

# Fake News Detection using Natural Language Processing

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**Abstract**—Fake news have become a major concern in today's digital world, false information that can harm our society democracy, and individual well-being and even entire nations which is a challenging aspect. Identifying and stopping the of such misinformation represents a significant challenge that requires effective solutions.

To stop the spread of fake news, we need to find ways to detect it. This research looks at using computer programs to analyze text and figure out if it's true or false. We're using special techniques called Natural Language Processing techniques like Tf-Idf, POS tagging, NER for English and Telugu languages to help us do this.

The evaluation of various NLP models have done using a large datasets which we scraped from online RSS feeds for both languages. In this work, we have implemented Logistic regression and K-nearest neighbours( K-NN) for english and Support Vector Machines(SVM) and K-nearest neighbours( K-NN) for telugu.

The results show that Logistic Regression achieved an accuracy rate of 89.3% for the English language, thus proving its effectiveness in this classification task. Moreover, the results section includes further performance metrics and a comparative analysis of K-NN results for both languages, thereby underlining the benefits and challenges related to detecting fake news in various linguistic contexts.

This research will show the potential in the use of natural language processing techniques, based on specific datasets, in pursuit of effective detection of false news in a multilingual framework, thus improving existing literature focused on combating misinformation.

## Keywords :

Natural Language Processing, Parts of Speech Tagging, Named Entity Recognition, Term Frequency-Inverse Document Frequency, Feature Engineering, Model Building, Prediction

## 1. Introduction

Fake news refers to false or misleading information presented as news. It can take many forms including misleading headlines, clickbaits, unverified claims, and manipulated

stories including created stories. With the widespread of social media, it is easy to mislead or create stories. The consequences of fake news can be severe influencing public opinion and causing harm to even large nations. Fake news can spread through various channels including social media platforms, news websites, blogs and online forums and discussion groups.

To solve above mentioned problems, we designed a ml model using nlp techniques to detect fake news using large datasets in telugu and english.

We scraped online web articles in both languages to create a dataset and labelled as true or fake, our model will identify key features like parts of speech, named entity recognition, term frequency-inverse document frequency and pattern recognition our model will detect the article as true or fake.

The system will be assessed against other current techniques for fake news identification using common measures including accuracy, precision, recall, and F1 score. By helping to create a solution to the fake news problem, this paper has the potential to have a big influence.

## 1.1. Motivation

**Real-World Relevance:** Fake news is a pervasive problem that affects individuals, societies, and even nations. With the widespread use of social media, misinformation spreads quickly, leading to confusion, panic, and sometimes harmful actions.

**Broad Applicability:** The techniques and models developed for this project can be applied to various other domains where information accuracy is critical, such as detecting spam, identifying biased content.

## 2. State of the art/Background

Paper [1] : "Identifying Fake News on Social Networks Based on Natural Language Processing: Trends and Challenges" by Nicollas R. de Oliveira, Pedro S. Pisa, Martin Andreoni Lopez, Dianne Scherly V. de Medeiros and Diogo M. F. Mattos. This paper contributes by defining fake news in contrast to related false information, categorizing traditional fake news detection processes with key datasets and

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features, discussing vectorization schemes for converting text into mathematical data, and highlighting research opportunities in fake news detection, with a focus on solutions leveraging Natural Language Processing techniques.

Paper [2] : "Hoax detection and review analysis using machine learning" by A. Ramachandran, Hari Narayanan N, and F.A. Kulam Magdoo 2022, The combination of Aggressive Classifier and Bidirectional Encoder Representations from Transformers(BERT) is applied in hoax detection and analysis of reviews. This aggregate predicts false news with excellent accuracy according to their findings. In most classifiers except for Decision Tree, great accuracy levels were observed. These result have shown that the high accuracies are related to how well accuracy and efficiency would define fake and real news.

