



# Fake News Detection using Natural Language Processing and Ensemble Learning

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**Abstract :** Nowadays, technologies to automatically identify fake news are being actively developed as a result of fake news that rapidly spreads on social media. However, the majority of them focus on the linguistic and compositional characteristics of fake news (e.g., Length of a message, frequency of negative words). This study proposes a fake news detection model based on machine learning which reflects the user characteristics, that of news content, and social networks based on social capital. To generalize the established models, this study performed a cross-validation step and compared the predictive accuracy of the established models. As a result, the highest prediction rate was indicated by the RF model at about 94%, while the NNET had the lowest performance rate at about 92.1%. The results of this study are expected to contribute to improving the fake news detection system in preparation for the more sophisticated generation and spread of fake news. The goal is to enhance the detection system for fake news to prepare for the more advanced generation and dissemination of such content.

**Index Terms -** NLP, Fake News Detection, Social Media, Ensemble Learning

## I. INTRODUCTION

The internet has completely changed how people access and share information, but it has also made it possible for false information to proliferate quickly. Spreading false information that cannot be independently verified and deliberately modified to deceive people is known as fake news. Because of the extensive diffusion of information from several sources brought about by the high internet adoption, it is challenging to determine the credibility of published news. Fake news has been spreading more widely as a result of the COVID-19 epidemic, which has had detrimental effects on patients, healthcare practitioners, and the general public. The goal of this research is to combine feature-based and content-based models to detect fake news in the healthcare industry.

This emphasizes how important it is to deal with the problem of false information on social media. This study compares the effects of internet rumor spread and fundamental predictors using machine learning on social media and numerical data in an effort to fill two holes in the field. Information technology, including robotic surgery, transportation systems, and natural language processing (NLP) applications, has been greatly impacted by artificial intelligence (AI). Nevertheless, there are negative aspects of the digital age, such as the propagation of hate speech and fake news. Ethiopia's government has made legislative declarations in an effort to counteract hate speech and fake news, although Ethiopian languages are still considered "low-resource" languages globally. Since spam can occur in online social networks (OSNs), an unsupervised method for spammer detection is suggested. The problem of bogus reviews demands continuing research to understand and develop workable solutions because dishonest people are always changing their strategies to avoid detection systems. In order to improve fake review identification performance, a psychological model that incorporates deception theories from two perspectives is needed.

Democracies are seriously threatened by the propagation of misleading information on social media platforms because of problems including echo chambers, dishonest actors, algorithmic biases, and human factors. The objective of this project is to classify mainstream and false news in Italy and the US in 2019 by identifying trends on social media platforms based on user interactions. The research employs a logistic regression model to classify news stories from 2019. The inefficiency of current solutions to the challenging problem of detecting false reviews stems from dishonest individuals introducing new features. In order to preserve credibility and enhance user experience, review-writing platforms need to constantly enhance their techniques for detecting bogus reviews. To improve understanding, a psychological model that takes into account deception theories from both angles is required.

