International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 10, ISSN No. 2455-2143, Pages 42-50
Published Online February 2023 in IJEAST (http://www.ijeast.com)

DETECTING ONLINE FAKE NEWS USING MACHINE LEARNING AND TOPOLOGICAL DATA ANALYSIS

Agbasonu Valerian Chinedum, Amanze Bethran Chibuike, Agbakwuru. A. Onyekachi
Department of Computer Science,
Faculty of Physical Science,
Imo State University Owerri, Nigeria

Abstract: **The internet is rife with different types of disinformation openly available to the public. The spreading of accidental or malicious misinformation on social media, specifically in critical situations, such as real-world emergencies, can have negative consequences on our health, democracy and economy. This facilitates the spread of rumors on social media where users share and exchange the latest information with many readers, including a large volume of new information every second. However, updated news sharing on social media is not always true. Consequently, disinformation is rapidly being recognized as a global risk alongside terrorism, cancer and global warming. The increasing demand for fact checking at scale has stimulated a rapid development of automated solutions using technologies such as Natural Language Processing (NLP) and Machine Learning (ML) in order to reduce the required human effort. This paper will explore novel methods for automated fake news detection through the integration of two powerful approaches to data science, ML and Topological Data Analysis (TDA). The main strength of ML lies in its predictive power. Deep learning in particular has yielded some impressive practical successes in various text processing tasks. However, ML can fail in more exploratory talks aimed at understanding the nature of the data and uncovering its insights. TDA is a fairly new field that applies topology and geometry to analyze high-dimensional data and construct its compressed representation offering a more exploratory approach. This paper will explore how the strengths of those two fields can be integrated in order to create novel method for the analysis of text data, which will potentially lead to the creation of a state-of-the-art fake news detection model.**

Keywords: **Social Media, Natural Language Processing, Machine Learning, Topological Data Analysis and Fake News**

I. INTRODUCTION

The Information Technology (IT) revolution of 21st Century has created a web of highly interactive platforms that enabled individuals, communities and groups share, generate, create, discuss and modify user generated content. With such qualities and possibilities, the phenomenon of social media is changing the shape of the world we are living in. To be more precise, it is evident that the communication landscape of the contemporary world is changed with the advancements in communication technology. Social Media, across the globe, has certainly carved a place for itself in the lives of people. It connects people and reduces if not removes the distance across boundaries of demography, geography and subject[1]. Recent examples from the Middle East echo the power it has acquired over the period. Social media movements have resulted in toppling of governments, collapse of brands and celebrity disclosures[1]. There are even agencies mushroomed up that handles only social media presence of their clients, whether brands or individuals, even companies now allocate budgets to monitor online conversations about their brand and leverage them to improve their products, customer service and build a positive vibe and recall. There hardly is any social network site or any popular website that do not offer sharing buttons on their webpage. These sharing buttons are icons or logos of popular social networking sites and are images that are universally recognized by almost all the users of internet. Whenever one comes across any interesting matter there is an urge to share. Though, it's not a novel phenomenon as it always was there with humans, yet social media provided the opportunity to satisfy that urge right at its moment. Just below the best picture of the day, best quote of the day, best status or anything of that sort, we would find the "share" button. The piece of information that may be unimportant, unknown or buried on some unknown webpage a moment ago becomes important, interesting and may be popular in a very short span of time. Individuals, groups and organizations with certain mindsets and objectives use social media to fulfill their hidden motives. Undoubtedly social media has its advantages but at the same time disadvantages also. Anyone

can create any number of identities over social media platforms. This, at times, poses grave threat to individual privacy and wellbeing. Gullible masses may get influenced by certain groups or individuals and become more vulnerable in certain instances. Individuals tend to share information which they find anywhere on internet and interests them. As the adoption of features such as sharing buttons works its way into the structure of websites, our ability to spread information across multiple social networks and to different audiences will become easier. This process of sharing pages and information to our social networks from across the web also increases our potential to engage with others and generate discussions [2].Users feel great about sharing information as they expect other members of his group to do the same and in the process he comes across more interesting pieces of information. Also they feel that sharing such information strengthens their ties and build a good image of theirs. The rise of social media has not, however, been without its critics. Some point to the unreliability of information in social networks and complain that the quality of information is being undermined by a growing 'cult of the amateur' and those rumors and falsehoods can be instantly spread around the world [3]. These issues have become pressing as mainstream media outlets integrate more and more social media content into their output and ordinary people increasingly use social media as a source of news. A 2013 survey of online news users in the UK showed that, on average, 25% used social media to find news at least once a week, but that less than 10% trusted that information. Over the years there have been a number of well-documented cases where misleading pictures and stories in social media have been given the 'oxygen of publicity' by news companies desperate to get one step ahead on a major news story. Following the death of Osama Bin Laden in May 2011, 'Photo Shopped' pictures purporting to show his dead body were distributed on social media and picked up by newspapers, news websites, and TV stations, potentially inflaming passions in the region [4]. Pictures are sometimes fabricated by governments or other official sources and then released via social media, on their own websites, or direct to news agencies. A large number of fake photographs were posted and a number of these were picked up by mainstream media outlets or re-tweeted by journalists (and thus given authenticity). It took painstaking analysis by several groups of journalists to confirm which images were faked [5]. An analysis of the top 100 most-tweeted picture stories for The Guardian data blog showed that 15% were fakes [6]. Social media raises a number of issues about how eyewitness material should be used and credited and, perhaps most importantly, what kind of checks should be made to ensure veracity.

