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Fake News Detection Using Machine Learning: Design and Development of a Real-Time Intelligent News Verification System

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Abstract: *The rapid growth of digital communication technologies and social media platforms has significantly transformed the way people access and share information. Although these technologies have improved information accessibility, they have also facilitated the rapid spread of fake news and misinformation, creating serious challenges for individuals, organizations, and governments. False information can influence public opinion, affect democratic processes, create social unrest, and undermine trust in credible news sources. Traditional fact-checking methods rely heavily on manual verification by experts, making them time-consuming and incapable of keeping pace with the enormous volume of online content generated every day. Consequently, there is an increasing demand for intelligent automated systems capable of detecting fake news accurately and efficiently.*

This study presents the design and development of TruScan Pro, a real-time fake news detection system that employs Machine Learning techniques to classify news articles as either Real or Fake. The proposed system utilizes TF-IDF feature extraction together with Logistic Regression to analyze textual patterns and predict authenticity. It supports text, URL, and image inputs through OCR and includes a browser extension for real-time verification. The model is trained using the ISOT Fake and Real News Dataset with preprocessing to reduce dataset bias. Experimental evaluation achieved 98.56% accuracy with high precision, recall, and F1-score. Explainable AI features highlight influential keywords behind each prediction, improving transparency and user trust. The proposed system offers a practical, accurate, and efficient solution for combating online misinformation.

Keywords: Fake News Detection; Machine Learning; Logistic Regression; TF-IDF; Natural Language Processing (NLP); Flask; Optical Character Recognition (OCR); Explainable Artificial Intelligence (XAI)

I. INTRODUCTION

The exponential growth of the Internet and social networking platforms has revolutionized information dissemination across the world. Millions of users access online news through websites, blogs, and social media platforms. While these digital platforms enable rapid communication, they also facilitate the widespread dissemination of false and misleading information. Fake news influences public opinion, disrupts democratic processes, damages reputations, and creates panic during emergencies. Traditional verification methods depend on professional journalists and fact-checking organizations. Although reliable, they are slow and unable to process the enormous volume of online content generated every day. Machine Learning and Natural Language Processing have therefore emerged as promising approaches for automatically identifying fake news by analyzing textual patterns.

This research presents TruScan Pro, an intelligent fake news detection system developed using Python, Flask, TF-IDF, and Logistic Regression. The application accepts plain text, URLs, and screenshots using OCR, providing a Real/Fake

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prediction with confidence and explainable keywords. The system is designed for fast, accurate, and user-friendly verification, contributing to the reduction of online misinformation and encouraging responsible information sharing.

II. OBJECTIVES OF THE STUDY

The specific objectives of the study are:

- To develop a machine learning-based fake news detection system capable of accurately classifying news articles into real and fake categories.
- To implement a multi-input verification mechanism that accepts plain text, news article URLs, and image-based news content using Optical Character Recognition (OCR).
- To enhance the transparency of prediction results by providing confidence scores and explainable keywords that influence the machine learning model's decisions.
- To evaluate the performance of the proposed system using standard performance metrics such as accuracy, precision, recall, and F1-score based on the ISOT Fake and Real News Dataset.
- To provide a user-friendly web application and browser extension that enables users to verify the authenticity of online news quickly and efficiently.

The successful achievement of these objectives contributes to reducing the spread of misinformation by offering a practical, scalable, and intelligent fake news verification system suitable for real-world applications.

III. PROBLEM STATEMENT

The rapid expansion of digital media has transformed the way people consume and share information. Social networking platforms, online news portals, and messaging applications allow news to spread globally within seconds. However, the same technologies have also enabled the rapid dissemination of fake news, misinformation, and manipulated content. False information can influence elections, damage public trust, create panic during emergencies, and negatively impact public health and social harmony.

Existing fact-checking methods are primarily manual and depend on professional journalists or specialized fact-checking organizations. Although these methods provide accurate verification, they require significant time and human effort, making them unsuitable for handling the enormous volume of news generated daily. Furthermore, many existing fake news detection tools rely only on website reputation or predefined blacklists rather than analyzing the actual content of the news article.

