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A Systematic Literature Review on Machine Learning Algorithms for the Detection of Social Media Fake News in Africa

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Abstract

Fake news has been around in history before social media emerged. Social media platforms enable the creation, processing, and sharing of various kinds of content and information on the Internet. While the mediums of information and content shared across social media platforms are hard for users to authenticate, if users are tracking fake information or fake content, it can harm individuals, society, or the world. Fake news is increasingly becoming a worrisome issue, especially in Africa, because it's difficult to identify and stop the distribution of fake news. Due to languages and diversity, it is difficult for humans to understand and subsequently identify fake news on social media platforms, so high-level technological strategies, such as machine learning (ML), would be able to tell if the content is false material. As such, this study sought to identify effective ML classifiers to detect fake news on social media platforms, and the systematic literature review followed the PRISMA standard. The study identified 14 effective ML classifiers to manage fake news on social media platforms, including Random Forest, Naive Bayes, and others. Four research questions guided the study focused on the effectiveness of the classifiers, their applicability for detecting different forms of false news, the features of the dataset size and features, and the metrics that were created to assess the metrics. A conceptual framework known as the Information Behavioral Driven Social Cognitive Model (IBDSCM) was proposed in a bid to affect the fake news detection on social media platforms. Overall, this study establishes a contribution to understanding the ML algorithms for detecting false news in Africa and allows for a conceptual base for future studies.

Keywords: Africa, machine learning, social media, Fake news

1. INTRODUCTION

Social media has a profound impact on society, both positive and negative. The rapid dissemination of information through social platforms has made it increasingly difficult to distinguish real news from fake news [1]. This spread of misinformation, whether direct or indirect, has significant consequences,

influencing various sectors such as education, politics, health, entertainment, and sports across Africa. These sectors shape individual and organizational opinions, attitudes, and behaviors. Some social media users exploit these platforms for financial gain, while others use them to propagate biased views or ideological narratives [3]. This environment fosters the virulent spread of fake news, which can reach vast audiences with alarming speed.

The consequences of fake news are not merely theoretical; they have tangible effects on both individuals and organizations. For instance, fake news can harm reputations, fuel societal panic, and promote dangerous propaganda. As noted by Konkobo, Zhang, Huang, Minoungou, Ouedraogo, and Li [4], fake news has garnered increasing attention in academic research. This growing body of work highlights the severe risks posed by false information on social media platforms. Furthermore, according to Ahmed, Aljabouh, Donepudi, and Choi [5], fake news can tarnish the reputations of individuals and organizations, leaving them vulnerable to the negative consequences of misleading narratives.

The challenge in combating fake news stems from human limitations in detecting it. The inability to easily identify fake and unverified content on social media platforms exacerbates the problem [1]. To address this issue, advanced technological solutions, such as machine learning (ML) algorithms, have emerged as promising tools for detecting fake news. These algorithms, which belong to the broader field of artificial intelligence (AI), are designed to learn and adapt to patterns in data. ML can effectively detect and flag fake news by analyzing vast amounts of social media content, making it an essential tool for addressing misinformation.

Machine learning algorithms can learn from large datasets and recognize patterns within them, making it possible to detect misinformation in real-time. ML is divided into three main categories: supervised learning, unsupervised learning, and reinforcement learning. Each of these categories relies on algorithms that are trained on specific datasets to predict or identify unknown behaviors or events. In the context of fake news detection, ML algorithms are trained to recognize characteristics of fake news articles or posts based on their features, such as language patterns, source credibility, and topic consistency. This study aims to explore the use of ML algorithms (specifically classifiers) in detecting fake news on social media, focusing on four key research questions. These include investigating various types of classifiers, examining their applications in detecting fake news, understanding the impact of dataset features, and assessing evaluation metrics, particularly in the context of African languages, a relatively under-researched area. The findings of this research are expected to empower both researchers and practitioners to develop more effective algorithms for combating fake news.

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The spread of fake news is often motivated by the intent to deceive, cause panic, or promote a specific agenda [6]. As Khan and Thakur [7] note, fake news refers to deliberately misleading or false information. In recent years, concerns about the proliferation of fake news on African social media platforms have reached alarming levels. A notable example occurred on January 9, 2018, when AllAfricaNews reported the resignation of South African President Jacob Zuma, a story that was later debunked as fake news [8]. This incident is just one example of the widespread impact that fake news can have on public perception and trust in media.