Paper [3]: "Thai Fake News Detection Based on Information Retrieval, Natural Language Processing and Machine Learning" by Phayung Meesad .This research introduces a new robust framework for Thai fake news detection, which includes modules of Information Retrieval(I.R), Natural Language Processing(NLP), and Machine Learning(ML). Some of the key contributions are the development of a feature selection algorithm for natural language analysis, creation of a labeled dataset of Thai news articles, which are either fake, real, or suspicious, and the development of an online Thai fake news detection web application. The Long Short-Term Memory (LSTM) model demonstrated superior performance, achieving 100% accuracy, precision, recall, and F-measure on the test set, surpassing traditional machine learning models.

Paper [4] : "Optimization and improvement of fake news detection using deep learning approaches for societal benefit" by Tavishee Chauhan , Hemant Palivela . This paper proposes a deep learning and machine learning - based Long Short-Term Memory(LSTM) model for detecting fake news,(even it can true news) leveraging GloVe(i.e GloVe is an unsupervised learning algorithm for obtaining vector representations for words) word embeddings and tokenization for feature extraction. The model achieved 99.88% accuracy, surpassing well known - transformers like FakeBERT (98.90%), DeepFakeE (88.64%), EchoFakeD (92.30%), and Adaptive Salp Swarm Optimization (99.50%). Its uniqueness lies in the effective use of LSTM architecture and GloVe embeddings for classification.

Paper [5] : "Fake News Detection using Machine Learning Algorithms " by Uma Sharma, Sidarth Saran, Shankar M. Patil . The paper explains a system(model) to detect fake news using machine learning algorithms, including well-known models like Naive Bayes, Random Forest, and Logistic Regression. They tested these on the LIAR dataset and achieved a classification accuracy of about 65% with the best model being Logistic Regression. They used grid search optimization which is hyper-parameter to tuning and find the

good parameters, which provide high accuracy to optimize the Logistic Regression model and further improved the accuracy up to 75%. This paper also discusses a dynamic system that uses a Passive Aggressive Classifier to achieve an accuracy of 93%. The uniqueness of this paper is in the use of multiple machine learning algorithms and the dynamic system that allows users to check the authenticity of news articles and website sources.

Paper [6] : "Detection of Fake News Using Machine Learning and Natural Language Processing Algorithms" by Noshin Nirvana Prachi, Md. Habibullah, Md. Emanul Haque Rafi, Evan Alam, and Riasat Khan .In this paper, it discusses designing a multiple variety of machine learning(ML), deep learning(DL), and natural language processing(NLP) techniques for automatic fake news detection. Authors Noshin Nirvana Prachi, Md. Habibullah, Md. Emanul Haque Rafi, Evan Alam, and Riasat Khan implemented logistic regression, decision tree, naive Bayes, support vector machine, long short-term memory (LSTM), and bidirectional encoder representation from transformers (BERT) models. The BERT-based NLP model obtained the highest accuracy of 98%, surpassing all other techniques as well as previous works. The novelty of this work is the use of the BERT model for effective fake news detection.

Paper [7] : "Analysis of Classifiers for Fake News Detection" byVasuAgarwala, H.ParveenSultanaa ,SrijanMalhotraa , AmitrajitSarkarb . This paper shows a system to detect fake news using natural language processing and machine learning. It includes feature extraction using bag-of-words, n-grams, count vectorizer, and TF-IDF, and testing of five classifiers: Naive Bayes, Logistic Regression, Linear SVM, Stochastic Gradient Classifier, and Random Forest; and it tested five different types of classifiers with SVM found the best for LIAR. The model did better for US politics and economics-related news because of the focus of the dataset, and future enhancements could be POS tagging, word2vec, and topic modeling to improve performance across a broader topic.

Paper [8] : "Fake News Detection using NLP" by Mohammed Ali Shaik , Makkaji Yasha Sree , Sanka Sri Vyshnavi , Thogiti Ganesh , Dasari Sushmitha , Narmetta Shreya . This paper, proposed by researchers from SR University, Warangal, presents a machine learning model for fake news detection using logistic regression, decision tree, random forest, and passive-aggressive algorithms to evaluate news content and aesthetics, where the passive-aggressive algorithm has the highest accuracy at 97.86% on a large dataset, surpassing existing systems and showing the potential of these techniques to address fake news challenges.

