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A Machine Learning Approach to Fake News Detection Using Support Vector Machine (SVM) and Unsupervised Learning Model

Hosea I.G., Waziri, V.O., Ismaila, I., Ojeniyi, J., Olalere, M. & Adebayo, O.
Department of Cyber Security Science
Federal University of Technology
Minna, Niger State, Nigeria
E-mails: hoseagungbias@plasu.edu.ng, victor.waziri@futminna.edu.ng; , ismi.idris@futminna.edu.ng; ojeniyija@futminna.edu.ng; lerejide@futminna.edu.ng; waleadebayo@futminna.edu.ng
Phones: +2347037987825; +23480169395872; +23458942018; +2348105518722; +2348034680087; +2348032100361

ABSTRACT

Blogging over the years have become a lucrative business, the bloggers main aim is to attract people to his or her blog. In the quest for that, many blogs or page post fake news by using enticing captions to captivate the minds of readers. The captions are mostly displayed on social media and by clicking on the captions, the reader will be redirected to the blog where the news is been posted. The posted fake news can sometimes lead to misinformation to the public, violence, inciting conflict and extreme cases, death. Many works have been done on fake news detection with good accuracy rate in terms of detecting fake news. This paper presents an effective way of detecting fake news using Support Vector Machine (SVM) and Lagrangian Duality which yielded an accuracy of 95.74%.

Keywords: Machine Learning, Fake News, Detection, Support Vector Machine (SVM), Security, Unsupervised Learning Model, Bloggers, Readers

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1.. INTRODUCTION

For most of us, social media has molded the digital world to the point where it is now an integral part of our lives. Online services' widespread usage is influencing and changing how we obtain information, organize to demand political change, and discover partners. One of the most appealing aspects of social media is that it is quick and easy to use. Since becoming a prominent and expanding source of news and information for hundreds of millions of people, this technology has drastically transformed the news and media sectors (Guo et al., 2020). People increasingly spend the majority of their time on social media and the Internet than they do on traditional news sources. Traditional news organizations are more appealing and less expensive than social media news, and it is simple to share, like, and comment on. Social media news, despite its advantages, falls short of traditional news sources. According to a survey performed in 2016, 62 percent of people consume news on social media, compared to 49 percent in 2012. It demonstrates that we are constantly overwhelmed with information and lack the resources, skills, or ability to verify it (Kesarwani et al., 2020).

Fake news items have been blamed for swaying votes in the majority of cases (Allcott & Gentzkow, 2017) and even causing injury and death. (Snell et al., 2019). Deceptive articles must have qualities that are comparable to those of true news reports in order to achieve their writers' purposes. Misinformation, on the other hand, is frequently overstated or otherwise meant to lure readers to read it (this is commonly known as click bait)(Snell et al., 2019). Anyone can register for free as an online news publisher. Similarly, anyone can set up a Facebook profile and post news or pretend to be a newspaper.

Fake news is manufactured with the intent of deceiving readers, making it difficult to detect based just on the content of the news. Fake news covers a wide range of themes, styles, and platforms, and it employs a wide range of linguistic techniques to misrepresent the truth while mocking real news.(Shu et al., 2017). Detecting fake news on social media is a difficult task and a significant challenge that is also technically difficult to solve. Even the human eye has trouble distinguishing between true and false news; one study found that when respondents were shown a fake news article, they found it "'somewhat' or 'very' accurate 75 percent of the time," and another found that 80 percent of high school students had trouble determining whether an article was fake. (Ruchansky et al., 2017).

The Support Vector Machine (SVM) is a machine learning method used to detect fake news in this study.

2. RELATED WORKS

Many various ways to detecting false news have been proposed by researchers all around the world. Julio, Andre, Fabrıcio, Adriano, and Fabrıcio (Reis et al., 2019) supervised learning was proposed as a tool for spotting fake news. Their model (XGBoost (XGB)) achieved an accuracy rate of 86%. Kasarwani, Singh, and Ramachandran (Kesarwani et al., 2020) used K-Nearest Neighbor classifier in fake news detections. They achieved an accuracy rate of 79% and a precision of 0.75 and a recall of 0.79.