As internet and social media usage continue to grow in Africa, the prevalence of false news is becoming an increasingly urgent issue. Misinformation on social media platforms can significantly influence public opinion on crucial issues, potentially leading to widespread disinformation. Traditional methods of fact-checking, although effective to some extent, are often too slow and limited in scope to keep up with the ever-evolving nature of fake news. With its ability to process and analyze vast amounts of data rapidly and reliably, machine learning has emerged as a promising solution for detecting fake news on social media platforms. However, the effectiveness of ML algorithms in African contexts, where linguistic, cultural, and socio-political factors come into play, remains an open question.

The issue at hand is the growing need for ML-based solutions to detect fake news in Africa, as the challenges faced by traditional fact-checking methods become more apparent. The specific research questions guiding this investigation include:

1. Why is machine learning essential for detecting fake news on social media?
2. Which machine learning classifiers are most suitable for detecting fake news on social media?
3. How can machine learning be trained to detect fake news on social media?
4. What are the key elements of the Information-Motivation-Behavioral Skills (IMB) model and the Social Cognitive Theory (SCT), and how can they be integrated to create effective interventions for promoting the detection of fake news on social media in Africa?
5. How effective are machine learning algorithms for detecting fake news on social media within the African context?

The difficulty in identifying and halting the spread of fake news on social media is exacerbated by Africa's unique linguistic, cultural, and socio-political context [10]. While machine learning has shown promise in detecting fake news in other parts of the world, most research has been conducted in contexts that differ from Africa's, with few studies focusing on the African continent. As such, there is a clear need for tailored ML models that account for Africa's diverse linguistic and cultural landscape.

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To address these challenges, theoretical frameworks like the Information-Motivation-Behavioral Skills (IMB) model and the Social Cognitive Theory (SCT) can provide valuable insights into how interventions can be designed to combat the spread of fake news. By incorporating these frameworks into the development of ML-based mechanisms, this study aims to create a more accurate and culturally appropriate approach for detecting fake news in Africa. Through this research, we hope to contribute to the development of more effective ML models and interventions that can be used to combat the spread of fake news across African social media platforms.

2. LITERATURE REVIEW

For decades in Africa, the growing concern about fake news is worrisome. For example, the 1994 genocide in Rwanda exemplified the consequences of fake news in Africa with social media platforms. Presently, social media platforms stand out as a major source of information and content on various issues and discussions, as well as a breeding ground for fake news and misleading information in Africa. Social media penetration presents a lot of consequences and challenges for humans and society. However, machine learning (ML) algorithms and classifiers are a promising tool to assist in detecting social media fake news and misinformation in social media platforms, especially in Africa. In practice, big datasets are available to ML, and it has the ability has access them, extract, evaluate, analyze, understand, and interpret data patterns and news trends.

The ML can utilize an assortment of highlights, like semantic, etymological, and network-based attributes (features), to recognize designs and characteristics of social media misleading information and fake news. Be that as it may, there are still numerous challenges to be addressed, such as the etymological and social differing qualities of African dialects, restricted resources for collecting and labeling datasets, and the potential for bias in ML models. Tending to these challenges will be vital for the improvement of compelling and moral ML algorithms for identifying fake news on social media in Africa.

Experts say that using ML can assist in detecting fake news on social media like Facebook, Twitter, and WhatsApp. Scientists found out that supervised ML tools like Random Forest, Support Vector Machines (SVM), and Logistic Regression do a good job of spotting fake news on social media [11, 12]. ML classifiers that can group things based on their features have mostly been tested on sets of data from different parts of the world. Most of these studies have been conducted using data collected in the United States [13, 14, 15, 16]. However, there is still a need to create and test these algorithms on fake news data that is posted on social media in Africa. Then, the cause of fake news on social media can be understood through

theories like "Social Cognitive Theory and Information-Motivation-Behavioral Skills model" to assist in creating better ways to stop the spread of fake news [17].

