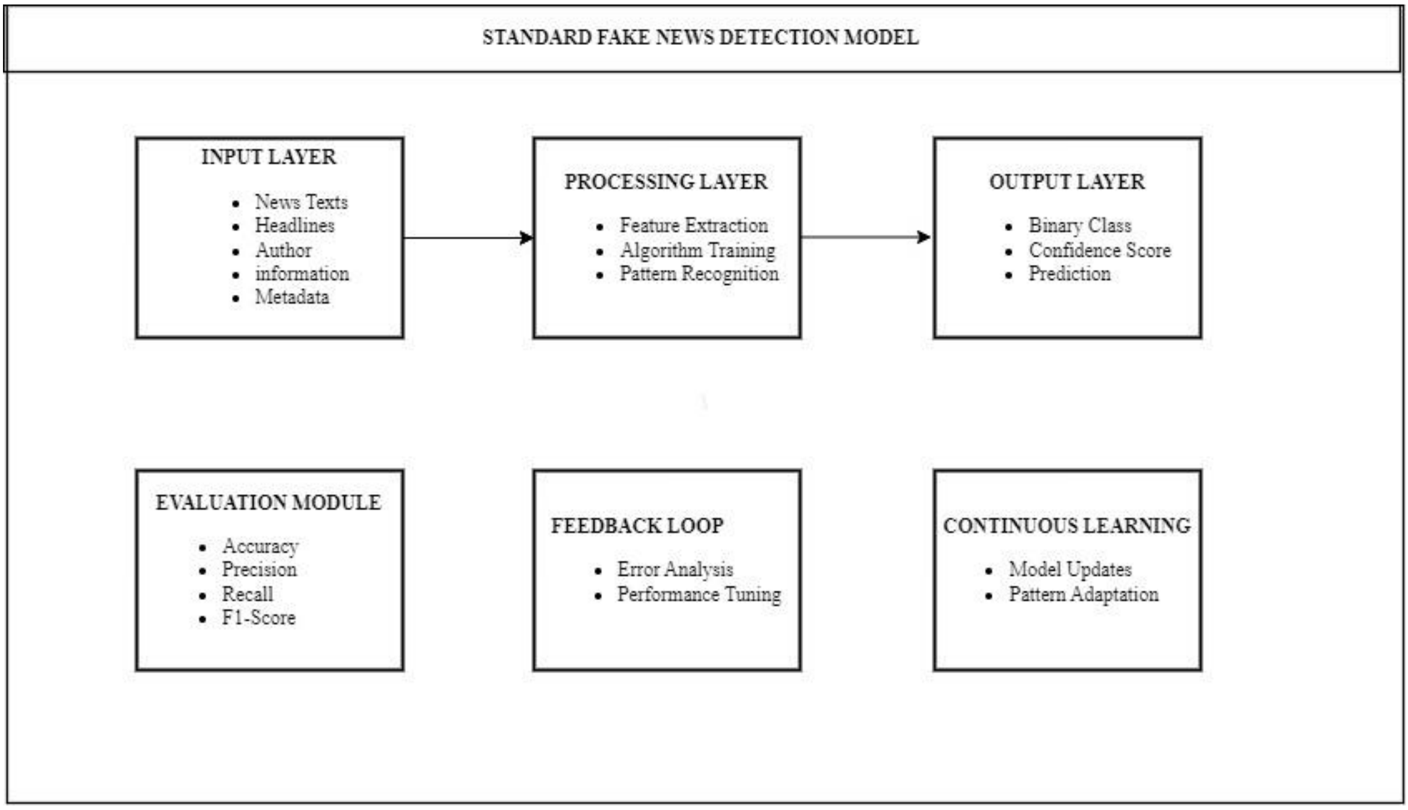

Figure 1. Conceptual Model Framework

2.0 SYSTEM DESIGN AND METHODOLOGY

This presents the design and methodology adopted for developing an enhanced fake news detection system using ensemble machine learning techniques. The developed system integrates multiple classifiers, advanced feature extraction, and optimized ensemble mechanisms to improve accuracy, robustness, and adaptability over conventional models. The methodology emphasizes systematic data preparation, multi-algorithm integration, and thorough evaluation to ensure reliable detection of fake news in diverse textual content.