## II. LITERATURE SURVEY

Sr No.	Paper	Best Classification Technique	Other Techniques Tested	Dataset	Performance Parameter
1.	CoAID-DEEP: An Optimized Intelligent Framework for Automated Detecting COVID-19 Misleading Information on Twitter [1]	LSTM 98.6%	DT, LR, KNN, RF, SVM, NB, TF-ID with N-Gram	COVID-19 healthcare misinformation Dataset, disaster dataset, PolitiFact dataset, gossip cop dataset	Accuracy, Precision, Recall, F1-measure
2.	Fake Online Reviews: A Unified Detection Model Using Deception Theories [2]	RF 60-65%	RF 75.7%, SVM	YelpChi, YelpNYC, YelpZip	Accuracy, Precision, Recall, F1-Score ROC AUC
3.	Predicting abnormal trading behavior from internet rumor propagation: a machine learning approach [3]	DT 80-90%	LR, k-Nearest Neighbors, SVM	Stocks	Accuracy, Sensitivity, Specificity, Precision, AUC ROC
4.	Detection of fake news and hate speech for Ethiopian languages: a systematic review of the approaches [4]	DL approaches	DL and ML approaches	(Review work)	Accuracy, Precision, Recall, F1-score
5.	An unsupervised method for social network spammer detection based on user information interests [5]	SMD 98.4%	SDPACM, DNNBD, K-Means	Social Honeypot, The Fake Project, Hspam14	Accuracy, Precision, Recall, F1-Measure
6.	Deep vs. Shallow: A Comparative Study of Machine Learning and Deep Learning Approaches for Fake Health News Detection [6]	AdaBoost-RF 98.9%(F1-Score)	DT, RF, SVM, AdaBoost, CNN-LSTM	Fake News Healthcare	Accuracy, Precision, Recall, F1-score
7.	Constructing a User-Centered Fake News Detection Model by Using Classification Algorithms in Machine Learning Techniques [7]	RF	XGBoost, LR, CART, NNET, SVM	Twitter	Accuracy, Precision, Recall, F1-Score, Specificity
8.	A multi-layer approach to disinformation detection in US and Italian news spreading on Twitter [8]	LR 94%	RF	Twitter(US dataset and Italian Dataset)	AUROC, Precision, Recall, F1-score
9.	OPCNN-FAKE: Optimized Convolutional Neural Network for Fake News Detection [9]	OPCNN 90%	TF-IDF, OPCNN-FAKE, SVM, NB, LR, DT, RF, RNN, LSTM	Dataset1(Kaggle), Fake Newsnet(gossipco and politifact), FA-KES5, ISOT(Politifact)	Accuracy, Precision, Recall, F1-score
10.	Fake News Detection: A Study [10]	LightGBM	CARBoost, RNN	ISOT	Accuracy, Precision

Diaa Salama Abdelminaam et. al. proposed optimized machine learning and deep learning systems to detect fake news related to COVID-19 and other datasets. Two feature extraction methods and six machine-learning techniques were used. The data was classified into two categories - fake and non-fake news. It was found that deep learning approaches performed better than machine learning approaches in the three datasets. Therefore, it was recommended to use the Keras-tuned Modified LSTM approach as a deep learning approach for fake news detection. [1]

Mujahed Abdulkader et. al. in their research, synthesized ten well-founded deception theories from psychology and selected nine relevant constructs to develop a unified model for detecting fake online reviews. They characterized the constructs using verbal as well as non-verbal features that were extracted from Yelp datasets and were used to train four machine-learning algorithms. It was concluded that non-verbal features have greater importance than verbal features, and combining features from both types improves prediction performance. [2]

Li-Chen Cheng et. al.'s study took up an innovative approach using social media data and decision tree induction to foretell abnormal stock trading behavior. Robustness checks using logistic regression, k- Nearest Neighbors, and SVM were performed out of which decision trees outperformed them. The results show that rumor propagation outperforms operation shocks and other variables in prognosticating abnormal trading behavior. Further, the random forest improves prediction in all aspects and can be

readily used by financial analysts and governing bodies seeking to achieve and maintain request efficiency and stability. [3]

Wubetu Barud Demilie et. al.'s work aims to analyze the optimal approaches as well as the relationship between them, dataset type, size, and accuracy. The results show that the combination of DL and ML approaches with a balanced dataset can improve the detection and performance of the system. [4]

Darshika Koggalahewa et. al. in their paper "An unsupervised method for social network spammer detection based on user information interests" address the limitations of data labeling and spam drifting through an unsupervised approach. The paper contributes to the introduction of a pure, unsupervised spammer detection approach based on users' peer acceptance. As it is unsupervised, it does not require a labeled dataset. [5]

Tripti Mahara et. al. proposed comparing various models under the categories of Content-Based and Feature-Based Models to find the best-performing model. It was concluded from the results that Adaboost-RF under the Feature-based Model is the best-performing model in comparison with Deep Learning Models. [6]