2.1. Theoretical perspective

Different theoretical frameworks can be integrated in this study to underpin the main objective of the paper. However, "Information-Motivation- Behavioral Skills (IMB) and Social Cognitive Theory (SCT)" provided the basis for proposing the conceptual framework to help in addressing the growing challenge in detecting social media-aided fake news using ML. The IMB model is a key in understanding variables that impact social media users' behavior. The next section provides a discussion of IMB components:

1) Information

Social media content and information vary. However, users need to have accurate and relevant information and content to be able to understand and detect social media-aided fake news. The information component of the IMB model focuses on identifying and understanding the attributes of fake news. Furthermore, users' ability to detect fake news and its consequences lies in whether accurate, correct, and relevant information is available to them. For example, the availability of accurate and correct information will increase the chance for users to spot and recognize fake news on social media. Then, the availability of accurate, verifiable, and relevant information will challenge the harmful effects of fake news and the spread, which will eventually discourage people from engaging in the act.

2) Motivation

Motivation is required for social media users to develop attitudinal behaviour and spot any form of misleading information or fake news. Motivation in the IMB model can be defined as an attitude, belief system, and social standard (norms) that assist users in spotting fake news. For example, if users see the need to stop the spread of fake news, they act positively to safeguard themselves and prevent others from being harmed. High motivation is linked to a lower chance of spreading fake and misleading news on social media. An optimistic attitude towards detecting false news can assist in promoting people's incentive to engage in positive behaviour.

3) Behavioral skills

This component believes that individuals should possess certain behavioral attributes to recognize and report fake news on social media. The capacity to spot and report false news using ML algorithms and other technologies to spot fake news and other misleading information can be controlled and managed through

behavioral skills within the IMB model. This component needs a feeder of knowledge and training for it to develop and function. According to Wang, Zhang, Fan and Zhao [18], a health communication that provide information, intervention, instruction and training in a medical emergence like COVID-19 pandemic dramatically improve their behavioral abilities to spot disinformation and misinformation online.

The IMB approach stressed the importance of equipping users with the correct, relevant, and pertinent knowledge, with the development of behavioral skills to spot fake news on social media with ML. Any interventions on these factors can decrease the dissemination of false news and misinformation on social media and promote the behavior to understand and spot such content.

The Social Cognitive Theory (SCT) can be regarded as another theoretical framework used in literature to understand and spot the trends and patterns of false news on social media with the aid of ML. To SCT, behavior is a function of individual, social (environmental), and behavioral variables. It means that people gain knowledge by observing and seeing others behave, and the consequences thereof. The SCT recognized that an individual's knowledge, attitudes, and level of self-efficacy, as well as contextual elements such as social norms and media literacy programs, are catalysts in identifying social media fake news. Also, SCT contends that identifying false news might reinforce one from engaging in leading to favorable effects such as feeling better educated or being appreciated and accepted by others.

In practice, Dabbous, Aoun Barakat, de Quero Navarro, and Malik, Islam and Mahmood [19] and Malik, Islam and Mahmood [20] applied SCT in studies to develop a model that evaluates components that affect people's intention to identify and understand social media fake news. The authors found that intentions to identify and understand false news are linked to self-efficacy, attitude, knowledge, and social norms. This implies that promoting good behavior of identifying and understanding social media false news might be possible by applying methods that promote people's self-efficacy, attitude, knowledge, and social support. The SCT elements can be applied in this form:

a) Self-efficacy: Self-efficacy shows that a person possesses a unique behavior. For example, a five-item scale study was conducted to estimate people's self-efficacy to spot social media false news [19, 20]. The study found that self-efficacy strongly predicts the intentions to identify false information. According to this research, social media users who have positive confidence in their ability and capacity to do so are likely to form an intention to detect fake news on social media.
b) Knowledge: Knowledge is understood to be the awareness of behaviour and its consequences. A study was conducted using a four-item scale in

order to assess participants' knowledge and understanding of false news [19]. The authors highlighted that knowledge is a predictor of users' intention to determine false news. The results suggest that individuals who have greater awareness of fake news are more likely to be able to avoid fake news.

c) Perceived social norms: The perceived social norms in an individual's social environment and social (others') view and expectations of what individuals should do are referred to as perceived social norms. Malik et al. [20] and Dabbous et al. [19] used a four-item scale to measure their participants' perception of social norms regarding detecting false news on social media. The results indicated that perceived social norms were a predictor of intention to detect false news on social media. Perceived social norms can reflect social norms and environments that can affect individuals' motivation when they think that detecting fake news is socially acceptable.