A number of research projects have investigated the role of influential experts in spotting and verifying news in social media posts. [7] have worked on creating a customizable tool where journalists could collectively assess the validity of social media sources, using visual icons to expose relevant information derived from Twitter, such as the likely location of a posting. They concluded that journalists needed to use a variety of methods for rating the usefulness of tweets. The importance of crowd-sourced news recommendations was emphasized by Morales[8] who found that an analysis of recommendations and popularity on social networks could help predict major stories. Unfortunately for journalists, most of this experimental work has not, yet, been translated into practical tools they can use to help them with their work. The tools used by journalists to interface with social media content vary according to their roles. Tools for verification of contributors come up with aggregate scores for a contributor, but these were considered to help journalists make judgments on authenticity in a fast-moving news story. In the absence of robust tools for sourcing and verifying news on social media news organizations have developed their own hybrid techniques. But currently, few posts are geo-tagged and tools often do not have enough fine-grained control. The biggest news organizations continue to try to verify every picture or video they plan to use by contacting the owner directly. They do this to protect their editorial integrity but also because rights and payment for newsworthy footage are increasingly factors. By 2019, the volume of material and the speed with which they were able to verify it were becoming significant frustrations and, in most cases, smaller news organizations simply don't have the manpower to carry out these checks. Additionally, social media companies also do not have sufficient market incentives to reliably verify the identities of their users. Therefore, the methods currently under consideration by private industry are insufficient to counter fake news proliferation by foreign actors, especially those with political incentives to misinform and deceive the public. This paper proposes a methodology to create a model that will detect if an article is authentic or fake based on its words, phrases, sources and titles, by applying supervised machine learning algorithms on ISOT Fake News Dataset[9]. Then, feature selection methods are applied to experiment and choose the best fit features to obtain the highest precision, according to confusion matrix results. The work developed a system that will enable information verification system in social media platform by using the identity of the person that posted the news, his/her location, peoples rating of his/her previous post to rate the authenticity of the post.

Fake news have caused a lot of harm and damages to individual personalities, company profiles and countries economy and security more especially in developing country like Nigeria. Most often conflicts and warm springs up between communities because of fake news posted on social media platform. The social media platform for now has no automated means of verifying the authenticity of

information unless by directly contacting the originator which most often is very difficult to accomplish because of the numerous posts on the platform. This is a big challenge to government as they are finding it difficult to regulate what is posted on social media platform without infringing on human rights for freedom of speech. So, there is need to develop a system that can verify information on social media before it can be allowed to spread online.

II. AIM AND OBJECTIVES OF THE STUDY

The aim of this paper is to develop of online fake news detection with machine learning and topological data analysis.

To achieve this aim, the following specific objectives were set:

1. To develop a social media platform for sharing of information online
2. To develop an algorithm for verifying information source using machine learning
3. To develop a system that maintains users identification / verification to prevent illegal posting of information on the platform
4. To develop a system that will detect fake news using the machine learning algorithm and topological data analysis.

III. SIGNIFICANCE OF THE STUDY

The work will be beneficial to companies, government and masses in the following ways.

The Company: This proposed system will benefit them in the following ways.

- The verification of information before it spreads online will help prevent de-marketing of companies product falsely by dubious competitors who leverage on social media platform to rundown companies

Masses: The proposed system will benefit them in the following ways:

- The new system will help limit the extent to which people's character can be assassinated through online media more especially politicians. This can be achieved by verifying every information before it can spread online.

Government: This proposed system will benefit them in the following ways.

- The security of the nation can be guaranteed as falsehood can no longer be propagated through social media platform
- There will be less litigations arising from libel suits in court hence government will have less cases to handle as the security mechanism introduced will help reduce such.