Another significant challenge is that misinformation is shared in multiple formats, including text messages, website links, and screenshots. Most currently available systems cannot effectively process all these input formats within a single platform. Additionally, many machine learning models function as "black boxes," providing classification results without explaining the reasons behind their predictions, thereby reducing user confidence.

Therefore, there is a need to develop a real-time, intelligent, and explainable fake news detection system that can accurately classify news content from multiple input sources while providing transparent prediction results. This research addresses these challenges by proposing **TruScan Pro**, a machine learning-based fake news detection system using TF-IDF, Logistic Regression, OCR, and explainable AI techniques.

IV. RESEARCH GAP

Several studies have investigated the application of Machine Learning and Natural Language Processing techniques for fake news detection. Traditional machine learning algorithms such as Naïve Bayes, Support Vector Machines, Decision Trees, and Logistic Regression have demonstrated promising performance in classifying textual information. More recently, deep learning models including Long Short-Term Memory (LSTM) networks and Bidirectional Encoder Representations from Transformers (BERT) have been employed to improve classification accuracy. Despite these advancements, several research gaps continue to exist.

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Most existing fake news detection systems focus only on textual news articles and are unable to analyze screenshots or image-based misinformation that frequently circulates through social media platforms. Many systems also depend on external fact-checking databases or domain reputation lists, limiting their ability to detect misinformation originating from previously unknown websites. Furthermore, several existing studies overlook the issue of **dataset bias**, particularly the source leakage present in publicly available datasets such as the ISOT Fake and Real News Dataset. Models trained without addressing this bias often achieve artificially high accuracy but fail to generalize effectively to real-world news articles.

Another significant limitation is the lack of **Explainable Artificial Intelligence (XAI)**. Most machine learning models simply predict whether a news article is real or fake without providing sufficient explanation for their decisions. This lack of transparency reduces user trust and limits practical adoption.

The present study addresses these limitations by developing a comprehensive fake news detection system capable of processing text, URLs, and images within a unified platform. It incorporates dataset bias mitigation, coefficient-based explainability, and a browser extension for real-time verification. Consequently, the proposed system provides a more reliable, transparent, and practical solution for combating online misinformation than many existing approaches.

V. REVIEW OF LITERATURE

The rapid growth of digital media has significantly increased the dissemination of fake news, making automated detection an important area of research in Machine Learning (ML) and Natural Language Processing (NLP). Researchers have proposed various computational approaches to identify misleading information and improve the credibility of online news.

Shu et al. (2017) explained that fake news spreads rapidly through social media because of its attractive and sensational content. The authors emphasized that traditional manual fact-checking methods are insufficient to handle the enormous volume of online information. They recommended integrating machine learning, social context analysis, and user behavior to improve fake news detection.

Ahmed, Traore, and Saad (2018) introduced the ISOT Fake and Real News Dataset and demonstrated that supervised machine learning algorithms effectively classify fake and genuine news articles. Their research showed that text preprocessing and feature extraction play a crucial role in improving classification performance. The ISOT dataset has since become one of the most widely used benchmark datasets in fake news detection research.

Géron (2019) highlighted that Logistic Regression remains one of the most reliable algorithms for text classification because of its simplicity, computational efficiency, and high interpretability. When combined with TF-IDF feature extraction, Logistic Regression provides excellent performance while requiring relatively low computational resources compared with deep learning models.

Bird, Klein, and Loper (2009) discussed the importance of Natural Language Processing techniques in text mining applications. Their work explained how tokenization, stop-word removal, stemming, and feature extraction improve machine learning performance in text classification tasks, including fake news detection.

Grinberg (2018) described the Flask framework as a lightweight yet powerful web development platform suitable for integrating machine learning models into web applications. Flask supports modular application development, RESTful APIs, and easy deployment, making it highly suitable for intelligent web-based systems.