For this investigation, knowledge, self-efficacy, and perceived social norms are three core SCT components that affect a person's intention to identify social media fake and misleading information. The research findings yield insights that any intervention suggesting people increase their knowledge, self-efficacy, and social support will encourage positive behaviour toward showing individuals how to identify social media fake news and content. The IMB and SCT provide better features and components that inform the conceptual framework that combines ML classifiers and algorithms to identify false news and content on social media.

2.2. Negative Consequences of Social Media Fake News

Can you trust what you read or see on social media? Social media is an online platform that connects a community of like-minded individuals and organizations to share content freely. The platform provides users with information and content to form opinions, behavior, attitude, reactions, and actions. Elsaeed et al. [21] suggest that social media provide an opportunity for users to communicate and share information and content unsupervised by anyone. The platform allows users to easily post, share, and comment on shared content. Social media freedom allows anyone to post anything they desire without editing or supervision [1].

Freedom of expression on social media promotes fake news. However, fake news spreads more quickly on social media platforms than any other media. Fake news is as old as history in the human race. It affects different sectors and countries in Africa. Different governments globally continue seeking ways to mitigate and fight their effects. Fake news and the Internet go together, especially in Africa, due to the high penetration of social media. Elsaeed et al. [21] and Bojjireddy, Chun and Geller et al. [22] believed that fake news is regarded as a critical issue with great consequences for individuals, organizations, and countries.

According to Aldwairi and Alwahedi [23], Internet fake news is fabricated news and information geared to deceive online users and readers. While Bojjireddy et al. [22] see fake news as false news or information on current issues, intending to mislead or deceive readers. Users on social media publish fake news to drive readership and audience. This process is a psychological affair or welfare to increase the audience for profit. There are different social media platforms, such as Facebook, WhatsApp, Twitter, Instagram, and others are used to spread fake news. However, Facebook is the most popular platform to spread fake news on social media [21]. Fake news on social media platforms spreads through videos, text, audio, and pictures, and detecting it is challenging.

Fake news is destructive and is fueling different crises in Africa and globally. Fake news is an intentional spread of misleading information using traditional or social media. Fake news spread can be attributed to an increase in social media usage in Africa among young and old. Fake news spreads quickly on social media, and it is difficult to distinguish fake from real news [1]. For example, the COVID-19 pandemic that was announced by the World Health Organization (WHO) at the beginning of February 2020 witnessed a lot of fake news since the outbreak of the virus, which caused much misleading information and infodemic [24]. The crisis created by fake news is a major concern for individuals, organizations, and the government.

The negative impact leaves the readers and recipients depressed and in a state of panic and perplexity [16]. For example, the US presidential election and other elections in Africa, and the COVID-19 pandemic saw the rise of fake news. People share and re-share social media information, which at the end of the day is confirmed to be fake news. According to [1], the main reason fueling fake news and information is caused by Naïve realism (some humans believe that personal views and opinions are correct, opposite views are labeled "uninformed, biased or irrational", Truth-bias (humans tend to presume truth through social engagement and interaction based on personal conviction) and confirmation bias (human tend to believe news/information that conform to the personal interest and views).

Fake news is contributed by contributors which can be categorized into three types, cyborg users (this is a combination of humans and computers to generate harmful news and information), trolls (real humans with the purpose to cause to provoking emotional pain /harm and change public opinion) and social bots (content creator by computer algorithm) [1]. No matter the causes and contributors of social media fake news, the effect is a concern and must be detected and controlled, which motivated the conduct of this research.

2.3. Machine Learning (ML)

As noted earlier, ML can be used to detect, manage, control, and eliminate social media fake news. ML works with text classification, which is used in natural language processing (NLP). According to Elsaeed et al. [21], NLP uses a program to group text documents based on defined classes. NLP uses a computer algorithmic system to understand and generate speech, which can be used to detect human or computer actions across different languages [24]. Using Emotion Analyzers and Detection, Named Entity Recognition (NER), Chunking, Parts of Speech, and even more, NLP can identify and extract actions for Italian, English, and Dutch speeches.

