A Comprehensive Analysis of Machine Learning Approaches for Fake News Detection and Its Effects

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Abstract: This study presents an overview of various studies examining the phenomenon of fake news. It specifically focuses on the impact of fake news on people and the advancements made in machine-learning methods for its detection. The study explores two main strategies for identifying fake news: network techniques and sentiment analysis. It also delves into the use of one-class classification models and the analysis of manually collected datasets from social media platforms. The summary highlights the creation of a labeled benchmark dataset for detecting deception and a study that combines news and social content approaches using machine learning. Additionally, it mentions research conducted on bot-generated posts on Twitter. The primary objective of this new study is to analyze the effects of fake news on individuals and develop machine-learning techniques to detect it, with a specific emphasis on mitigating conflicts, crime, and terrorism resulting from fake news. The methodology involves a systematic literature review to gather qualitative data. The summary concludes by providing a concise summary of the main findings related to the impact of fake news on people and the utilization of machine learning methods for its detection.

Keywords: Fake news, Fake news Publishers, Sentiment analysis, Effects of fake news on humans, Opportunity seekers, hurt the sentiment of people, Machine Learning.

1. Introduction

Everyone is very fond of reading fake news (Awan et al.,2021). Fake news is a false statement of fact defined as an online publication or internationally. When an article or message is posted online with anticipation of the message going viral is known as fake news. Fake news spreads through false rumors, hoaxes, sensationalism, and scandal resulting from the dissemination of news articles through social media and it is spread about monetary, social, and political benefits, for this reason, international harm is debated (Zhang et al.,2019). Fake news is published by opportunity seekers and publishers published fake news in a way that attracts people because they use directly hurt the sentiment of the people. Fake news publishers' main target is anyhow they represent their news as true news and people believe it and their purpose must be achieved at any cost. In essence, fake news applies to sentiment analysis, the branch of information retrieval and information extraction (Rehma et al.,2019). Spreading fake news for the sake of entertainment is a terrible crime. One example would be the news about the *Padma* Bridge in Bangladesh. When the piling work of the *Padma* Bridge started, then rumors spread that "human heads and blood are required" for the piling work of the *Padma* Bridge. This type of news should not be shared with the people because when it turns out to be inaccurate, they become disheartened, afraid, affected by psychological illness or distress, and depressed. Some people are blindly motivated and occurring crimes by this false news or rumors (Amin,2019). Once a person is caught in the trap of fake news, it is challenging to remove themselves from it. In essence, fake news destroys a nation and it has many effects on humans (Pulido et al.,2020). Machine learning also needs to detect fake news (Wang, 2017).

1.1 Objective

This research aims to analyze the effects of fake news on humans and found out the machine learning methods to detect fake news. For fake news, humans are the only sufferer, and fake news is a curse for humans. Fake news has no value but it has a black hand that mentally affected people to do something wrong, to create occurrence (Domenico et al.,2021). My research aims to analyze the effect of fake news on humans and find machine-learning techniques to detect fake news because no one does this.

1.2 Contributions

From my research, people are aware of reading fake news and find out the effect of fake news on humans and find out the machine learning techniques to detect fake news. My research helps humans to know the effect of fake news, especially helping those people who hanker after fake news, and who are so sentimental. The group of people who are so sentimental and maudlin is the audience of my research. They also benefited to know the effect of fake news and the reality of fake news. The war between a country with another country and crime and terrorism are reduced because fake news creates those things but after finishing my research, people know the effect of fake news. My research also helps researchers to find out the machine learning techniques of fake news. In essence, my research helps humans to know and find out the effect of fake news, and find out the machine learning techniques to detect fake news. (Alonso et al.,2022).

2. Related Studies

Over the years, millions of computer scientists have studied and researched the field of fake news, which occurs in our lives every day. Many of them work on fake news and give solutions. One of the solutions is for discovering fake/false news two significant classes of strategies are overviewed. There is two types of classes, one class covered concerned network techniques, in which network information, such as message metadata or organized information organization queries, could be combined to create total misdirection measures (Conroy et al.,2016). One more solution is produced 41 articles on sentiment analysis (SA) through natural language processing. The investigation continues to identify phony websites or erroneous reviews rather than managing false, spurious, or incorrect news. Additionally, the average precision rate decreases the more a feeling difficulty is explored. According to the paper, the emphasis should be on expanding the examination circle so it can continue to examine input in the future (Hussein,2018). One another solution is using one-class classification to detect fake news by developing a solely bogus sample in the training dataset (OCC) model (Fastuni and Covoes,2019). Those researchers have been trying to work on fake news, and they have also somehow been successful (Awan et al.,2021).