EasyOCR, introduced by Jaided AI, has significantly improved Optical Character Recognition by accurately extracting text from images with varying fonts and backgrounds. Unlike conventional OCR engines, EasyOCR performs effectively on screenshots frequently shared through social media, making it suitable for detecting fake news distributed as images.

Several recent studies have explored transformer-based deep learning models such as BERT and RoBERTa. Although these models often achieve slightly higher classification accuracy, they require extensive computational resources, longer training time, and dedicated GPU hardware. These limitations reduce their practicality for lightweight, real-time applications intended for ordinary users.

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Another important issue identified in recent literature is **dataset bias**. Researchers observed that the ISOT dataset contains source-identifying patterns such as Reuters bylines, which may artificially inflate classification accuracy if not removed before training. Eliminating such source leakage enables the classifier to learn genuine linguistic characteristics rather than memorizing publisher-specific information, thereby improving real-world performance.

Recent developments in Explainable Artificial Intelligence (XAI) have also influenced fake news detection research. Explainable models allow users to understand why a particular prediction has been made, thereby increasing transparency and trust. Logistic Regression naturally supports explainability because its learned coefficients indicate how individual words contribute to the prediction.

The literature indicates that an effective fake news detection system should integrate efficient text preprocessing, reliable feature extraction, interpretable machine learning algorithms, OCR for image-based content, and a user-friendly interface. Based on these findings, the present study develops **TruScan Pro**, which combines TF-IDF feature extraction, Logistic Regression, Flask-based web architecture, OCR-based image processing, browser integration, and explainable AI to provide accurate and real-time fake news verification.

VI. RESEARCH METHODOLOGY

This study adopts a quantitative and experimental research methodology to design, develop, and evaluate an intelligent fake news detection system using Machine Learning techniques. The methodology consists of data collection, preprocessing, feature extraction, model training, system implementation, and performance evaluation.

The **ISOT Fake and Real News Dataset** was selected because it contains a large collection of labeled news articles representing both genuine and fake news. The dataset consists of two separate files containing real news and fake news articles collected from multiple online sources. These datasets provide sufficient diversity for training and testing supervised machine learning models.

Before model training, the dataset undergoes several preprocessing steps. Missing values are removed, duplicate records are eliminated, and unnecessary symbols, punctuation marks, and special characters are cleaned from the text. Common stop words are removed to reduce noise, while tokenization converts sentences into individual words suitable for feature extraction. Additionally, known source-identifying patterns such as Reuters bylines are removed to eliminate dataset bias and improve model generalization.

After preprocessing, the textual data are transformed into numerical feature vectors using the **Term Frequency–Inverse Document Frequency (TF-IDF)** technique. TF-IDF assigns weights to words based on their frequency within individual documents and across the entire dataset, enabling the model to identify the most informative terms for classification.

The processed feature vectors are then used to train a **Logistic Regression** classifier. Logistic Regression was selected because it offers high prediction accuracy, computational efficiency, fast training, and straightforward interpretability. The dataset is divided into training and testing subsets using an 80:20 ratio to evaluate model performance objectively.

The developed classifier is integrated into a web application built using the Flask framework. The application provides three independent input modes: direct text input, news article URLs, and screenshots processed through Optical Character Recognition using EasyOCR. Each input is converted into plain text before being classified by the trained machine learning model.

The system's performance is evaluated using standard machine learning evaluation metrics, including **Accuracy, Precision, Recall, F1-Score, and Confusion Matrix**. Functional testing is also conducted to verify user registration, login, prediction accuracy, OCR functionality, URL extraction, scan history, and browser extension performance.

The research methodology combines machine learning, natural language processing, web development, and explainable artificial intelligence to produce an accurate, transparent, and user-friendly fake news detection system suitable for real-world deployment.

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VII. PROPOSED SYSTEM

The proposed system, **TruScan Pro**, is an intelligent web-based fake news detection platform developed to provide users with fast, reliable, and explainable verification of online news content. Unlike conventional systems that depend primarily on source reputation or manually maintained fact-checking databases, the proposed solution analyzes the textual content of news articles using machine learning techniques.