A geometric deep learning approach was used in detecting fake news on social media (Frasca & Mannion, 2019). The model uses classical convolutional neural networks and graphs, allowing the fusion of heterogeneous data such as content, user profile and activity, social graph, and news propagation. The model achieved an accuracy of 92.7%.

For fake news detection, Granik and Mesyura (Granik & Mesyura, 2017) suggested a model based on the Naive Bayes Classifier. Their model was accurate to within a quarter of a percent. SpotFake, a multi-modal framework for fake news detection was proposed by Singhal, Shah, Chakraborty, Kumaraguru and Satoh (Singhal, 2019). The model exploits both the textual and visual features of an article. Specifically, they made use of language models (like BERT) to learn text features, and image features are learned from VGG- 19 pre-trained on ImageNet dataset.

The research referenced by (B et al., 2020) adopted a neural network to separately extract textual and visual features for news representation and further investigate the relationship between the extracted features across modalities in order to build a Similarity-Aware Multi-modal Fake News Detection (SAFE). This model achieved an 89.6% accuracy.

Bedi, Pandey, and Kumar (Bedi et al., 2019) developed a system for detecting and protecting fake news on social media. Authorized news website database, extension, social media, feedbox, validation, and description make up the framework. Major news sites, small news sites, Business and cultural news sites, and Fake news sites were all classified under the framework. Convolutional Neural Network (CNN) was adopted by (Yu, 2018) for fake news detection. The model which was named as TI-CNN (Text and Image information based Convolutional Neural Network) was by projecting the explicit and latent features into a unified feature space. TI-CNN was trained with both the text and image information simultaneously and the model achieved a 92.2% accuracy.

Yang, Shu, Wang, Gu, Wu, and Liu proposed a generative approach based on unsupervised learning for fake news detection on social media which leverage on a Bayesian network model to detect fake news in an unsupervised manner (Yang et al., 2019). The model achieved a 75.9% accuracy.

For detecting fake news, Ruchansky, Seo, and Liu proposed a hybrid deep model (Ruchansky et al., 2017). The CSI model incorporates three elements of a news article: the article content, the user response, and the user source. The paradigm is made up of three modules: Capture, Score, and Integrate, which is why it's called CSI. The accuracy rate of the model was 89.4 percent.

Manzoor, Singla, and Nikita (Manzoor et al., 2019) examined machine learning techniques for detecting fake news in depth. Researchers employed language modeling, deception, clustering, predictive modeling, content cues, and non-text signs to classify fake news.

3. METHODOLOGY

The procedure for detecting fake news is depicted in Figure 1 below. Data gathering, machine learning, and outcome evaluation are the three steps of the detection architecture.

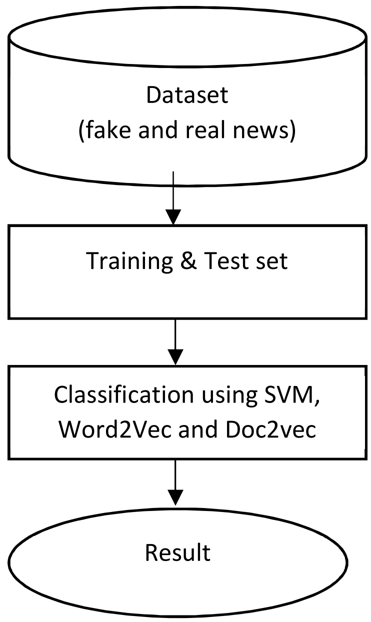

Fig. 3.1. Fake News Detection Architecture

3.1 Data Collection And Preprocessing

The dataset was gotten from Kaggle, which contained 26000 instances. The dataset was split into two parts: a training set and a test set, with the training set receiving 80% of the data and the test set 20%.