Another solution was utilized manually collected datasets from Twitter API and DMOZ, and employed algorithms like Naïve Bayes, Decision Trees, SVM, Neural Networks, Random Forest, and XG Boost. The results indicated that 15% of the tweets were fake, 45% were real, and the rest were undecided (Helmstetter & Paulheim, 2018). Wang, 2017 presented a paper suggesting the use of a labeled benchmark dataset called "LIAR" for deception detection, which exhibited improved efficiency in identifying fake posts/news. The authors advocated for the use of this corpus in various classification tasks such as stance classification, opinion mining, rumor detection, and political NLP research. In (Della et al.,2018), the authors introduced the concept of hoax detection by combining news content and social content approaches using machine learning. They claimed that their approach outperformed the existing literature and implemented it through a Facebook messenger chatbot. Three different datasets consisting of Italian news posts on Facebook were utilized, and both content-based methods and social signals using Boolean crowdsourcing algorithms were employed. The methods used included content-based analysis, logistic regression on social signals, and harmonic Boolean label crowdsourcing on social signals. Finally, (Hinton et al., 2006), the authors observed approximately 14 million messages retweeted about 400 thousand times on Twitter during and after the 2016 U.S. Presidential campaign and election, which were determined to be spread by bots. The paper described the methods used to categorize these bot-generated posts. But still, no one has ever produced research in the field on the effect of fake news on humans and found out the machine learning methods to detect fake news.

Agarwal et al. (2020) focused on developing an innovative approach to detect fake news by employing a combination of neural networks. Their research revolved around the application of deep learning techniques in this context. They emphasized the increasing significance of data as the most valuable asset in our possession. They highlighted the crucial role of data transfer and sharing, particularly when it transforms into valuable information. News articles, available both in physical and digital forms, serve as a common medium for disseminating this information. However, they expressed concern over the detrimental impact of fake news, which hinders the intended purpose of genuine information. They specifically pointed out the profound political consequences of fake news, including the manipulation of public ideologies and opinions regarding democracies and governments. This manipulation further exacerbates societal divisions, particularly during critical political events and elections, ultimately leading to the fragmentation of nations. The objective of their work is to investigate the current solutions available for the specified problems, outline the approach and design of the proposed model, and ultimately evaluate and compare it with the existing solutions. They focus exclusively on addressing the problem of fake news through Natural Language Processing techniques. They propose a method that involves classifying articles as either real or fake, without considering the credibility of their sources. To accomplish this, they utilize

the Kaggle fake news dataset, which contains various columns such as author, text, and title. Given the lack of information about the authors, the authors combine the title and text of the articles in their model. In order to improve practical applications, one potential enhancement could involve verifying the reliability of news sources by extracting data from websites and determining which sources are more likely to propagate fake news. The combined utilization of convolutional and recurrent deep learning approaches in the proposed model demonstrated superior performance compared to using each approach individually. It surpassed alternative methods such as SVM and GRUs, as evidenced by the results and the accompanying plots. The model was implemented in various scenarios, with and without the inclusion of a dropout layer. Incorporating the dropout layer resulted in an approximate 5% increase in accuracy, effectively mitigating overfitting issues inherent in the dataset. The model's architecture was further fine-tuned by adjusting parameters like the number of filters in the Conv1D layer and the number of dense layers, leading to improved outcomes. In future investigations, incorporating additional features such as article source, author, and user responses alongside the proposed model could potentially pave the way for an advanced solution to address the potentially harmful phenomenon of "digital wildfire." The limitations of the approach described in the paper include its exclusive reliance on a labelled dataset, limited pre-processing using the NLTK library, and the use of pre-trained GloVe embeddings. While GloVe embeddings provide valuable word representations, they do not capture context-specific nuances, and the model's feature extraction primarily relies on convolutional and recurrent neural networks, which may not fully capture complex linguistic patterns. Additionally, the proposed tool lacks a rating or label system for article credibility, and further improvements are needed to incorporate additional input attributes for more accurate predictions and user engagement.