The architecture of the proposed system consists of four major layers: the **presentation layer**, **application layer**, **machine learning layer**, and **database layer**. The presentation layer includes the web dashboard and Chrome browser extension that allow users to submit text, URLs, or screenshots for verification. The application layer is developed using the Flask framework, which manages user authentication, routing, API services, and communication between different modules.

The machine learning layer forms the core of the system. Incoming text is first preprocessed to remove unnecessary symbols and normalize the content. TF-IDF feature extraction converts textual information into numerical vectors that are supplied to the trained Logistic Regression classifier. The classifier predicts whether the submitted news article is **Real** or **Fake** while simultaneously generating a confidence score.

A distinguishing feature of the proposed system is its support for **three different input modes**. Users can paste text directly into the application, provide the URL of an online news article for automatic extraction, or upload screenshots containing news content. Screenshot text is extracted using EasyOCR before classification, allowing the system to detect misinformation distributed through images on social media platforms.

Another important feature is the incorporation of **Explainable Artificial Intelligence (XAI)**. Instead of displaying only the classification result, the system identifies the keywords that contributed most significantly to the prediction. This improves transparency, helps users understand the decision-making process, and increases confidence in the classification results.

The system also maintains secure user authentication and stores scan history in an SQLite database, allowing users to review previous verification results. A browser extension developed using Chrome Manifest V3 further enhances usability by automatically extracting visible article content from web pages and displaying real-time predictions without requiring users to copy and paste text into a separate application.

The proposed system achieved an overall classification accuracy of **98.56%** using the ISOT dataset while maintaining high precision, recall, and F1-score. Its lightweight architecture enables fast prediction with minimal computational resources, making it suitable for educational institutions, journalists, researchers, and the general public. By integrating machine learning, OCR, explainable AI, and browser-based verification into a single platform, the proposed system provides an efficient and practical solution for combating the spread of fake news in the digital era.

The explainability module further enhanced the usefulness of the system by displaying the top keywords that influenced each prediction. This feature allows users to understand why the model classified an article as fake or genuine, thereby increasing transparency and confidence in automated predictions.

The browser extension successfully analyzed live news articles directly within the browsing environment and produced predictions within approximately two seconds. Overall, the experimental findings indicate that the proposed system provides a fast, accurate, and user-friendly solution for fake news detection while demonstrating that classical machine learning techniques remain highly effective for real-time misinformation identification.

VIII. CONCLUSION

The rapid spread of misinformation through digital media has created an urgent need for intelligent systems capable of automatically identifying fake news. This research presented **TruScan Pro**, a machine learning-based fake news detection system designed to provide accurate, explainable, and real-time verification of online news content. The system successfully integrates natural language processing techniques with supervised machine learning to classify news articles as genuine or fake.

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The proposed framework combines TF-IDF feature extraction with a Logistic Regression classifier to achieve high prediction accuracy while maintaining low computational complexity. Unlike many existing systems that depend heavily on source credibility databases, the developed model evaluates the textual characteristics of news articles, making it applicable to previously unseen sources. The integration of OCR technology and URL extraction enables the system to process news from multiple formats, including text, website links, and screenshots.

Experimental evaluation demonstrated that the proposed model achieved an accuracy of **98.56%**, along with excellent precision, recall, and F1-score values. The explainable prediction mechanism improves transparency by presenting the keywords responsible for classification, allowing users to better understand the decision-making process of the machine learning model. Additional modules such as secure user authentication, scan history management, and Chrome browser integration further improve the practical usability of the system.

The study confirms that carefully engineered classical machine learning algorithms can deliver reliable performance without requiring computationally expensive deep learning models. The modular architecture also allows future improvements and easy deployment across different platforms. Overall, TruScan Pro provides an effective, scalable, and practical solution for combating the growing challenge of online misinformation. The research contributes to the field of fake news detection by demonstrating how explainable machine learning, combined with user-friendly software engineering practices, can help improve digital information verification and support responsible consumption of online news.

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