IV. REVIEW OF RELATED WORKS

[10] surveyed two major categories of methods for finding fake news. The first one corresponded to linguistic approaches in which the content of deceptive messages is extracted and analyzed to associate language patterns (usage of words, grams and syntactic constructions, semantic similarity, and rhetoric relations between linguistic elements) with deception. The second one corresponded to network approaches in which network information, such as message metadata or structured knowledge network queries, can be harnessed to provide aggregate deception measures. In the specific case of the detection of fake reviews, Sentiment Analysis (SA) was considered a useful technique not specifically to detect fake texts but to detect fake negative reviewers as they overproduced negative emotional terms when compared to truthful reviews as a result of exaggerations of the sentiment they were trying to convey[10].[11]in their paper "Detection of Online Fake News Using Blending Ensemble Learning" said that the exponential growth in fake news and its inherent threat to democracy, public trust, and justice has escalated the necessity for fake news detection and mitigation. Detecting fake news is a complex challenge as it is intentionally written to mislead and hoodwink. Humans are not good at identifying fake news. (e detection of fake news by humans is reported to be at a rate of 54% and an additional 4% is reported in the literature as being speculative. Consequently, social networks are ramping up the usage of detection tools and educating the public in recognizing fake news. In the literature, it was observed that several machine learning algorithms have been applied to the detection of fake news with limited and mixed success. However, several advanced machine learning models are not being applied, although recent studies are demonstrating the efficacy of the ensemble machine learning approach; hence, the purpose of their study was to assist in the automated detection of fake news. An ensemble approach was adopted to help resolve the identified gap. The study proposed a blended machine learning ensemble model developed from logistic regression, support vector machine, linear discriminant analysis, stochastic gradient descent, and ridge regression, which is then used on a publicly available dataset to predict if a news report is true or not. The proposed model will be appraised with the popular classical machine learning models, while performance metrics such as recall, accuracy, precision, and f1-score will be used to measure the performance of the proposed model. Results presented showed that the proposed model outperformed other popular classical machine learning models. [12] described the psychological and social foundations of fake news in traditional and social media and surveyed the features and models used by detection techniques designed to address this phenomenon, considering news content features and models as well as social context features and models, which

can be based on posts, individual users, or user networks. They considered that Sentiment Analysis (SA) should play a role in determining post-based features, as people express their emotions or opinions towards fake news through social media posts, such as skeptical opinions or sensational reactions. Years later, [12] revisited the subject by exploring weak social supervision for fake news detection and they stated that user comments that are related to the content of original news pieces are helpful to detect fake news and to explain prediction results. They also considered that machine-generated text created by successful deep generative models can be a new type of fake news that is fluent, readable, and catchy. With respect to sentiment analysis, they still considered sentiment among the features that can be extracted from text for fake news detection given that conflicting sentiments among news spreaders may indicate a high probability of fake news. [13] proposed a protuberant issue of the present time is that, organizations from different domains are struggling to obtain effective solutions for detecting online-based fake news. It is quite thought-provoking to distinguish fake information on the internet as it is often written to deceive users. Compared with many machine learning techniques, deep learning-based techniques are capable of detecting fake news more accurately. Previous review papers were based on data mining and machine learning techniques, scarcely exploring the deep learning techniques for fake news detection. However, emerging deep learning-based approaches such as Attention, Generative Adversarial Networks, and Bidirectional Encoder Representations for Transformers are absent from previous surveys. This study attempts to investigate advanced and state-of the-art fake news detection mechanisms pensively. We begin with highlighting the fake news consequences. Then, we proceed with the discussion on the dataset used in previous research and their NLP techniques. A comprehensive overview of deep learning-based techniques has been bestowed to organize representative methods into various categories. The prominent evaluation metrics in fake news detection are also discussed. Nevertheless, we suggest further recommendations to improve fake news detection mechanisms in future research directions.[14] reviewed news and comments on social media related to the 2016 US presidential election, examining changes and effects related to the publication of fake stories and false news in this regard. The researchers conducted a comprehensive online assessment and created a large database of online news websites that identified the four most important features, including "very important" news sources, findings, and repetitions. In the three months since the election, 14% of Americans followed very important news directly from Facebook and Twitter, of which 30 million times Trump and 8 million times Clinton have been repeated and reposted on Facebook. By evaluating fake or semi-fake news, it has been found that 12% of people believe this news to some extent and considered the candidacy of these people to be ideal [14]. [15] conducted a study on the automatic discovery of fake news as a challenging problem in detecting deception and political and social effects in the real world. He has been severely restricted by using statistical approaches to counter fake news due to a lack of tagged data sets. In his paper, he presents a new and publicly available data set to detect fake news [15]. [16] assessed the impact of the spread of fake news in various fields on the Internet, describing it as a global concern that can affect various social, economic, cultural and industrial aspects and play a deviant role. The researchers said that a new system of protection measures is needed [16]. [17] assessed the interactions between the 2016 US presidential election and the country's economic situation. The researchers examined the effects of fake news on the country's electoral conditions and the country's social and political climate, and considered the scientific, social, journalistic, media and public aspects. They stated that fake news and the phenomenon of fake news and public deception can have negative effects on all dimensions [17]. [18] studied the impact of fake news on the 2016 US presidential election on social media, noting the extent of this impact for Facebook. Demonstrating the Democrats' deliberate move to change the electoral situation, the researchers assessed the creation of fake stories and social deception. Based on the results of these researchers, the use of false news is always accompanied by special titles with a label "disputable" or "false" [18]. [19] stated that a large part of recent work has focused on understanding and discovering fake news published on social media. To achieve this goal, the present work explored several types of news-derived features, including social media resources and posts. In addition to examining the main features presented in the literature to detect fake news, the researchers used monitored algorithms such as SVM to detect fake news. Introducing a new collection in this field, they showed that the results of the research are useful in recognizing the importance of the features of false news discovery [19]. [20] used geometric deep learning (GDL) to identify and extract fake news on social networks and cyberspace. Using natural language processing (NLP) and deep convolution neural network (CNN), the researchers identified general and counterfeit deception news. The accuracy of the algorithm was 92.7% [20].[21] differentiated fake news from other forms of disseminating disinformation, misinformation, and misinformation, such as hoaxes, propaganda, satire/parody, rumors, clickbait, and junk news. They added misinformation to the classical categories of disinformation and misinformation. Misinformation was defined as the sharing of genuine information with the intent to cause harm. However, fabricated and junk news, which cannot be considered to contain genuine information, were considered as a possible misinformation realization, which seems contradictory.