2.1 Unstructured Interview

Unstructured interviews were conducted with domain experts, including data scientists and information security analysts, to gather insights into common challenges in fake news detection. These discussions informed feature selection, algorithm choice, and performance evaluation strategies. The interviews also highlighted practical considerations for scalability, adaptability, and real-world applicability of the detection framework.

2.1.1 System Requirements Analysis

The system was implemented using widely available computational tools and software environments. Key components included:

- Python Programming Environment for algorithm development and integration.
- Natural Language Toolkit (NLTK) for text preprocessing and tokenization.
- Scikit-learn Framework for model training, evaluation, and ensemble coordination.
- Feature Extraction Tools TF-IDF, Bag-of-Words (BoW), and N-gram analysis to capture semantic and linguistic patterns.
- Kaggle Dataset Platform for access to a comprehensive, labeled news article dataset.
- Hardware requirements were modest, with standard desktop or laptop systems sufficient to execute training and evaluation for datasets of up to 20,800 articles.

2.2 System Design

2.2.1 Model Process Flow

The system design follows a modular, layered architecture to ensure efficiency, scalability, and robustness: Data Management Module Handles acquisition, cleaning, filtering, and storage of news articles. Feature Engine Module Performs advanced feature extraction using TF-IDF, BoW, N-gram analysis, and semantic pattern recognition. Algorithm Engine Module Integrates five machine learning classifiers (Logistic Regression, Decision Tree, Random Forest, SVM, Gradient Boosting) for parallel training. Ensemble Engine Module Coordinates the outputs of multiple classifiers using weighted voting and confidence scoring for final predictions. Evaluation Module Computes accuracy, precision, recall, and F1-score to validate model performance. Output Interface Module Presents classification results, probability scores, and performance reports. This design ensures that the system can handle large-scale datasets, adapt to evolving fake news patterns, and provide reliable, interpretable results suitable for real-world deployment. See Figure 2