Monitoring social media and other platforms for disinformation and fake news poses a challenge that needs to be dealt with promptly. No one is safe from the effects of disinformation, considering that it can lead to severe damage to society and humankind. Among other options mentioned provides quite an intriguing workaround in automating disinformation and fake news detection. Automated solutions offered by Artificial Intelligence do provide streamlining alternatives at the level of human-machine interactions of sorts. In Bojjireddy et al. [22] analysis, ML appears to be one of the promising methods in squashing the problem of discerning credible news from dubious content.

As a result of social media's ever-growing popularity, various social media platforms have posed significant research scenarios due to their complex structure. Furthermore, social media is a rich source of data and information for every individual due to its limitless exploration opportunities despite financial constraints, the scope of usage, and diverse interests. In recent studies, this approach led to social media deceit detection algorithms that can automatically identify stories that are false and categorize them accordingly. Such algorithms, which use labeled data to detect distinguishing features of fake news, can now be applied to social media platforms. This method has promising results in prior investigations [3].

Automation of monitoring and analysis via social media, ML practitioners can help detect and remove false news and content. It also opens opportunities for automated monitoring, evaluating, and analysis of large amounts of datasets to be scanned for patterns, behaviors, and traits that distinguish false from true and accurate news. For example, ML algorithms are trained to identify patterns and traits associated with false news by seeing two groups of input patterns of data labelled as false news and true news. The discovery of patterns, traits, and distinctions associated with misleading and misconception laden news produces sufficient knowledge for the ML algorithm to trigger action to flag the news as either fake or misleading news. Random Forests, SVM, and Deep Neural

Networks (DNN) are only a few examples among many in employing ML algorithms for understanding the challenges presented by fake news within social media [25, 26].

In addition, ML models can also utilize aspects such as language features (traits), user movement patterns of engagement, sentiment analysis, and even social network movement behavior to identify false information. The enhancement of ML with natural language processing (NLP) can be used to evaluate and break down what a news text is and look for manipulative language and tactics. In addition, news social networks can be analyzed using social network analysis technology to evaluate the structure, function, and movement of a disinformation social network, which will assist in drawing the source and pathways of that activity [25]. The multilayered nature of data, combined with the complexity of data and our universal reliance on social media, has made it possible for machine learning algorithms to effectively and efficiently identify false news within and across social media platforms.

The models can also continue training on real-time data, meaning that the models can continue customizing and responding to trends, traits, new feeds, and strategies developed by purveyors of false news. The ML algorithms, together with the ongoing monitoring of social media platforms, will assist with the flagging and detection of false or questionable content and information in real-time and give time to users and moderators for notification. This proactive stance will be able to slow the instantaneous dissemination of fake news and its subsequent immediacy effects on the public, and the trust that society places on content [27]. There are potentially scalable, semi-automation, or automated approaches from ML that can assist with the detection and moderation of false news on social media platforms.

3. RESEARCH METHODOLOGY

It is possible to do academic research in the form of a literature review. A literature review methodology can help answer some research questions [5]. In a literature review methodology, the information systems researcher is able to find answers to the questions underlying this research. This research used a systematic literature review (SLR) to apply the principles of systematic review and meta-analysis (PRISMA) to study how ML can be used to identify social media fake news and to answer the research questions. In answering the research questions, we screened, reviewed, and discussed the academic papers. The research applied inclusion and exclusion criteria to decide on a relevant paper for the research. Inclusion and exclusion criteria were aimed at setting the parameters for the academic papers (materials) to use and those not suitable for the research. Table 1 presents the inclusion and exclusion criteria for the study [5]. Importantly, the included and selected papers were based on the quality assessment that includes but is not

limited to peer-reviewed papers, papers addressing and focusing on the research topic, abstract and introduction covering the key areas of the research topic, and conclusion providing a guide for future studies, and many more.