Abdulrahman et al. (2020) focused on developing machine learning and deep learning algorithms for detecting fake news. With the advent of the Internet and mobile smart devices, people have increasingly turned to online platforms to access news, instead of relying on traditional TV stations. However, it is important to acknowledge that obtaining news from the Internet has its drawbacks, including lower overall news quality compared to traditional television. Nonetheless, the trend of individuals receiving news through the Internet continues to rise. The primary objective of this research was to tackle the difficult task of categorizing fabricated news on social media platforms using natural language processing techniques. The study utilized various classifiers for analysis, including machine learning models such as random forest (RF), k-nearest neighbor (k-NN), Naïve Bayes multinomial (NB), linear support vector machines (LSVM), logistic regression (LR), and boosting classifiers like AdaBoost and XGBoost. Additionally, deep learning models were employed, namely an artificial neural network implemented with Keras (ANN), a recurrent neural network incorporating long short-term memory (RNN+LSTM), and a convolutional neural network-integrated with long short-term memory (CNN+LSTM). The study applied machine learning and deep learning classifiers with different feature extraction techniques. The TF-IDF method combined with machine learning classifiers achieved the highest average rating accuracy of 91.23%, with AdaBoost achieving a perfect accuracy of 100%. However, the K-NN classifier showed poor performance with an accuracy of 81.92%. The use of other feature extraction techniques such as count vectorizer and character level vectorizer resulted in balanced performance across classifiers. In the deep learning stage, CNN + LSTM achieved 100% accuracy quickly. The study compared these results with previous work, both in general and specifically using the Kaggle fake news dataset. An unexplored area not addressed in this study pertains to the dissemination of fake news through non-textual means, such as fake images or videos, on social media. To address this limitation, future research should consider employing the CNN algorithm, known for its efficacy in classifying both text and images, to classify various types of fake news, whether textual or non-textual in nature.

Sharma et al. (2020) worked on developing machine learning algorithms for the detection of fake news. They devoted their efforts to provide models that could effectively distinguish between real and fake news articles. The objective of this research is to utilize Artificial Intelligence, Natural Language Processing, and Machine Learning to classify online news articles into two categories: fake or real. Additionally, they intend to offer users the ability to verify the credibility of the websites that publish these news articles. With the increasing prevalence of online social media platforms, people are increasingly turning to these platforms to obtain news instead of relying on traditional news organizations. This shift in consumption behavior can be attributed to two key factors. Firstly, consuming news on social media is often more convenient and cost-effective compared to traditional journalism mediums such as newspapers or television. Secondly, social media platforms make it easier for users to share, discuss, and engage with news stories alongside their friends and other readers. This paper presents a three-part system. The first part involves a static component that utilizes a machine learning classifier. The researchers examined and trained four different classifiers, ultimately selecting the most effective classifier for the final execution. The second part is dynamic and involves taking keywords or text input from the user, which is then used to search online for the likelihood of the news being true. Lastly, the third part focuses on verifying the authenticity of the URL provided by the user. The authors of the paper utilized Python and its Sci-kit libraries for their work. Python offers an extensive collection of libraries and extensions, making it convenient for machine learning tasks. They specifically relied on the Sci-Kit Learn library, which provides a comprehensive range of

machine learning algorithms that can be easily implemented in Python. This allowed for quick and straightforward evaluation of machine learning algorithms. To facilitate web-based deployment of their model, they employed Django, which enabled them to incorporate client-side implementation using HTML, CSS, and Javascript. Additionally, they utilized Beautiful Soup (bs4) and requests for online scraping purposes. After evaluating various models, they found that Logistic Regression performed the best with an initial accuracy of 65%. To further enhance its performance, they employed grid search parameter optimization, resulting in an increased accuracy of 75%. Consequently, if a user submits a specific news article or its headline to our model, there is a 75% probability that it will be correctly classified according to its true nature. If a user inputs a specific news article or its headline into their model, there is an 80% likelihood that it will be classified correctly according to its true nature.