Paper [9] : "Efficiency of fake news detection with text Classification using Natural Language Processing" by Salman al farisy, Felik hidayat, Muhammad hanif az-farezat,Ghinaa zain nabilah , Rojali . The paper investigates

the efficiency of fake news detection using text classification and natural language processing (NLP) techniques. It explores the application of various NLP algorithms, including Naive Bayes, Random Forest, Logistic Regression, Decision Tree, and XGBoost, to identify and classify news articles as real or fake. The study evaluates the performance of these algorithms using a comprehensive dataset. The results show that the XGBoost and Decision Tree algorithms performed the best, achieving accuracy scores of 99.76% and 99.53% respectively in detecting fake news. The paper highlights the promising potential of NLP-based text classification methods for effectively and efficiently identifying fake news. The findings contribute to the ongoing efforts to combat the spread of misinformation and improve the reliability of information in the digital age.

Paper [10] : "Fake News Detection using Natural Language Processing and TensorFlow in IoT System" by Vivek Veeraiah<sup>1</sup>, Dr. Ravikumar G.K., Dr. Veera Talukdar, Dr. Shaziya Islam, Dr. Sudhir Sharma, Rajesh Tulasia, Ankur Gupta. This paper presents a fake news detection system by using NLP and the TensorFlow deep learning framework in an IoT environment. The multi-stage approach that consists of data collection, feature engineering, model selection, training, and evaluation is proposed. In this research work, the LSTM, BERT, and RoBERTa models were experimented, and it has been found that the performance is better in terms of accuracy in the case of the RoBERTa model. A comparison of accuracies on different models for training reveals that RoBERTa systematically beats LSTM as well as BERT while BERT reports an accuracy of 95.33%, 94.55%, and 94.07% in comparison, RoBERTa results for the dataset have achieved accuracy up to 98.78%, 98.19%, and 97.51%. This paper proposes using NLP and Machine learning techniques like TensorFlow for content-based analysis and discovering patterns related to the spread of fake news. Its novelty is noted in the integration of deep learning models and advanced NLP techniques within the context of IoT, hence making it innovative and comprehensive.

Paper [11] : "A Comprehensive Review on Fake News Detection With Deep Learning" by M.F. Mridha (Senior Member, IEEE), Ashfia jannat keya, MD. Abdul hamid, Muhamma mostafa monowar and MD. Saifur rahman. The paper gives an overall review of deep learning-based techniques for fake news detection, including CNNs at 98.3%, RNNs at 96.3%, GNNs at 94.1%, GANs, Attention Mechanisms, and BERT at 98.9%. The authors discuss the merits of deep learning over traditional machine learning methods and cover the datasets, NLP techniques, and evaluation metrics used in previous research. The authors suggest several future research directions, including feature engineering, visual data incorporation, and multi-modal approaches. This paper is published in IEEE Access and provides a comprehensive overview of the state-of-the-art in deep learning-based fake news detection.

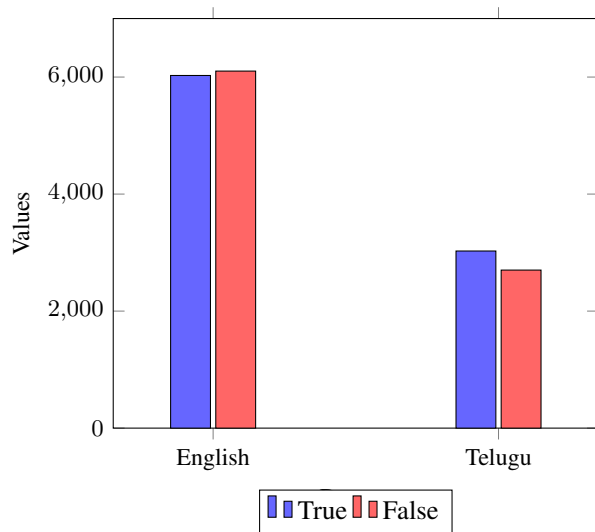
Paper [12] : "Sentiment Analysis for Fake News Detection" by Miguel A. Alonso, David Vilares, Carlos Gómez-Rodríguez and Jesús Vilares. The paper covers the topic of using sentiment analysis in detecting fake news. The two approaches taken are as follows: 1) Systems that are based on sentiment analysis but complemented by other features, and 2) Systems based on sentiment analysis as just one of the features together with other textual and contextual features. This paper points out the hard things in this field, like multilingual support, handling multimedia content, detecting subtle forms of fake news, and ensuring fairness and explainability of the detection systems. On the whole, the paper provides a very detailed survey of the state-of-the-art in using sentiment analysis for fake news detection.