International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 10, ISSN No. 2455-2143, Pages 42-50
Published Online February 2023 in IJEAST (http://www.ijeast.com)

V. ANALYSIS OF THE PROPOSED SYSTEM

The main goal of the proposed system is to apply a set of classification algorithms to obtain a classification model in order to be used as a scanner for fake news by details of news detection and embed the model in python application to be used as a discovery for the fake news data. The implementation involves tasks such as data preprocessing, feature extraction, training models etc. The architecture diagram of the implementation is provided in figure 1.

The dataset provided information about users and user-news interaction. Furthermore, the dataset included real and fake news content. Based on our intuition and research, we found that the "body" of the news articles, that is, main content, and best represents the news articles core information and variance. After extracting the body of all the news articles we constructed a data frame of the news-ids and the body of the text. A label was also added to the data frame to indicate whether the news article is fake or real.

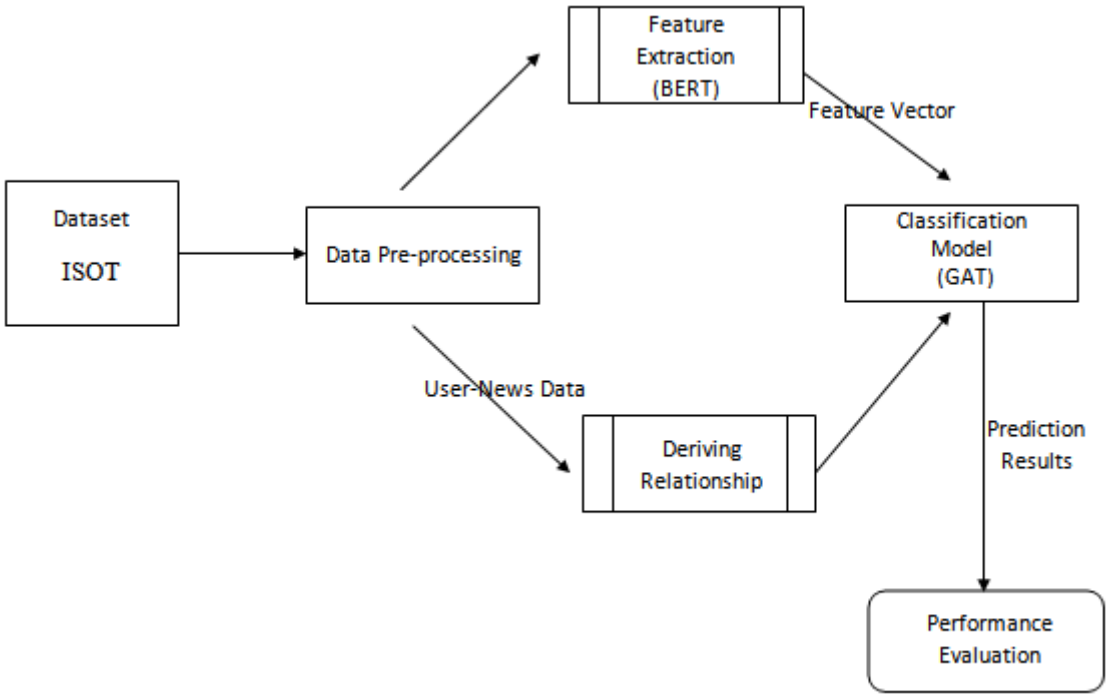

Figure 1: Fake New detection Architecture Diagram

Text data requires preprocessing before applying classifier on it, so we will clean noise, using Stanford NLP (Natural language processing) for POS (Part of Speech) processing and tokenization of words, then one must encode the resulted data as integers and floating point values to be accepted as an input to ML algorithms. Once the important aspects of the data were identified for feature extraction, the next step involved establishing relationships among the news articles that can be leveraged by classification model. The relationship between the news articles was established using a graph data structure. Here, the news articles act as the nodes of the graph and the edges between the nodes represent the relationships among the new articles. This process will result in feature extraction and vectorization; the research using python scikit-learn library to perform tokenization and feature extraction of text data, because this library contains useful tools like Count Vectorizer and Tiff Vectorizer. For the fake news detection, the actual news data (body of the news article) is being considered as features. But the data is in the form of text. It is known that for the machine learning analysis, text data does not work well. So the text data has to be converted into a numerical representation. This process is called vectorization. Every record (i.e. news article in this