Table 1. Inclusion and exclusion criteria

No	Inclusion criteria	Exclusion criteria
1	Only academic papers	Not academic papers.
2	English written papers.	Papers not written in the English language.
3	Screen papers.	Papers not screened.
4	Papers whose contents cover machine learning, social media, and detecting fake news.	Papers without the content of machine learning, social media, and detecting fake news.

After establishing the inclusion criteria, the paper's search process begins. The search process involves the discovery of papers relevant to the study in addressing the research objectives and questions. The search process and screening were done online across different academic databases. The academic online databases used are Elsevier (Scopus), Google Scholar, and ResearchGate in searching the research keywords like machine learning, social media, and detecting fake news. Any retrieved papers on the included databases were screened. The search process starts with the evaluation of the paper topic, followed by an abstract, full content, and conclusion. Through the PRISMA techniques, the researcher selected and analyzed peer-reviewed academic papers and materials, textbooks, and books that cover the research topic [28] with keywords like fake news, social media, machine learning, and others.

3.1. The paper selection eligibility

The selection process in determining the article eligibility began with the paper topic and abstract, in looking at those papers that focused on the study under investigation, and non-aligned papers were immediately excluded from the screening. Only those that met the inclusion criteria were considered and used for the study. A total of 150 academic papers were gathered and deemed suitable from the above-mentioned search engines and databases against the keywords guiding the study, and 25 were used and discussed in the study. The excluded papers were only those that failed to cover issues within the keywords and the topic at large. Figure 1 presents the screening, selection, and eligibility of the papers for the study following the PRISMA in an SLR principle. PRISMA presents four prime categories, namely Identification/Selection, Screening, Eligibility/Qualification, and Used/Included [29]. Identification/selection provides the number of all the

articles searched and recorded on the chosen academic database search engine, screening deals with the articles screened for study including the excluded ones, and eligibility/qualification covers all the articles that are considered including those removed for specified reasons and used/included all the articles that used in the study (meta-analysis) [28, 29].

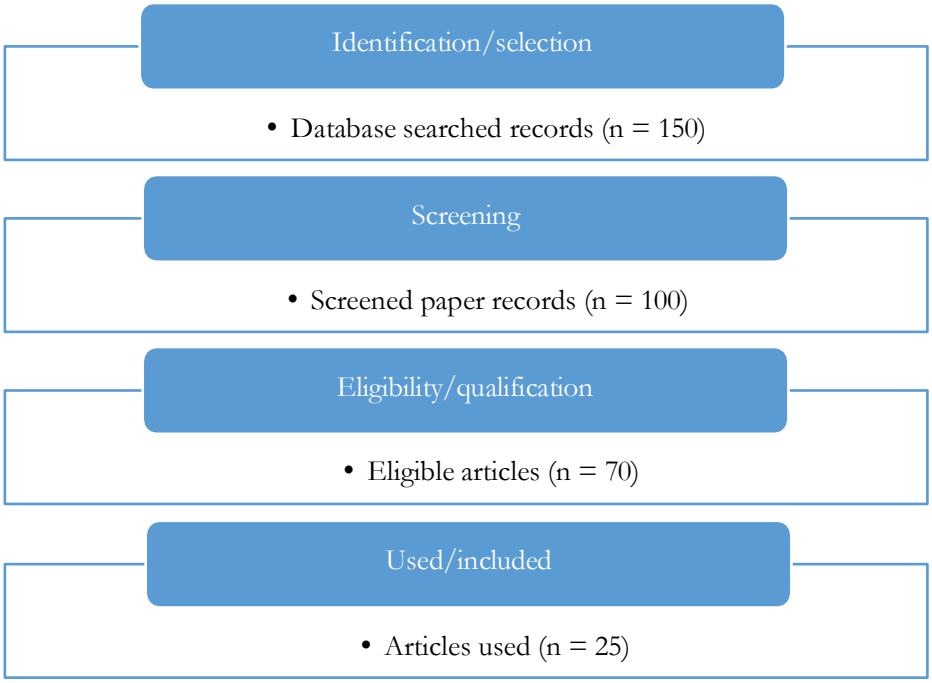

Figure 2. PRISMA eligibility process for the study

There is a growing academic research interest in ML and social media. For example, the detection of fake news through ML techniques, approaches, and ensembles methods [2, 24, 22, 3, 30]; the application of neural networks in the fake news detection [16]; fake news using a multi-level voting model and classifier [5, 21]; detecting social media fake news [23, 1]; using deep learning to detect fake news [4]. These researchers continue to research and argue about the application of ML and deep learning in detecting fake news on social media and online. However, the focus of their research shows the critical ability of ML in the fight against fake news on social media, but the research focus is not on Africa as a continent, and this paper was compiled to address this gap.