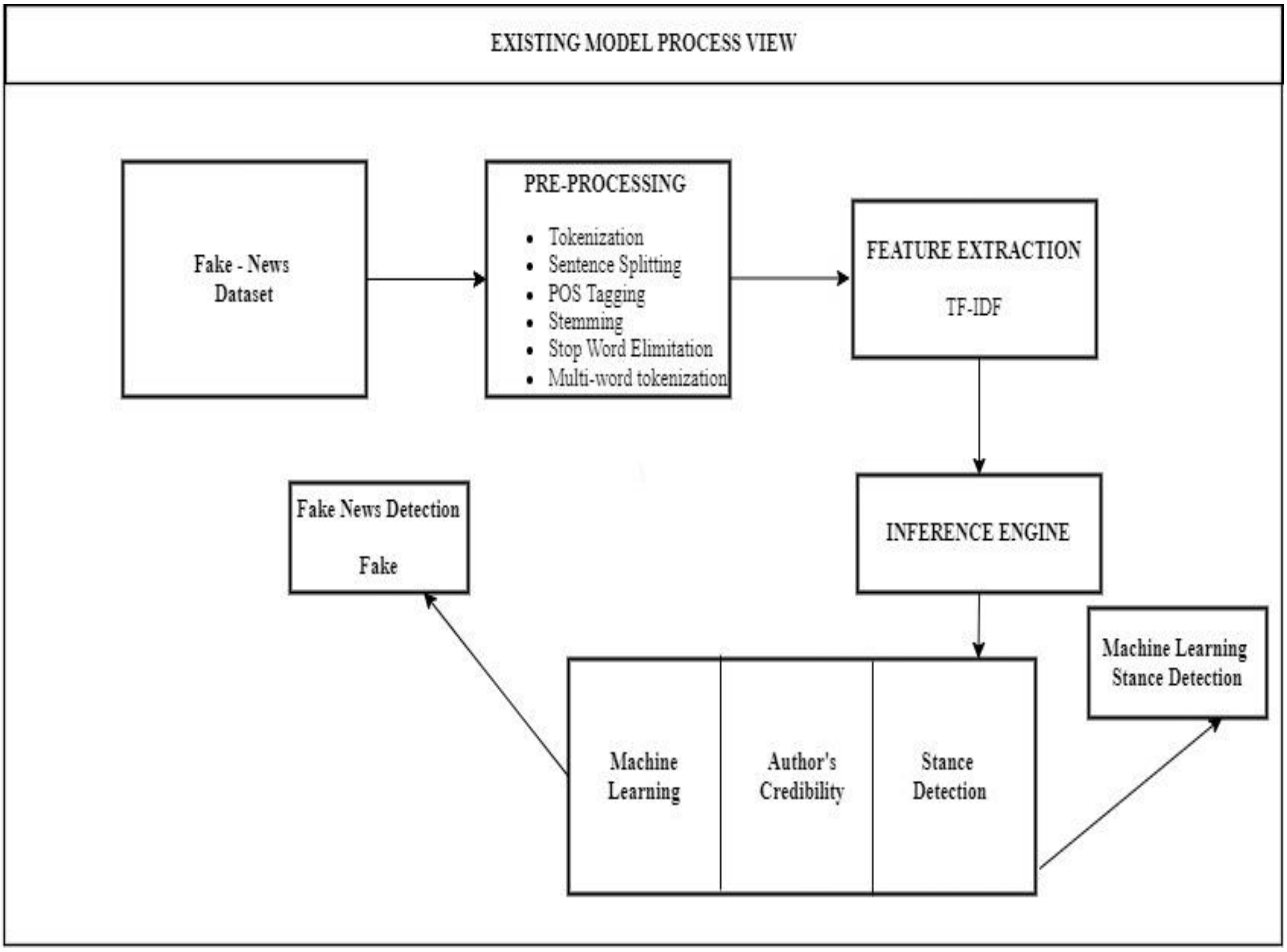

Figure 2 Model Process Flow

2.2.2 Developed Model Process Flow

The functional hierarchy of the proposed enhanced fake news detection model describes a modular system designed for efficient, accurate, and robust classification. At the top level, the Model Controller coordinates all system operations and manages the flow of data across modules. The Data Management Module handles data collection, cleaning, and storage, while the Feature Engine Module converts textual news content into numerical representations using TF-IDF, Bag-of-Words, and N-gram techniques. The Algorithm Engine Module processes these features using multiple machine learning classifiers, and the Ensemble Engine Module integrates their outputs through optimized voting and confidence scoring to produce final decisions. The Evaluation Module measures system performance using standard metrics, and the Output Interface Module delivers classification results and reports. This hierarchical structure ensures scalability, adaptability, and improved detection accuracy over conventional single-model approaches. See Figure 3 & 4