case) should be converted into a vector. BERT stands for Bidirectional Encoder Representations from Transformers. It is one of the state-of-the-art vectorization techniques which have achieved state of the art results on the standard datasets. This is also driven by a neural network. As the name suggests, the technique masks a particular word and tries to predict the word by running a neural network from both sides (Forward and backward). BERT is the first successful model to implement bidirectional vectorization. As a result of these fantastic results achieved by this model, in this project, BERT was used to obtain feature vectors from the text data (news article).The fake news detection task has network-based input in the form of adjacency matrix representing the relationship between news articles. This relationship is

International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 10, ISSN No. 2455-2143, Pages 42-50
Published Online February 2023 in IJEAST (http://www.ijeast.com)

derived from the information provided in the form of users and their association with the news articles (post, share, re-tweet etc). The classification task needed a model which can utilize graph-based architecture of the dataset and the feature vectors generated for the news articles using BERT. Fake news detection in social media aims to extract useful features and build effective models from existing social media datasets for detecting fake news in the future. Thus, a comprehensive and large-scale dataset with multidimensional information in online fake news ecosystem is important. The multidimensional information not only provides more signals for detecting fake news but can also be used for research such as understanding fake news propagation and fake news intervention. Though there are several datasets for fake news detection, the majority of them only contain linguistic features. Few of them contain both linguistic and social context features. To facilitate research on fake news, we used a publicly available data repository called ISOT Fake News Dataset includes not only news contents and social contents, but also spatiotemporal information. To collect reliable ground truth labels for fake news, fact-checking websites were used to obtain news contents for fake news and true news.

Data Flow Diagram (DFD) of the Proposed System

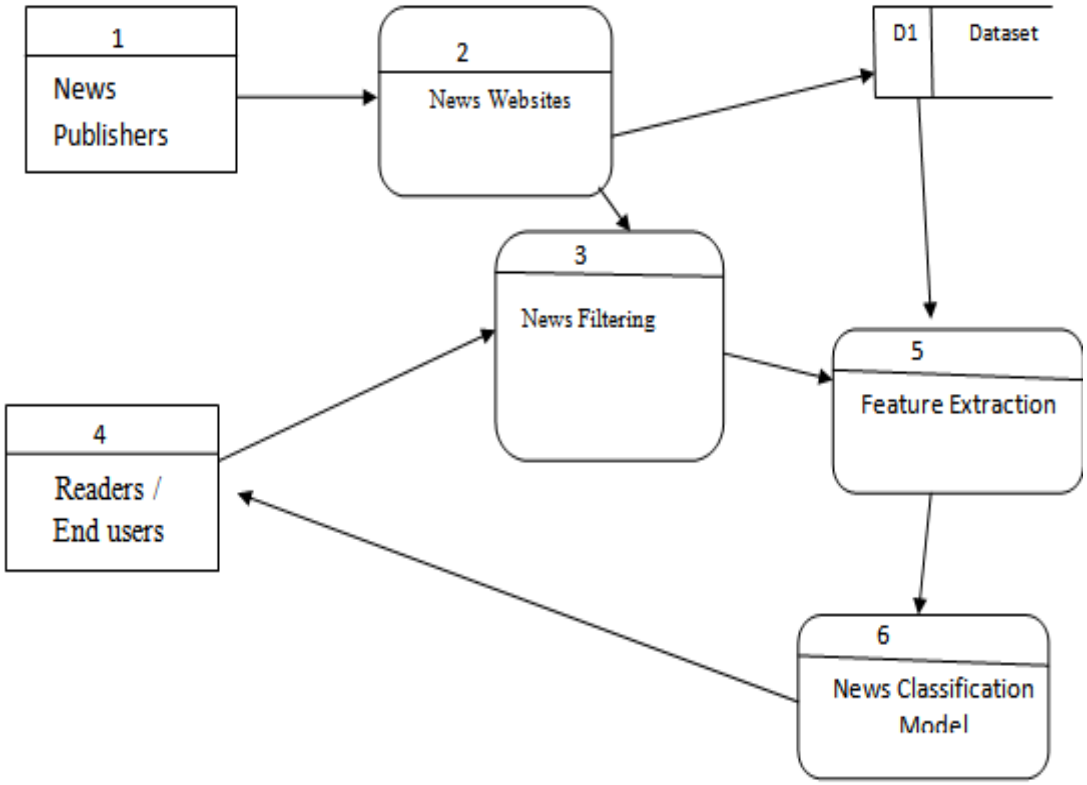

Figure 2: Data Flow Diagram of the proposed system

Object Diagram of the Proposed System
Use Case Diagram

International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 10, ISSN No. 2455-2143, Pages 42-50
Published Online February 2023 in IJEAST (http://www.ijeast.com)