Khanam et al. (2021) explored the application of traditional machine learning models to develop a supervised machine learning algorithm for fake news detection. They utilized tools such as Python's scikit-learn library and NLP techniques for textual analysis, aiming to create a model capable of classifying news articles as true or false. Misinformation, commonly found in fake news, disseminates misleading data that can be fact-checked. It perpetuates false claims about statistics in a country or exaggerated costs of services, potentially inciting unrest, as seen in events like the Arab Spring. To address this, organizations such as the House of Commons and the Crosscheck project aim to establish author accountability and combat these issues. The suggested solution takes into account the limitations of relying solely on human manual detection, given the vast number of articles being published or removed every minute. To address this challenge, they propose the development of an automated system that can provide a reliable index scoring or credibility rating for different publishers and the context of news articles. This solution aims to overcome the limitations posed by manual processes and offer a more feasible and accountable approach in the ever-expanding global landscape of news content. They suggested, utilizing the Python scikit-learn library for feature extraction and vectorization of text data. This library offers valuable tools such as Count Vectorizer and Tfidf Vectorizer. Following that, they will apply feature selection methods to identify the most suitable features, based on the confusion matrix results, aiming to achieve optimal precision. The analysis of a dataset using six different algorithms for fake news detection revealed the following results: XGboost achieved the highest accuracy of over 75%, followed by SVM and Random Forest with approximately 73% accuracy. The confusion matrix obtained through Python code provided these findings. In their study, they aim to enhance existing methodologies by incorporating POS textual analysis as a quantitative approach. By introducing additional numeric statistical features, such as total words, total unique words, TTR, number of sentences, ASL, number of characters, AWL, nouns, prepositions, adjectives, etc., they anticipate that employing a random forest algorithm will yield improved precision results. [4]

Chauhan et al. (2021) worked to enhance the effectiveness of fake news detection through the utilization of deep learning methodologies, with the ultimate goal of benefiting society. The rise of the internet and social media platforms like Facebook and Twitter has revolutionized information dissemination. News outlets now deliver real-time updates to subscribers through online platforms, benefiting from social media's wide reach. However, these platforms can also be misused for spreading fake news, leading to problems in various domains, including politics, finance, and health. Consumers' decision-making and worldview are influenced by the information they consume, making it crucial to identify and address fake news effectively. According to the findings of the researchers, the majority of existing literature concentrates on specific datasets or fields, with a strong emphasis on the politics domain. Consequently, the algorithm's performance is most effective when applied to articles within a specific domain, and it does not attain optimal results when presented with articles from different domains. Given that articles from various domains possess distinct textual structures, developing a generic algorithm that performs optimally across all news domains proves challenging. Their research introduces a solution to the problem of detecting fake news through the application of a machine learning ensemble approach. They investigate various textual properties that can be utilized to differentiate between fake and genuine content. These properties are employed to train a combination of diverse machine learning algorithms using ensemble methods that have not been extensively explored in existing literature. Ensemble learners have demonstrated their utility across a wide range of applications, effectively reducing error rates through techniques like bagging and boosting. These techniques facilitate the efficient and effective training of different machine learning algorithms. They further conducted extensive experiments using four publicly available real-world datasets. The outcomes confirm the enhanced performance of our proposed technique, as measured by commonly used performance metrics, namely accuracy, precision, recall, and F-1 score. The accuracy results of different algorithms on the four datasets are summarized as follows. On DS1, the random forest algorithm and Perez-LSVM achieved the highest accuracy of 99%, while linear SVM, multilayer perceptron, bagging classifiers, and boosting classifiers achieved an accuracy of 98%. Ensemble learners had an average accuracy of 97.67% on DS1, outperforming individual learners (95.25%). On DS2, the best performing algorithms were the bagging classifier (decision trees) and boosting classifier (XGBoost) with an accuracy of 94%. On DS3, ensemble learners achieved an accuracy of 93.5%

compared to individual learners' accuracy of 80%. The random forest algorithm achieved the highest accuracy of 91% on DS4. Precision, recall, and F1-score results indicate that boosting classifiers (XGBoost) performed well across multiple metrics, followed by the bagging classifier (decision trees) and logistic regression.