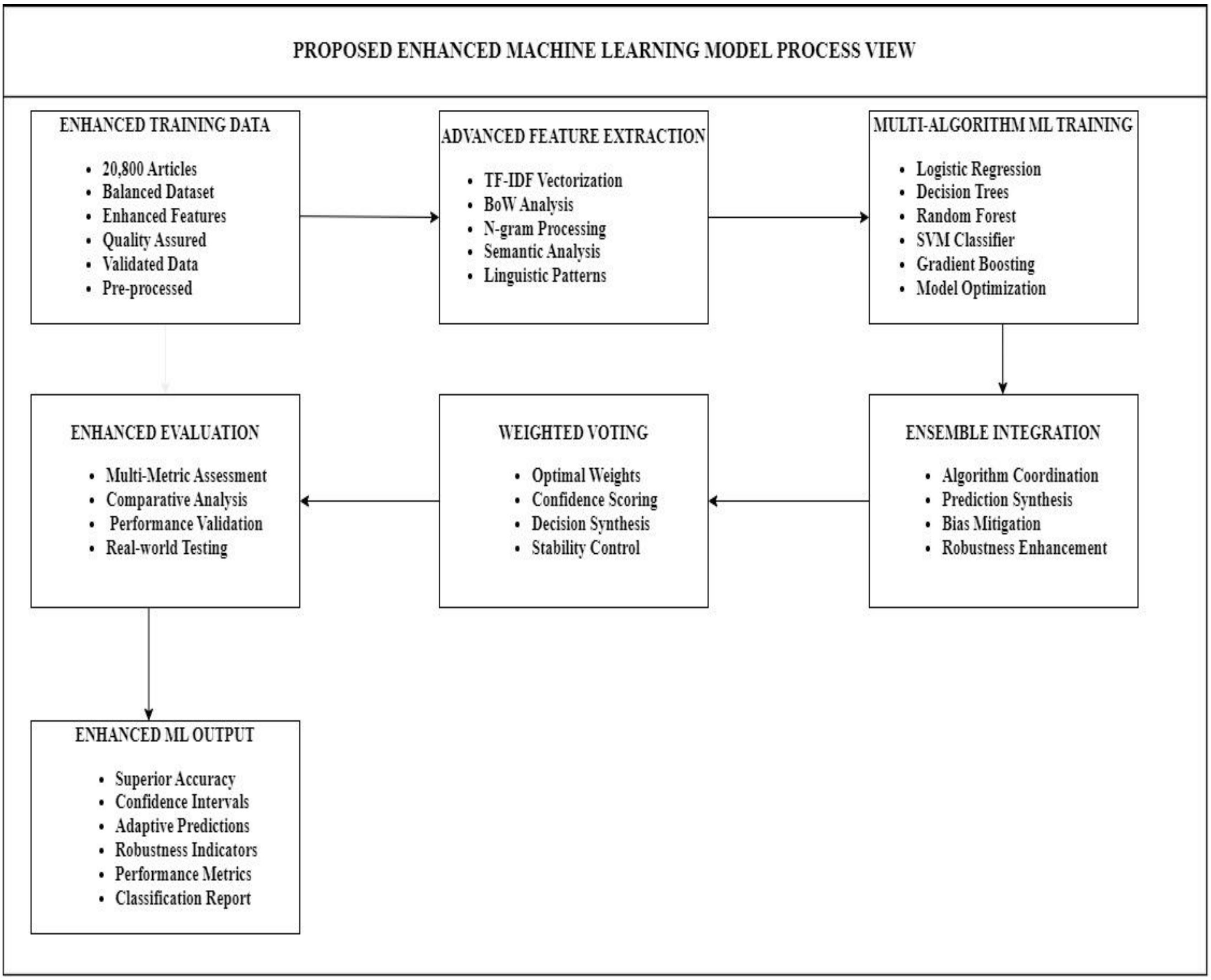

Figure 3. Proposed Model Process Flow above

Figure 4 Functional Hierarchy Diagram

3.0 DATASETS

The study utilizes a Kaggle fake news dataset consisting of 20,809 labeled news articles, each categorized as either real or fake. The dataset provides a balanced and reliable foundation for training and evaluating machine learning models. Before model training, the textual data undergoes preprocessing, including tokenization and stop-word removal, to eliminate irrelevant words and improve learning efficiency. The cleaned text is then transformed into numerical form using Bag-of-Words (BoW), TF-IDF, and N-gram feature extraction techniques, allowing the algorithms to recognize linguistic and semantic patterns.

Five machine learning algorithms Support Vector Machine (SVM), Logistic Regression (LR), Random Forest (RF), Decision Tree (DT), and Gradient Boosting (GB) are trained on the extracted features. Their individual predictions are combined using a majority voting ensemble technique, which selects the

most common prediction as the final output, improving accuracy and robustness. The system performance is evaluated using accuracy, precision, recall, and F1-score, ensuring a comprehensive assessment of classification effectiveness

Table 1: Comparative Analysis of Accuracy on the Training and Testing Dataset

Machine Learning Models	Percentage Accuracy		Average Percentage Accuracy
	Training Set	Testing Set	
Support Vector Machine	99.43%	96.97%	98.20%
Logistic Regression	97.99%	95.43%	96.71%
Random Forest	100%	92.50%	96.25%
Decision Tree	100%	96.42%	98.21%
Gradient Boost	97.01%	96.41%	96.71%
Ensemble Method	**99.83%**	**97.86%**	**98.84%**

Table 2: Comparative Examination of the Six Machine Learning Models

Machine Learning Models	Assessment in Percentages			
	Accuracy	Precision	Recall	F1-score
Support Vector Machine	96.97%	97.00%	97.00%	97.00%
Logistic Regression	95.43%	95.00%	95.00%	95.00%
Random Forest	92.50%	93.00%	93.00%	93.00%
Decision Tree	96.41%	96.00%	96.00%	96.00%
Gradient Boost	96.41%	96.00%	96.00%	96.00%
Ensemble Method	**97.86%**	**98.00%**	**98.00%**	**98.00%**

Table 3: Comparative Analysis of the Improved Model with Existing Models

Authors	Learning Model	Percentage Accuracy
(Agudelo et al., 2018)	Naïve Bayes	89.30%
(Waikhom and Goswami, 2019)	AdaBoost	75.00%
(Ahmad et al., 2020)	Logistic Regression	90.00%
(Yerlekar, 2021)	Naïve Bayes	80.00%
(Ramkissoon and Goodridge, 2022)	Legitimacy	96.90%
Developed Model	**Ensemble Model**	**98.86%**