There were five attributes in the dataset:

1. Id: Indicates a news article's unique identification.
2. Title: represents a news article's title
3. Author: the name of the news article's author
4. Text: represents the article's text; it may be incomplete.
5. Label: specifies the label that identifies the article as possibly untrustworthy
    a. 1: untrustworthy
    b. 0: trustworthy

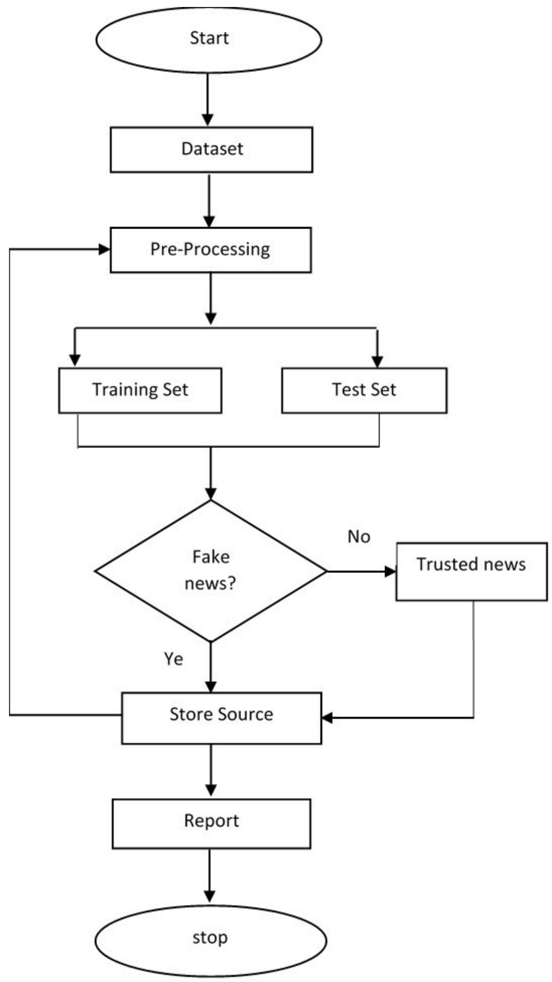

Fig. 3.2 Flowchart diagram showing the model

The model was built using Word2Vec and Doc2Vec which is used to generate vector representation for words (Le & Mikolov, 2014).

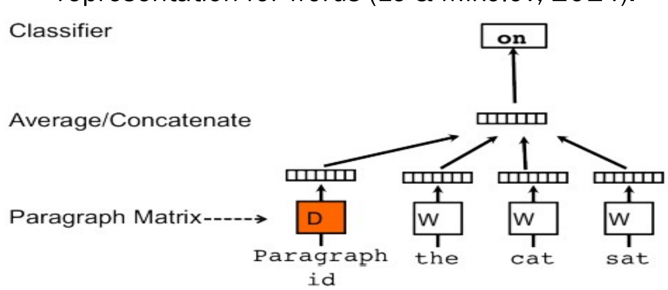

Fig.3.3 Doc2Vec Model

(*Doc2vec Implementation Principle-Smile Sun-博客园*, n.d.)

3.2 Support Vector Machine (SVM)

SVMs are a type of supervised learning algorithms for classification and regression that are used in conjunction (Vapnik, 2000). SVM belongs to the generalized linear classification family. SVM provides the distinct advantage of enhancing geometric margin while lowering empirical classification error as a result, SVM is also known as Maximum Margin Classifiers. Structural Risk Minimization (SVM) is a method for reducing structural risk (SRM). The input vector is mapped to a higher-dimensional space in which a maximal separation hyperplane is constructed using SVM. (Srivastava & Bhambhu, 2010).