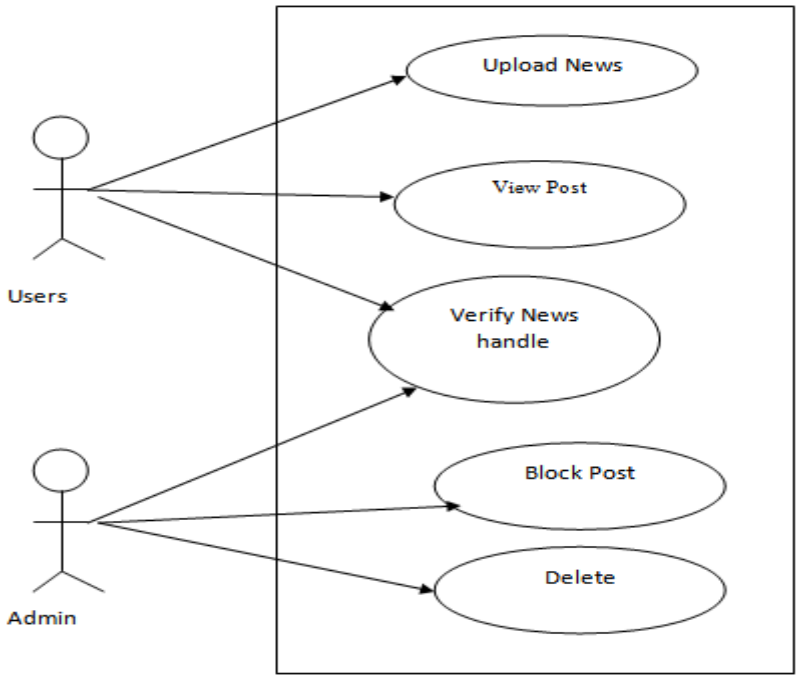

Figure 3: Use Case Diagram of the proposed system

Figure 3 shows the user requirements functions that are performed by the users on the system. The users of the proposed system are categorized into users and admin. The activities of these users are described in figure 3.4 using use case diagrams.

Sequence Diagram

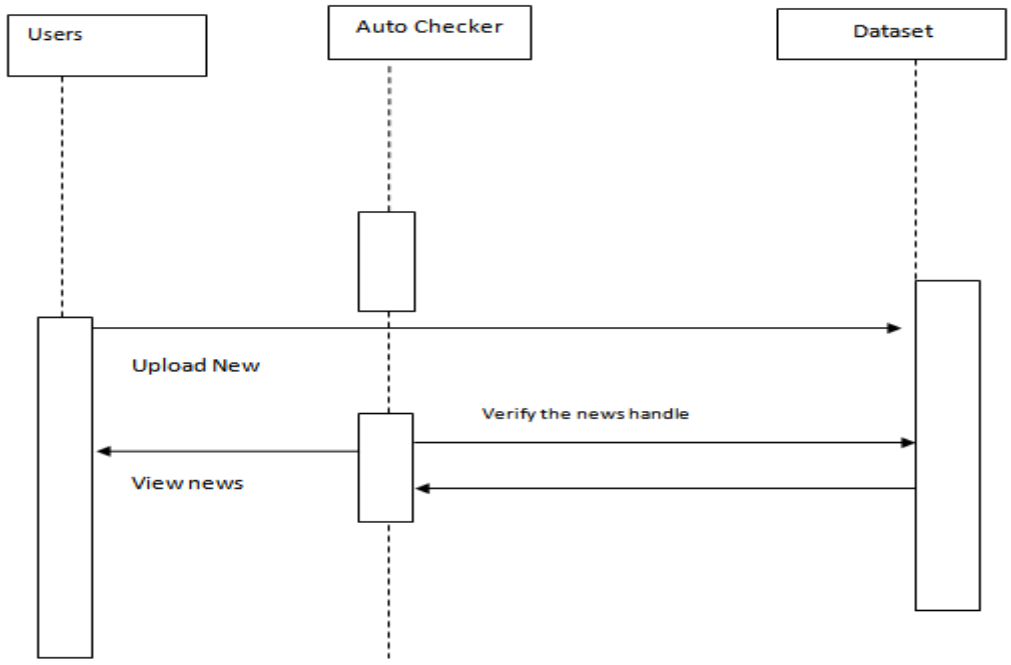

Figure 4: Sequence diagram of the proposed system

International Journal of Engineering Applied Sciences and Technology, 2022
Vol. 7, Issue 10, ISSN No. 2455-2143, Pages 42-50
Published Online February 2023 in IJEAST (http://www.ijeast.com)

Figure 4 shows the sequence diagram of the proposed system and it depicts how objects interact with one another and in what order.