### 3. Proposed System

The system to be adopted is based on the need for a robust framework with identification of news content against fraudulent ones. In developing this, NLP methods would be adopted. Advanced preprocessing operations like lemmatization, stemming, parts of speech tagging (POS), named entity recognition (NER), and term frequency-inverse document frequency (TF-IDF) would be used while extracting significant attributes from newsgroups. The important features are extracted by another technique known as PCA and the obtained features are used by different machine learning algorithms so that the process of getting articles classified as either true or false is done very accurately where Logistic Regression, SVM as well as KNN etc. are used to classify between true and false. Also, our developed system underlines its multilingual property by processing datasets in both English and Telugu, thereby ensuring enhanced applicability and reliability.

#### 3.1. Data Collection

A total of 12,000 news stories were collected using Python scripts from across a variety of diverse news websites such as BBC, News18, India Today and Deccan Chronicle for articles in English news content, and Eenadu, NTV, and TV9 for Telugu news articles. After the collection process, we categorized all identified articles as fake news. For the reduction of biasing the model, we increased our dataset by including extra data on fake news from the Kaggle platform.



### 3.2. Data pre processing

In data preprocessing, the following steps are implemented:

**Tokenization:** In tokenization, text is broken into smaller units, called tokens, to make it easier for machines and models to process.

We use `.split()` function to tokenize, where data is split where spaces are present.

**Lowercasing:** Lowercasing is the process of converting the text to lowercase letters. It is done to standardize the format of text, making it easier to analyze.

We used `.lower()` function to lowercase the tokens.

**Removing non alphabetic characters:** Punctuations, URL's and irrelevant symbols are replaced with white spaces or an empty string. This is used for data cleaning, where the text is prepared for analysis, by removing unnecessary noise.

`isalpha()` function is used to check and remove the punctuation, URLs, and irrelevant symbols.

**Stop-word removal:** Stop words are commonly used words in a language that are removed from text before it is used for future analysis. Stopwords don't usually carry much meaning on their own. They are filtered out from a stop list.

A predefined list of stopwords was defined, to check and remove the stopwords.

**Lemmatization:** Lemmatization is the process of reducing words to their base form, or lemma, to make them easier to analyse. For example, "runs," "running," and "ran" would be lemmatized to "run".

We implemented rule based lemmatization, where the words are converted to lemma based on a pre-defined set of rules.

### 3.3. Feature extraction

Principal Component Analysis (PCA) is a technique for reducing the dimension of the data, transforming the dataset

into a new coordinate system defined by the principal components. The principal components are linear combinations of the original features and describe the maximum variance in the data. PCA reduces the variance space of the original dataset, keeping the most significant variation, hence it is computationally efficient without loss of important information.

Additional techniques used in the extraction of features of text data include:

- **TF-IDF:** This was applied to count the words in text according to their frequency over a set of documents.
- Pre-trained word embeddings such as Word2Vec, GloVe, and contextual embeddings including BERT were used to represent words in a continuous vector space, reflecting their semantic relationships.
- **N-Grams:** N-grams were added for better understanding the significance of word sequences as this considers combinations of consecutive words for better contextual understanding. Such methods collectively enhance the representation of features that will facilitate more robust and accurate analysis.

### 3.4. Model Development - Training

**3.4.1. Key Terms :. Named Entity Recognition:** In Named Entity recognition the data in the dataset is divided into persons, locations, Organizations and Languages. It counts how many of these words are belong to each dataset and what are those based on the last letter of the words and what are those words in the data frame.