3. Methodology

A systematic Literature Review (SLR) is appropriate for my research because I planned to answer from other studies (kitchenham et al.,2010). Quantitative data helps me to find out for analyzing numeric values (Bloomfield and Fisher,2019). For my research quantitative data don't help me to answer my research question, qualitative data help me that's why I selected SLR for my research. According to kitchenham et al. (2010); Kalhoro et al. (2021) both also used SLR as their research method. Ismail et al. (2023) also used SLR in their research.

3.1 Literature Search

For my research purpose, I searched 6 publishers, they are named Google Scholars, Science Direct, IEEE Xplore, IGI Global, Springer, Wiley. In those publishers, I searched using some keywords, those are affects or impacts or result or outcome or out-turn and fake or false rumors or hoax news. I also applied forward searches, backward searches, and DBLP to gather relevant information for my research purpose.

3.2 Literature Selection

For literature selection from the initial search, I select 6 papers from Google Scholar, 2 papers from Science Direct, 1 paper from IEEE Xplore,1 paper from IGI Global, 1 paper from Springer, and 1 paper from Wiley. After that, I select 7 papers as my final selection from those 12 papers. I exclude one paper for redundant,3 for not relevant, and one for not in English. I excluded those papers because of wrote down the laws for publishing fake news, writes about some legal concerns, laws, and punishment for publishing fake news, write about the detection of fake news and give the idea why, how, which reason, or which way fake news spread, and paper is written in Chinese language but the title of the paper is in English.