System Model

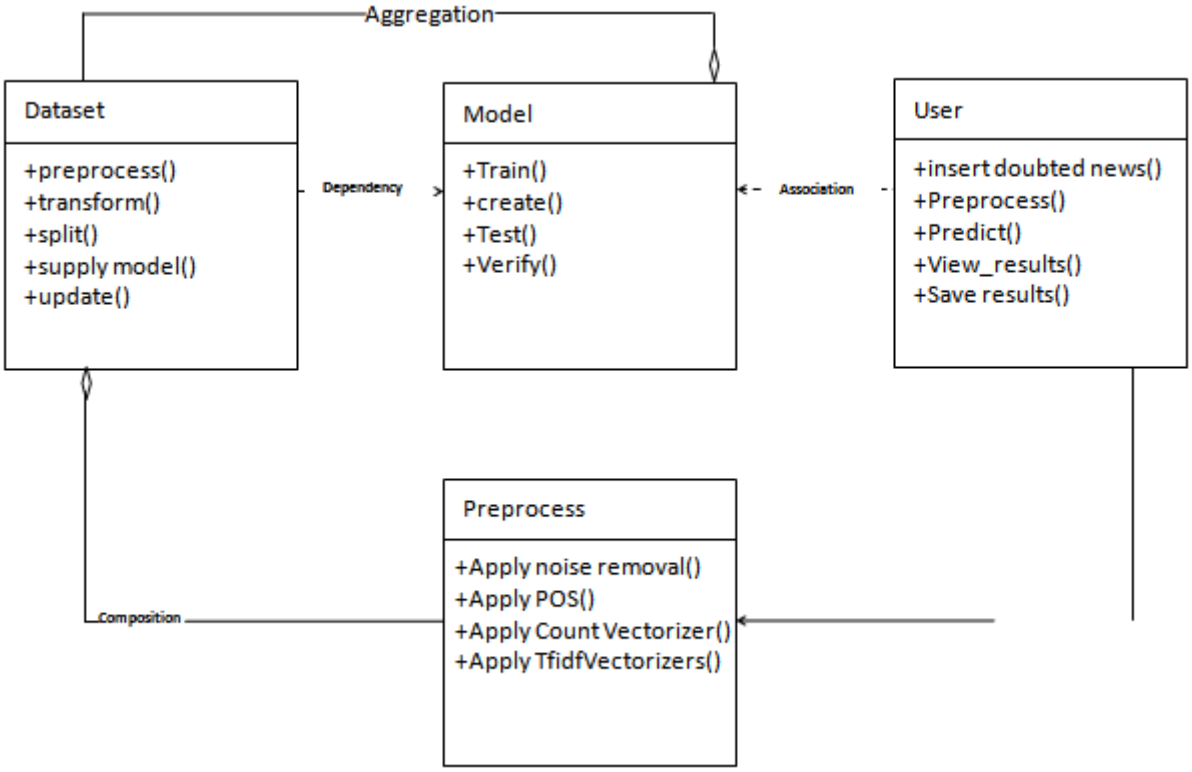

Figure 5: Fake Detector Model using machine learning

As shown in figure 6, text data requires preprocessing before applying classifier on it, so we will clean noise, using Stanford NLP (Natural language processing) for POS (Part of Speech) processing and tokenization of words, then we must encode the resulted data as integers and floating point values to be accepted as an input to ML algorithms.

IV. SUMMARY

This paper has presented for detecting fake news, which was tested using several news articles from credible websites, like BBC news, and some not-so-credible websites like posts on social media, in order to show the claimed performance of detecting malicious misinformation through machine learning. First, the data is collected and checked if it is a link to an article or a block of text from an article then passed to the vectorizer. Then, the vectorizer removes stopwords, transforms to an array of tokenized vectors then passes the array to the prediction model which then determines if the content is real or not. The outcome of this prediction is then returned to the user.

V. CONCLUSION

The purpose of the study is to develop a Content-Based fake news detection system using a machine-learning approach that can serve as a basic building block for Fake news detection. To achieve this some labeled data was selected as training and testing sets because they clearly distinguish fake from real. The designed system involves preprocessing like tokenization, Normalization, stop word removing and abbreviation resolving, and feature extraction using Term-Frequency-inverted document frequency, term frequency, and hash to know word importance that appears in the news and word appears in the corpus and N-grams which is a powerful Natural Language Processing technique in order to capture semantic and syntactic sequences was also used. Based on the features extracted different classification algorithms like multinomial Naïve Bayes, random forest, gradient boosting, and passive-aggressive are used. The final model was created by combining the n-grams, features extracted and transformed, and classifiers. The performance of the models was accessed and compared on the same news dataset using the most significant metrics by which a machine learning model performance is measured like

classification accuracy and Error matrix. The model served as a better model as compared with other classifications, this is quite fitting because the passive-aggressive algorithm is an online algorithm and fake news detection is also an online challenging problem. The model generated some errors. Indeed, it is possible to anticipate such considerable contributions and positive effects of the system since the English language is a complex language. The error rate was about 2.8%. This shows that the system can be performed with low error rates in highly inflected languages such as English and other popular languages.