Minjung Park et. al. proposed a fake news discovery model based on machine learning that reflects the characteristics of users, news content, and social networks grounded on social capital. A cross-validation step was performed to generalize and compare the predictive accuracy of the established models. The results are expected to improve the fake news detection system. [7]

Francesco Pierri et. al. "A multi-layer approach to disinformation detection in US and Italian news spreading on Twitter" highlight differences in the sharing patterns of the news domains that appear to be common in the US and Italy. Their network-based approach provides useful insights that facilitate the future development of a system to detect misleading and harmful information on social media. [8]

Hager Saleh et. al. in their research work, aim to find the optimal model that obtains high-accuracy performance. An optimized Convolutional Neural Network model to detect fake news (OPCNN-FAKE) was proposed. It was concluded that the OPCNN-FAKE model achieved the best performance for each dataset compared with other models. The proposed model will be used to detect COVID-19 fake news. [9]

Mayank Kumar Jain et. al. in their study mentioned that prior research on the identification of fake news in the field of artificial intelligence focused mostly on traditional machine learning techniques. It was concluded that the majority of research articles employed ensemble learning and neural networks to classify fake news. There is also room for improvement which includes the detection of users based on shared interests and behaviors, the use of an ensemble technique yields. [10]

### **III. METHODOLOGY**

In our study on "Fake News Detection," we aim to develop an effective fake news detection system. This section provides an overview of our methodology, which includes data preprocessing, feature extraction, model training, and ensemble techniques.

#### **3.1 Main Dataset**

The main dataset could refer to the primary or central dataset that is the focus of analysis or the one that contains the most critical information for a project. For example, news and Facebook can be our main datasets.

The dataset is divided into two parts:

- 1) Training dataset (70 percent)
- 2) Testing dataset

#### **3.2 Data Preprocessing**

There are different data preprocessing steps that are used, and they are as follows:

##### **3.2.1 Tokenization**

Tokenization in machine learning, and natural language processing (NLP) in particular, is the process of splitting text into smaller units, typically words or subwords, which are called "tokens." Tokenization is one of the fundamental preprocessing steps in NLP, and it is essential for various text analysis tasks. Word\_Tokenize function from NLTK library is used for Tokenization.

##### **3.2.2 Lemmatization**

It is a natural language processing technique used to reduce words to their base or dictionary form, known as the "lemma." The purpose of lemmatization is to standardize words so that different inflected forms or conjugations of a word are treated as a single common base form. This is particularly useful in text analysis, information retrieval, and text mining, as it helps to simplify the analysis of text by reducing words to their canonical or root forms. From nltk.stem, WordNetLemmatizer is used.

##### **3.2.3 Stemming**

It reduces all the variants of a word with a single stem word. It usually includes plural and general forms. Porter Stemmer algorithm from nltk.stem library is used.

### 3.2.4 Stopword Removal

It is defined as the removal of words that occur most frequently in the documents.

It is one of the most commonly used preprocessing steps across different NLP applications. The idea is to remove the words that occur commonly across all the documents in the collection. The stopword usually includes articles, prepositions, conjunctions, and pronouns. Stopwords package from nltk.corpus library is used.

### 3.3 Feature Extraction

It is the process of selecting or transforming the most relevant and informative aspects (features) of the raw data to use as input for a machine-learning model. Features are characteristics or attributes of the data that help the model understand and make predictions or classifications. It is an essential step in the data preprocessing pipeline and plays a key role in the performance of algorithms. It includes mainly TF-IDF with N-Gram.

### 3.4 Ensemble Learning

Ensemble methods are powerful because they leverage the wisdom of the crowd, combining the strengths of multiple models while mitigating their weaknesses. They are effective for improving predictive accuracy, reducing overfitting, and handling complex and noisy datasets. The choice of the ensemble method depends on the specific problem and dataset characteristics. Cross-validation is one of the ensemble learning methods.

Different Cross Validation Techniques:

- a) 5-fold cross-validation
- b) 10-fold cross-validation
- c) 15-fold cross-validation

We have proposed two different algorithms that can be used in systems and have the highest accuracy. Those are Random Forest and Support Vector Machine. Both algorithms can be trained using the supervised learning method.