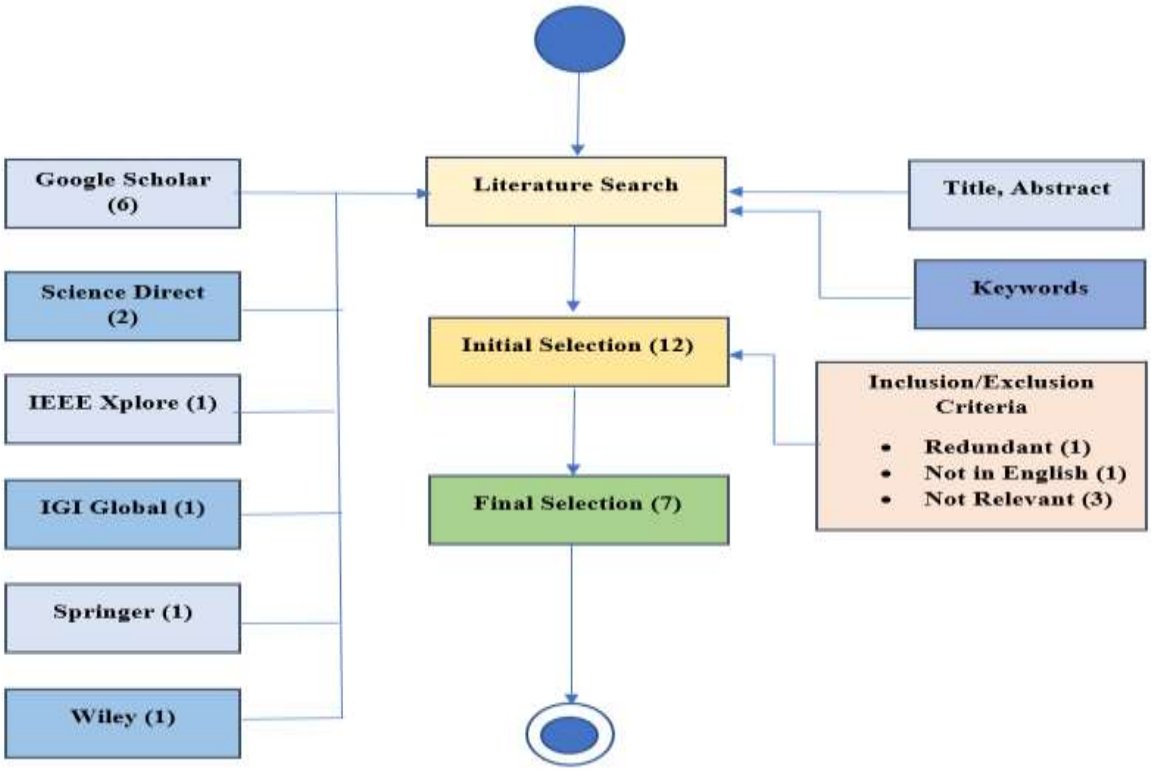

Figure 1: Use of Prisma guideline for Literature Selection

4. Results and analysis

4.1 Effects of Fake News

SN	Citation	Extracted Information
1	Zhang et al.,2019	Fake news has the power to impact how a person makes decisions and can distort their understanding of accurate information.
2	Awan et al.,2021	Tarnish the good standing of a highly regarded corporation through the dissemination of false information or unfounded rumors, causing detriment to the government, resulting in financial, social, and political losses, exploiting public sentiment and leading to criminal activities.
3	Meel and Vishwakarma,2021	Deceiving individuals through the dissemination of fabricated or inaccurate information.
4	Olan et al.,2021	The impact of false information is influencing societal norms, reshaping perspectives on important subjects, and challenging established facts, truths, and convictions.
5	Parikh et al.,2019	Fake news is mistakenly perceived as genuine by individuals who consume news, leading them to react in a state of panic.
6	Liao et al.,2021	Pose a risk to the trust of the public and consistently lead to confusion.
7	Tandoc,2019	Publishers have the ability to damage reputations, destroy businesses, distort public discussions, and influence political choices through the dissemination of fabricated news.

4.2 Subfields of AI To detect fake news

SN	**Citation**	**Used Techniques**
1	Helmstetter & Paulheim, 2018	Naïve Bayes, Decision Trees, SVM, Neural Networks, Random Forest, and XG Boost
2	Wang, 2017	NLP
3	Della et al.,2018	Content-based, Logistic regression on social signals, Harmonic Boolean label crowdsourcing on social signals.
4	Abdulrahman et al. 2020	Utilized various classifiers for analysis, including machine learning models such as random forest (RF), k-nearest neighbor (k-NN), Naïve Bayes multinomial (NB), linear support vector machines (LSVM), logistic regression (LR), and boosting classifiers like AdaBoost and XGBoost. Additionally, deep learning models were employed, namely an artificial neural

		network implemented with Keras (ANN), a recurrent neural network incorporating long short-term memory (RNN+LSTM), and a convolutional neural network-integrated with long short-term memory (CNN+LSTM).
5	Sharma et al. 2020	Used Logistic Regression
6	Khanam et al. 2021	Random Forest, XGBoost, SVM

5. Analysis and Discussion

The research on fake news shows the effect of fake news on humans. Humans are disheartened, afraid, affected by psychological illness or distress, depressed, panicked, misled, and sentimentally dishearten by reading fake news. Sometimes people are reading fake news interpreted as real and they do terrorism, crimes, tarnish reputations, ruin businesses, and go against the government. We can get rid of these effects by justifying real or fake news, paying attention to where news is coming from if get information from social media, checking the original source, finding out what other information is out there, and getting news from varieties of sources, and so on. We also found that machine Learning techniques are efficient to detect fake news.

6. Conclusion

The field of fake news has been extensively studied by computer scientists, who have proposed various solutions to tackle this issue. The research has primarily focused on two main areas: network techniques and sentiment analysis. Network techniques involve utilizing network information to create measures for detecting fake news. Sentiment analysis, on the other hand, focuses on identifying fake websites or erroneous reviews. Additionally, machine learning algorithms such as Naïve Bayes, Decision Trees, SVM, Neural Networks, Random Forest, and XG Boost have been employed to detect fake news. Despite the extensive research on fake news, there is a gap in understanding the effects of fake news on humans and developing machine learning methods to detect it. Fake news has a detrimental impact on individuals, influencing decision-making, distorting perceptions of real news, threatening public confidence, and causing misunderstandings. It can also lead to reputational damage, harm governments, result in financial and social losses, and even incite criminal behavior. The research objective of this study is to analyze the effects of fake news on humans and develop machine-learning techniques to detect it. By addressing this research gap, it will contribute to raising awareness among individuals, particularly those who are vulnerable to fake news due to their sentimentality. This research has the potential to mitigate the negative consequences of fake news, such as reducing conflicts, crime, and terrorism that may be instigated by misinformation. Additionally, it will provide valuable insights to researchers working on developing machine-learning methods for fake news detection.

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