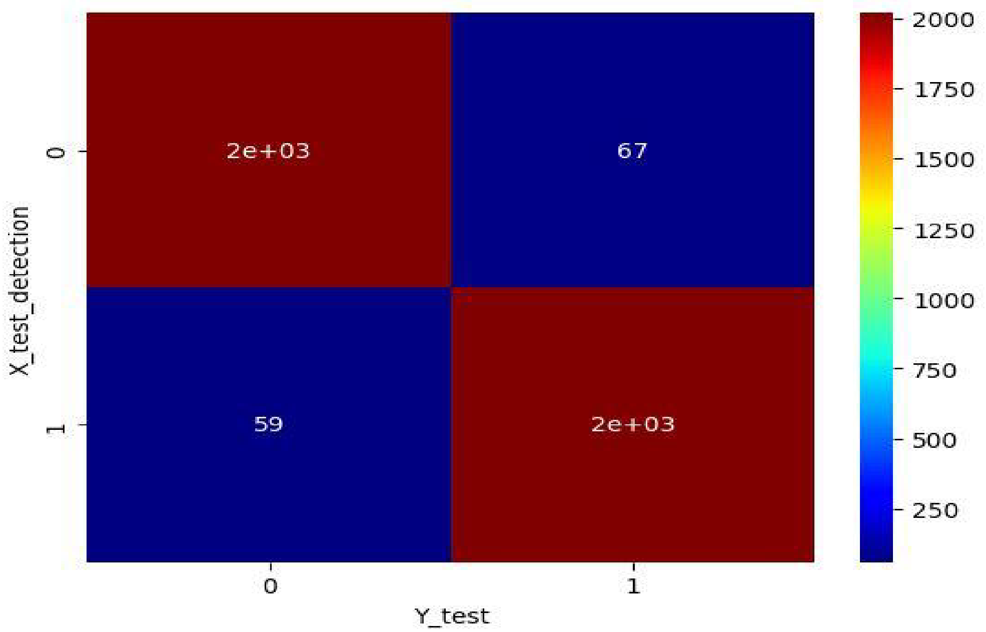

Figure 5 Confusion Matrix for the SVM Algorithm

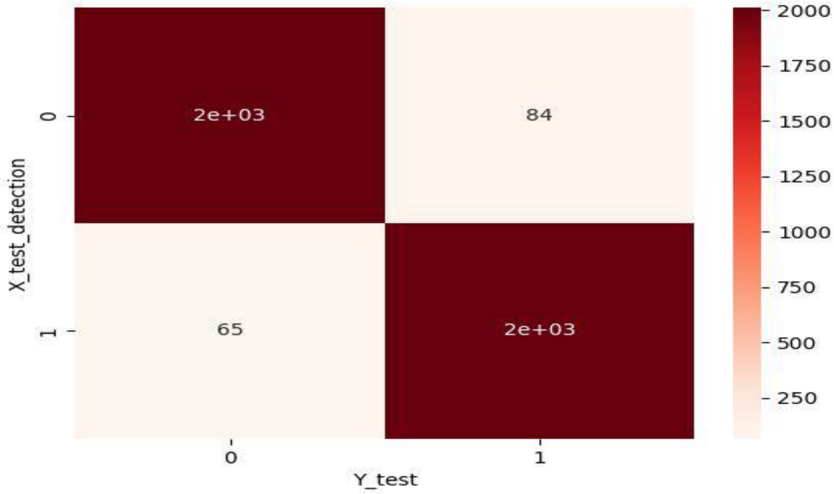

Figure 6 Confusion Matrix for the Decision Tree Algorithm

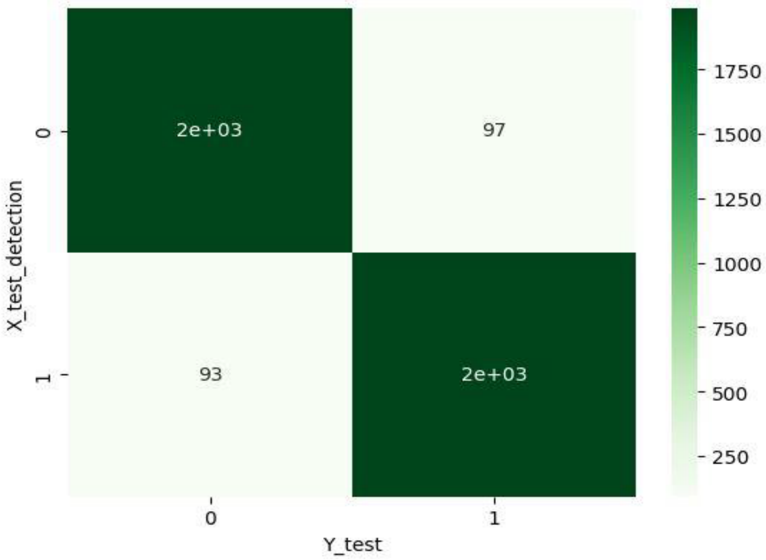

Figure 7 Confusion Matrix for the Logistic Regression Algorithm

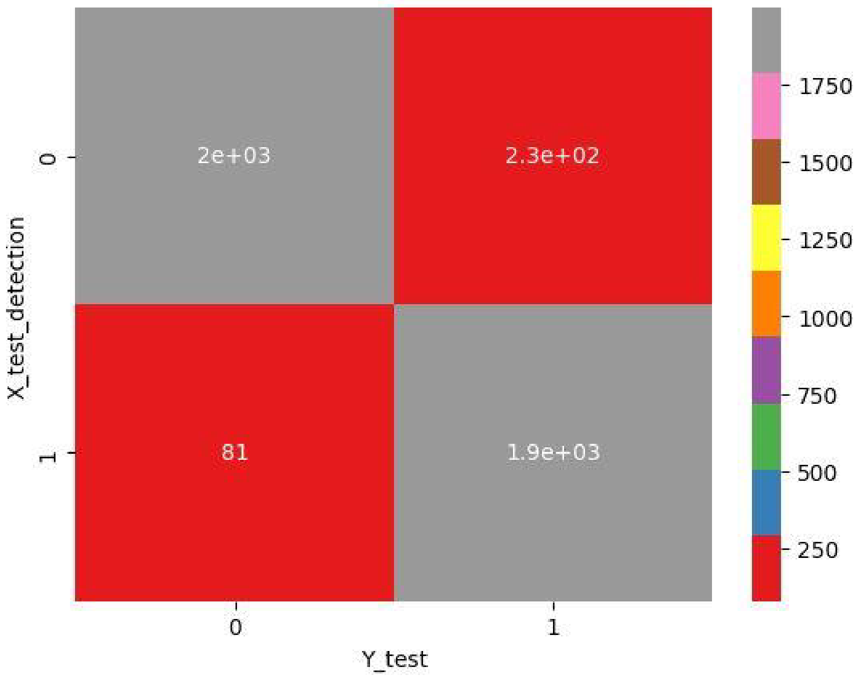

Figure 8 Confusion Matrix for the Random Forest Algorithm

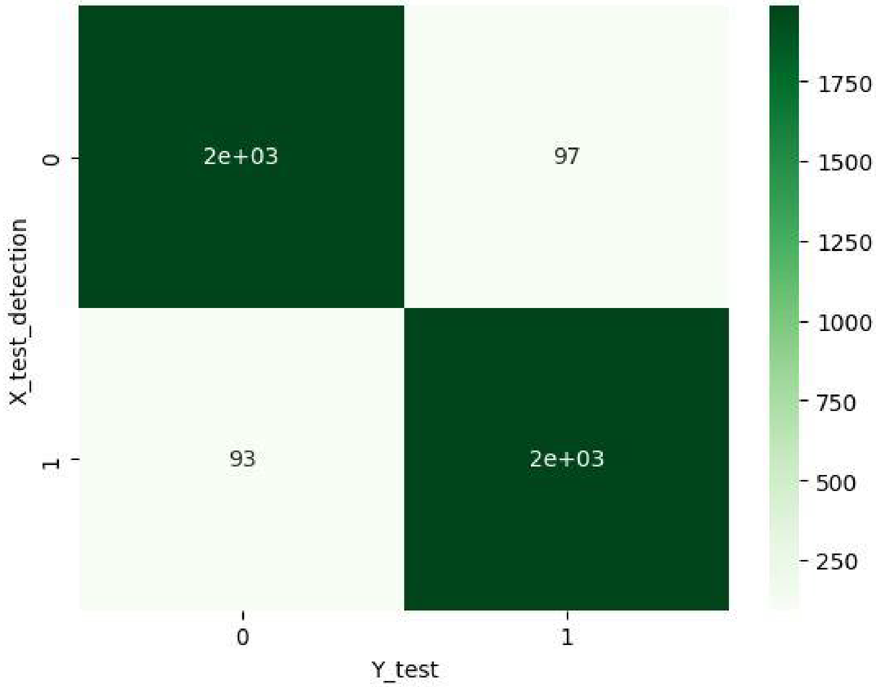

Figure 9 Confusion Matrix for the Gradient Boost Algorithm

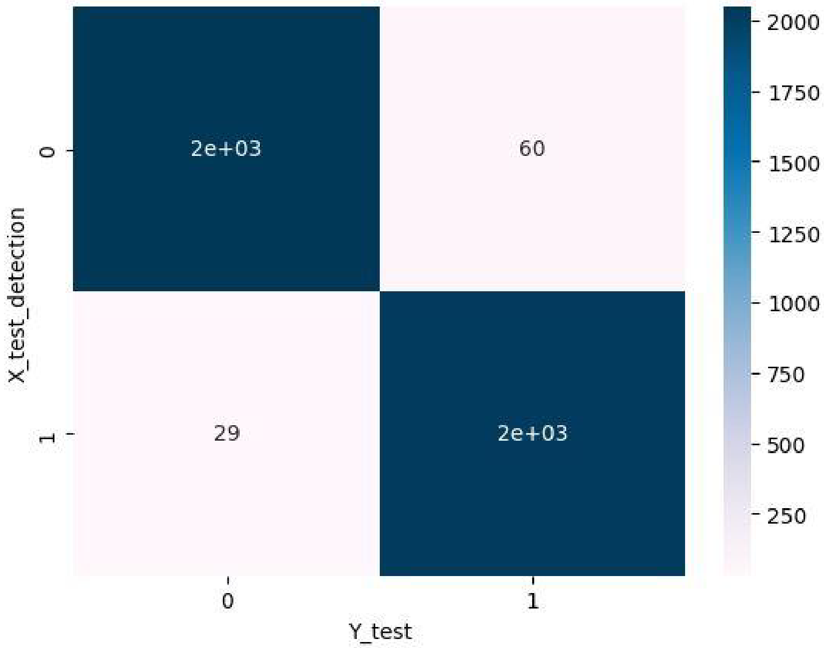

Figure 10 Confusion Matrix for the Integrated Model

The comprehensive analysis of accuracy on training and testing the datasets examines how well machine learning models learn from the training data and how effectively is generalized to unseen testing data. The process compares performance metrics such as accuracy, precision, recall and F1-score across both datasets to identify issues like overfitting or underfitting. This analysis helps determines whether the model is balanced, robust, and reliable. As shown in table 1,2 & 3. Above.

3.1 System Implementation

This phase involves the practical development of the proposed fake news detection system using the Python programming environment. The system was implemented by integrating data preprocessing modules, feature extraction techniques (TF-IDF, Bag-of-Words, and N-grams), multiple machine learning classifiers, and the ensemble voting mechanism. Each component was developed and tested individually before being combined into the complete system to ensure accuracy, efficiency, and reliability.

3.1.1 System Testing

System testing was conducted to verify that the entire fake news detection framework operates correctly and meets the specified performance requirements. The testing process evaluated the interaction between data processing, feature extraction, classification, and ensemble integration. Standard evaluation metrics such as accuracy, precision, recall, and F1-score were used to measure the effectiveness and reliability of the system.

3.1.2 Unit Testing

Unit testing focused on validating the functionality of individual system components, including data preprocessing, feature extraction modules, and each machine learning classifier. Each unit was tested independently to ensure it produced correct outputs before being integrated into the full ensemble system. This approach helped identify and correct errors early, improving system stability and overall performance.