#### *Random Forest*

It includes a random selection of k features from total m features where k is less than m in order to construct n decision tree. Then taking the test vector and using each randomly created decision tree to predict the outcome and then store the predicted outcome. After that calculating the votes for each predicted output takes place and hence finally the highly voted predicted outcome is considered as the final predicted output given by the random forest algorithm. From sklearn.ensemble library random forest package is used.

#### *Support Vector Machine*

Support Vector Machine (SVM) is an algorithm used for both classification and regression. They can be used for various tasks, such as classification of text, image classification, spam detection, handwriting identification, face detection, etc. svm package from sklearn library is used.

### 3.5 Evaluation measures and accuracy precision Accuracy

It is an evaluation metric that lets us measure the total number of correct predictions.

#### Precision

It explains how many of the correctly predicted cases turn out to be positive.

#### Recall

It defines the number of actual positive cases that were able to be predicted correctly with a model.

#### F1 Score

The harmonic mean is calculated between recall and precision.

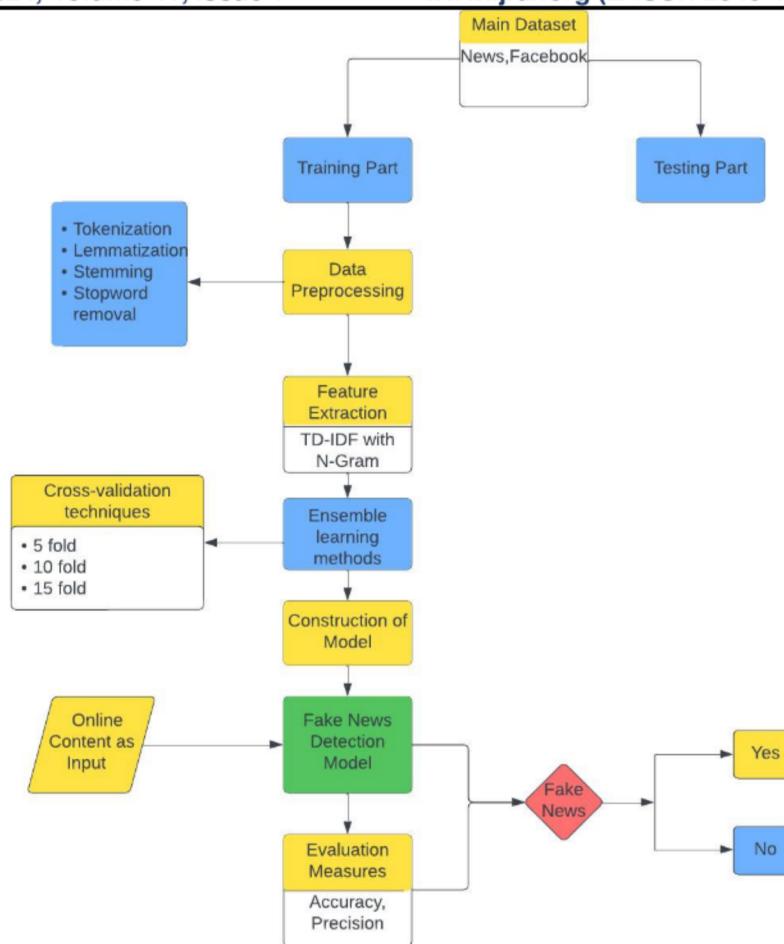


Figure 1. System Architecture

#### IV. CONCLUSION

In this study, we proposed a model based on ensemble learning for the detection of fake news on social media. From the literature survey, it was found that algorithms such as Random Forest and Support Vector Machine give the highest accuracy for fake review detection. Thus, in our ensemble learning model, we have used the above mentioned algorithms. Furthermore, we have incorporated the experimentation with various cross-validation techniques, such as 5 fold, 10 and 15 fold cross-validation.

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