**Lemmatization and Stemming:** In Lemmatization the data in data sets will be reduced to the base form of the word if possible or it will remove few letters of the word and at the end and give us the words and in stemming part the words are converted to base form of the word based on the rules for each language given.

**Parts of Speech Tagging:** In Parts of Speech Tagging the data in the dataset is classified into the words based on their grammar of the language for english and telugu. Suffix based POS tagging is done lu, gam, mallu,etc are taken as noun. tuna, chadam, tadu,etc for the verbs and maina, chinna, gala,etc are taken for Adjectives for the telugu language and after that we are counting how many of these words belong to each parts of speech. Similarly in English there are some suffixes for nouns,verbs,adjectives and adverbs.and their are only seven pronouns in the language we can mention and give the POS tagging for English Version

**Stop Word Removal:** Stop Word Removal means where we remove the most commonly occurring words in the corpus and give us the dataset without the stop words which occur very rapidly and effect the working of the model so we mention these stop words and remove them.

**Term Frequency-Inverse Document Frequency:** In TF-IDF What is happening is we are checking the impor-

tance of the word Which is Inverse document Frequency and how many times the words are repeating in the corpus Which is Term Frequency. The lower the value of Inverse Document Frequency which reduces the importance of the word in the code and we can keep those words not to play major role in the working of the model.

### 3.5. Evaluation Metrics

The models were evaluated using metrics such as accuracy, precision, recall, F1-score, and the confusion matrix to assess true positives, true negatives, false positives, and false negatives. Additionally, ROC-AUC was used to gauge classification performance, and k-fold cross-validation ensured reliable performance assessment.

Actual Positive	False Positive (FP) <b>FP</b>	True Positive (TP) <b>TP</b>
	True Negative (TN) <b>TN</b>	False Negative (FN) <b>FN</b>
Actual Negative	Predicted Negative	Predicted Positive

**3.5.1. Accuracy.** Accuracy(A) is defined as the fraction of correct prediction out of all predictions made.

$$A = \frac{TP + TN}{TP + TN + FP + FN}$$

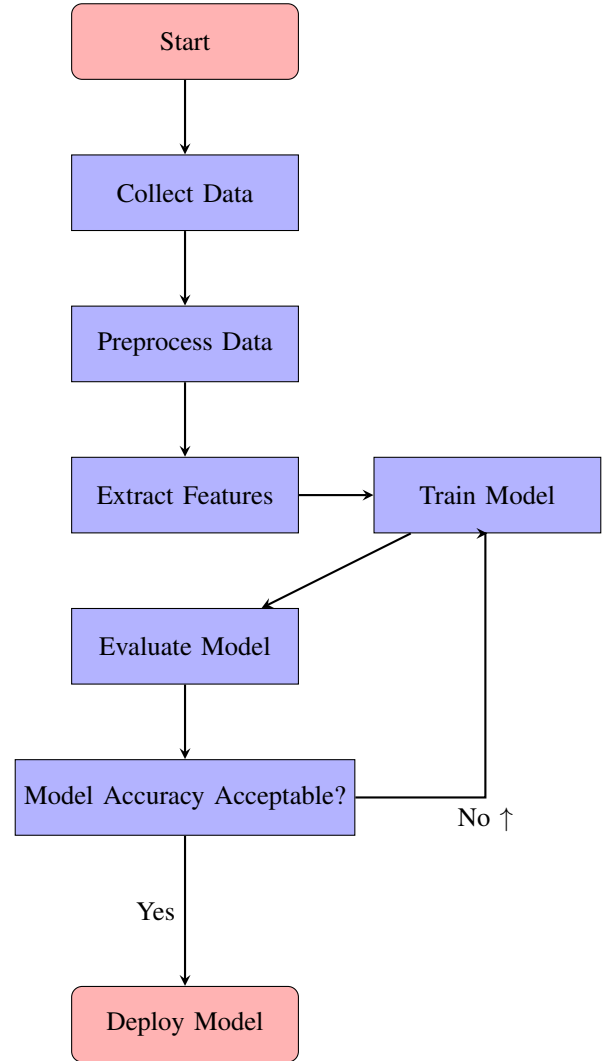
**3.5.2. Precision.** The precision(P) rate percentage of the truly classified positive cases out of all the positives classified.