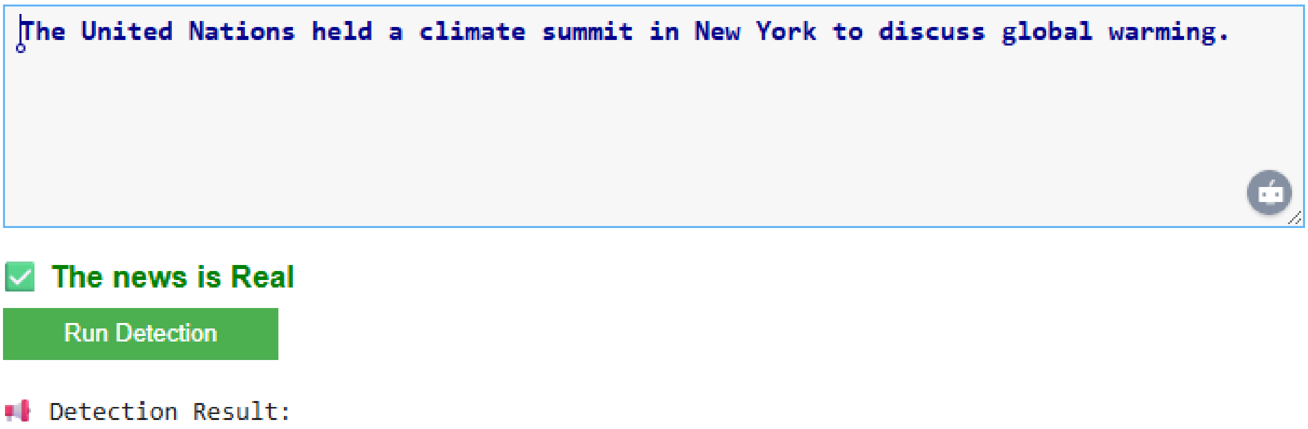

Figure 11 Interface of Real News Detection

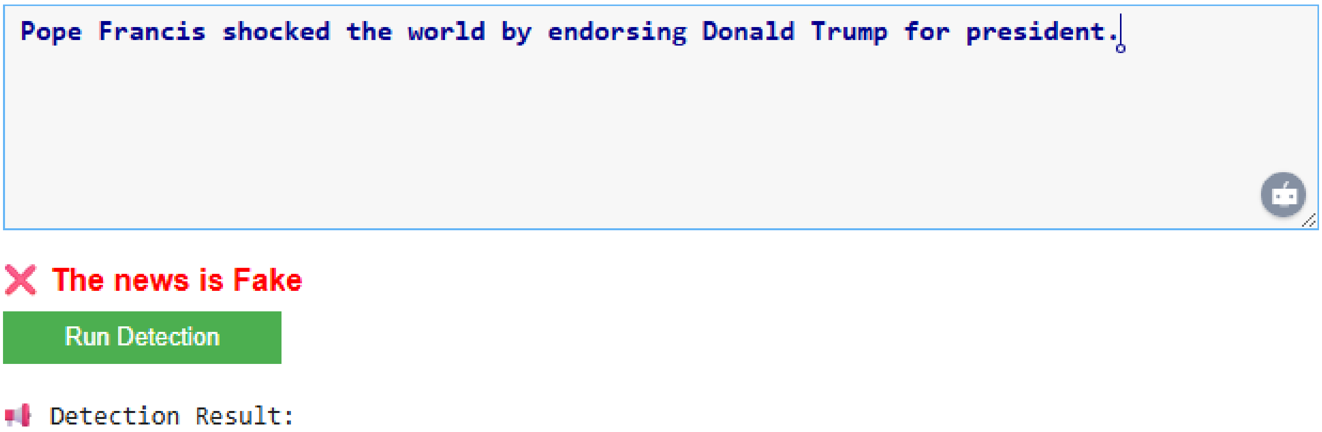

Figure 12 Interface of Fake News Detection

3.2 CONCLUSION

In this Research work, enhanced fake news detection system using multiple machine learning algorithms has been developed to address the limitations of conventional single-classifier models. By integrating multiple machine learning classifiers through an ensemble majority-voting technique and applying advanced feature extraction methods such as TF-IDF, Bag-of-Words, and N-grams, the proposed system achieves higher accuracy, precision, recall, and F1-score. The modular and hierarchical design ensures robustness, scalability, and adaptability to evolving fake news patterns. Overall, the study demonstrates that ensemble-based approaches provide a reliable and practical solution for detecting misinformation across large-scale digital news content.

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About the authors

E.E. Umoh is a lecturer in the department of Computer science, University of Cross River State Calabar. E.E. Umoh holds a B.Sc., MSc and a Ph.D. in Degree in Computer Science

L.A. Ayim is a student in the department of Computer science, University of Cross River State Calabar. **L.A. Ayim** holds a B.Sc. and MSc. Degree in Computer Science.