VI. REFERENCES

[1]. Girard, J. P., & Girard, J. L. (2016). Social Knowledge: Using Social Media to Know what You Know. New York: IGI Global.

[2]. Greek, J. (2014). Social Network-Powered Information Sharing. New York: The Rosen Publishing Group, Inc.

[3]. Keen, A. (2017). The Cult of the Amateur: How Today's Internet is Killing OurCulture. London: Broadway Business.

[4]. Newman, N. (2011). The Mainstream Media and the Distribution of News in the Age of Social Discovery. Working paper. Reuters Institute for the Study of Journalism, Oxford University.

[5]. Madrigal, A. (2012). "Sorting the Real Sandy Photos from the Fakes." TheAtlantic, October 29. http://www.theatlantic.com/technology/archive/2012/10/sorting-the-real-sandy-photos- from-the-fakes/264243/

[6]. Burgess, J., Farida, V. and Axel, B. (2012). Hurricane Sandy: The Most Tweeted Pictures.The Guardian Data Blog, November 6. http://www.guardian.co.uk/news/datablog/gallery/2012/nov/06/hurricane-sandy-tweeted-pictures

[7]. Diakopoulos, N., Munmun, C., and Mor, N. (2012). Findingand Assessing Social Media Information Sources in the Context of Journalism.Proceedings, CHI'12, Austin, Texas, May.

[8]. Morales, G., Aristides, G. and Claudio, L. (2012). From Chatter to Headlines: Harnessing the Real-TimeWebfor Personalized News Recommendations." Proceedings WSDM'12, Seattle. Washington, February

[9]. Ahmed, H., Traore, I., Saad,S.(2018). Detecting opinion spams and fake news using text classification", Journal of Security and Privacy, Volume 1, Issue 1, Wiley

[10]. Conroy, N.J.; Rubin, V.L.; Chen, Y. (2015).Automatic deception detection: Methods for finding fake news. In Information Science with Impact: Research in and for the Community—Proceedings of the 78th ASIS&T Annual Meeting, ASIST 2015, St. Louis, MO, USA, 6–10 October 2015; Wiley: Hoboken, NJ, USA, 2015; Volume 52, pp. 1–4. [CrossRef]

[11]. Arvin, H., Timothy, T. A., and Jeanette, W. (2021). Detection of Online Fake News Using Blending Ensemble Learning. ICT and Society Research Group, Durban University of Technology, Durban 4001, South Africa

[12]. Shu, K.; Sliva, A.; Wang, S.; Tang, J.; Liu, H. (2017).Fake News Detection on Social Media: A Data Mining Perspective. SIGKDD Explor. 2017, 19, 22–36.

[13]. Mridha, M. F., Ashfia, J. K., Abdul, H., Muhammad, M. M., andSaifur, R. (2021). A Comprehensive Review on Fake News Detection with Deep Learning. Department of Computer Science and Engineering, Bangladesh University of Business and Technology, Dhaka 1216, Bangladesh

[14]. Allcott, H., Gentzkow, M. (2017). Social Media and Fake News in the 2016 Election Journal EconomicsProspect 31(2):211-236

[15]. Wang, W. Y. (2017). Liar, liar pants on fire: A new benchmark dataset for fake news detection," ACL 2017 - 55th Annu. Meet. Assoc. Comput. Linguist. Proc. Conf. (Long Pap., vol. 2, pp. 422–426, 2017, doi: 10.18653/v1/P17-2067

[16]. Lazer, D.M.J., Baum, M.A., Benkler, Y., Berinsky, A.J., Greenhill, K.M., Menczer, F., Miriam,J.M. (2018). The science of fake news. Science 359(6380):1094-1096

[17]. Bakir, V., McStay, A. (2018). Fake News and The Economy of Emotions. Digit Journal 6(2):154-175

[18]. Clayton, K., Blair, S., Busam, J.A., Forstner, S., Glance, J., Greem, G., Bright, A., Welch, A.T., Wolff, A.G., Zhou, A., Nyhan, B. (2019). Real Solutions for Fake News? Measuring the Effectiveness of General Warnings and Fact-Check Tags in Reducing Belief in False Stories on Social Media. Polit Behav. https://doi.org/10.1007/s11109-019-09533-0

[19]. Reis, J.C.S., Correia, A., Murai, F., Veloso, A., Benevenuto, F. (2019). Supervised Learning for Fake News Detection. IEEE Intell Syst 34(2):76-81

[20]. Monti, F., Frasca, F., Eynard, D., Mannion, D., Bronstein, M.M. (2019). Fake News Detection on Social Media using Geometric Deep Learning. Soc Inform Networks arXiv:1902.06673

[21]. Elhadad, M.K.; Li, K.F.; Gebali, F. (2019).Fake News Detection on Social Media: A Systematic Survey. In Proceedings of the IEEE Pacific Rim Conference on Communications, Computers and Signal Processing, PACRIM 2019, Victoria, BC, Canada, 21–23 August 2019; IEEE: Piscataway, NJ, USA, 2019; pp. 1–8.