$$P = \frac{TP}{TP + FP} \times 100$$

**3.5.3. Recall.** Recall (R) - the percentage of correct predictions made by the model of actual positive cases.

$$R = \frac{TP}{TP + FN} \times 100$$

### 3.6. Flowchart of the Model



## 4. Results

### Logistic Regression

Logistic Regression is a type of statistical analysis that is often used for predictive modeling. In this approach, the dependent variable is finite or categorical, it can be either A or B (binary regression) or multiple choices such as A, B, C or D (multinomial regression). The Logistic Regression method can be used to detect hoax news by going through several stages, namely data collection, the tokenization process, the modeling phase, the evaluation phase, to the deployment phase. The Logistic Regression method can be used to detect fake news with an accuracy of up to **89.3%** for english news In addition, this method can also be used to compare the accuracy of text properties with the Support Vector Machine (SVM) algorithm.

### K Nearest Neighbours

K-Nearest Neighbors (k-NN) is a clustering technique based on closeness or similarity between data points. This technique relies on the assumption that similar data points are found nearby each other in the feature space. The way the k-NN classifier works is by finding the k nearest data points (neighbors) to a given input and classifying based on the majority class of these neighbors.

Fake news detection using k-NN Fake news detection is another area where k-NN can be identified. Feature extraction, data collection, classification phase, evaluation phase, and deployment phase. Based upon the analysis of the model that is created, we can say this model can be useful for the prediction of fake news or facts with the F1 score value at a score of **69%** accuracy from the data.

### Support Vector Machine (SVM)

Support Vector Machine (SVM) is a supervised machine learning algorithm mainly used for classification. SVM finds the optimal hyperplane which best separates marked support vectors in a high-dimensional space. SVM tries to maximize the margin (distance) between the support vectors (closest points to the classes) to avoid overfitting.

SVM is best suited to detect fake news in Telugu. This includes data collection, preprocessing, feature extraction, training, evaluation, and deployment of the model. The SVM algorithm learns linguistic and statistical features for classifying news articles. For a classification task on fake news by SVM, it showed impressive predictions when the F1-Score along with accuracy stood at around **74%**.

From the results it is clear that logistic regression classifier and svm (support vector machines) have the best performance on this dataset in the model, with logistic regression classifier performing slightly better than SVM (support vector machines). The same can be perceived from other evaluation metrics like the f1 scores.

Also, the training data is largely based on entire news topics, instead of focusing on a single topic or a single domain, so it has been observed in our test cases, that most of the news statements have been correctly classified and fake news was detected. But the test cases that have been taken from topics that have not been taken have been wrongly predicted.

Model	Accuracy
Logistic Regression	89.3%
K-NN	68%

Table 1. RESULTS (ENGLISH)

Model	Accuracy
SVM	74%
K-NN	69%

Table 2. RESULTS (TELUGU)

## 5. Conclusion & Future Work

Our project is now built on these models of Natural Language Processing and ML. It helps in the detection of Fake news and We are getting highest accuracy for the Logistic Regression (**89%**) and our NLP models that we used are correctly pre-processing the data to check whether the news is real or fake.

We are going to increase our scope of detecting fake news by using the Sarcasm detection and Sentiment analysis in the future. Why we need to do sarcasm detection is that in some news sarcasm needs to be detected for the movie news most of the comments given by actors of the cinema industry are sarcastic and we need to implement sentiment analysis in this project as we need to understand the sentiments of the talk given by the common people in case of crises like earthquakes, Tsunamis, etc.

We are going to expand it not only based on the text but also the images of the news given which we need to work on the detection of images and Processes the required news from the image and check it matches with the article given by the reporter is accurate to the images or not. Also if possible we are going to make the project multi-language (telugu, hindi, tamil, kanada, etc) and also for extracting the article from the videos of news and make a article and detect it.

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