The Gaussian Radial basis function was used to build the SVM model;

$$k(\vec{x}_i, \vec{x}_j) = \exp(-\gamma \frac{\|\vec{x}_i - \vec{x}_j\|^2}{2\sigma^2}) \quad (3.1)$$

To compute for the SVM classifier;

$$\text{Classifier} = \left[\frac{1}{n}\sum_{i=1}^{n} \max(0, 1 - y_i(w^T x_i - b))\right] + \lambda\|w\|^2 \quad (3.2)$$

Using the primal problem for the SVM optimization;

$$for\ each\ i \epsilon \{1, \dots, n\}\ a\ variable\ c_i\ is\ introduced.\ where\ c_i = \max\left(0, 1 - y_i(w^2 x_i - b)\right)$$

$$minimize\ \frac{1}{n}\sum_{i=1}^{n} c_i + \lambda\ \|w\|^2$$

$$subject\ to\ y_i(w^T x_i - b) \geq 1 - c_i\ and\ c_i \geq 0\ for\ all\ i$$

$$arg_{w,b}^{max} \left\{\frac{1}{\|w\|}{}_{n}^{min} \left[t_n(w^T \varphi(x_n) + b)\right]\right\} \quad (3.3)$$

$$s.t \quad t_n(w^T \varphi(x_n) + b) > 1. for\ n = 1, \dots. N$$

3.3 Lagrangian Duality

The Lagrangian Duality is then used to get rid of the constraints;

$$\boldsymbol{L(w, b, a) = \frac{1}{2}\|w\|^2 - \sum_{n-1}^{N} a_n\{t_n(w^t \varphi(x_n) + b) - 1\}}. \quad (3.4)$$

Where;

$$\boldsymbol{a_n \geq 0, n = 1, \dots N}$$

4. RESULT AND EVALUATION

The results were assessed using the performance measures listed in the table below.

Table 4.1 Confusion matrix

Predicted / Actual	Positive	Negative
Positive	True Positive	True Negative
Negative	False Positive	False Negative

Using the above confusion matrix, the following measures were calculated to evaluate the classifiers' performance. A binary classifier labels all data items in a test dataset as positive or negative. The four outcomes of this category are true positive, true negative, false positive, and false negative (or prediction).

a. True Positive (TP): Positive prediction is correct. As a result, the TPR (precision) is the proportion of correctly categorized positive events.
   TPR (Precision) = $\frac{TP}{TP+F}$
b. False Positive (FP): Positive prediction that was inaccurate. As a result, FPR is the fraction of negative incidents that are incorrectly labeled as positive.
   FPR = $\frac{FP}{FP+TN}$
c. True Negative (TN): Negative prediction is correct. As a result, TNR stands for the proportion of correctly categorized negative events.
   TNR = $\frac{TN}{TN+F}$
d. False Negative (FN): Negative prediction was inaccurate. As a result, FNR stands for the fraction of positive events that are incorrectly labeled as negative.
   FNR = $\frac{FN}{FN+T}$
e. Accuracy: The proportion of cases that are accurately categorized is measured.
   Accuracy = $\frac{TP+T}{TP+TN+FN+F}$

4.1 Result

Table 4.2. Performance on Test set

Classifier	Accuracy (%)	TPR	FPR	Precision	Recall	F-measure
SVM	95.74	0.9574	0.0426	0.9574	0.9574	0.9574
KNN	79	0.786	0.214	0.786	0.786	0.786
Naïve Bayes	75	0.75	0.25	0.75	0.71	0.75
XGB	86	0.86	0.14	0.86	0.86	0.81
CSI	89.2	0.892	0.108	0.892	0.892	0.894

From Table 2 above, the result shows SVM having an accuracy of 95.74% which is a better result when compared to the accuracy gotten in the reviewed literatures; Reis et al., 2019 achieved an accuracy of 86%, Kesarwani et al., 2020 achived an accuracy of 79%, Granik & Mesyura, 2017 achieved an accuracy of 75% and Ruchansky et al., 2017 achieved an accuracy of 89.2%.

5. CONCLUSION

Fake news has been on the rise as a result of the rising demand for news. People use the newfingle of social media to propagate fake news, which has incited anxiety, tension, political debates, and even violence in recent times. As a result, the importance of detecting and identifying fake news cannot be overstated. The Sopport Vector Machine (SVM) with Lagrangian duality is used in this paper to detect fake news using machine learning. This model has achived an accuracy rate of 95.74%.

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