4. RESULTS AND DISCUSSION

In this section, the findings are presented under each research question.

RQ1: Why do we need ML to detect social media fake news in Africa?

The increase of social media across the African continent continues to promote fake news across its platforms. Ahmed et al. [5] and Khanam et al. [24] suggest that fake news on social media spreads like fire, and the control of fake news is critical for everyone and organizations. However, detecting news is challenging, but one can detect some fake news after reading the full story. However, many individuals and organizations start believing some news without reading, watching, or verifying the full story. Against the negative effects of fake news on social media, the question remains: how can fake news be detected, verified, and controlled? The detection, verification, and control of fake news can be done through modern and emerging technology called ML. ML can be used to detect fake news easily [5].

Currently, social media organizations like Facebook, Twitter, WhatsApp, LinkedIn, Instagram, and others only rely on users' personal information, like name, location, and phone number, to authenticate users. This authentication system can be flawed and insufficient because users still bypass the process to clone, abuse other users' personal information, and spread fake news, content, and information [2]. The failure of the authentication system calls for a robust system and processes that can assist in detecting fake news and information on social media platforms. In conclusion, the consequence of the reduction of fake news on social media can be problematic in the modern day because of the danger in society. and it is more difficult to detect fake news in Africa because of Africa's different languages, cultures, and social situations.

RQ2: What are the most suitable ML classifiers for detecting social media fake news?

Social media contains a lot of information and news, and some of them are fake. There are a number of ML classifiers that can be used to handle fake news and detect and verify news on social media. This study provided the positive aspect of each of the classifiers in assisting in detecting fake news on social media while ignoring any form of limitations that may be associated with any of them. ML classification is a computer program to produces results accurately after training is completed. According to Ahmed et al. [5], for a classifier to detect fake news, the classifier must be trained, and the trained model can provide the correct result.

Researchers have suggested some ML classifiers because of their accuracy and correctness in detecting social media fake news, among the classifiers are: Logistic regression, Naïve Bayes, Neural network, K-Nearest Neighbour, Support vector machine (SVM), Stochastic gradient descent, Linear support vector machine (LSVM), Support vector machine, Decision tree, Recurrent neural network, and Random Forest [5, 24, 3, 30]. ML can assist in detecting fake news, which is

difficult for a human to perform [5, 21]. Raja and Raj [2] stated that ML classifiers can be used in conjunction with NLP text representation models like term frequency-inverse document frequency (TF-IDF) Vectorizer, N-gram, and Count Vectorizer to achieve maximum accuracy in detecting fake news and information on social media. Text representation models convert raw text data into numbers that can then be used to train and test ML classifiers.

The power of ML classifiers can assist in detecting fake news spreading, which can harm individuals' and organizations' reputations. Ahmed et al. [5] and Ahmad et al. [3] found that SVM and Neural network provide 90.9%, Naïve Bayes proves 96.08%, while logistic regression and SVM proved 92% social media fake news higher accuracy detection. Also, LSVM and N-Gram features achieved a fake news accuracy of 87.0% in detecting fake news from the real one [21]. The researchers further state that Linear SVM fake news detection results are good enough; however, on Facebook, Naïve Bayes has produced 74% accurate results. The ability of ML classifiers to detect social media fake news depends on the training of the classifiers, which is critical in the process. Any trained classifier can produce an accurate detection result.

A description of the classifiers used in detecting social media fake news results is given below [5]:

1) Logistic regression (LR) – This classifier is used to detect news when the prediction is categorized. For instance, it can be used to determine whether posts on social media are true or false. Researchers have used classifiers like Kaur, Kumar and Kumaraguru [31] to classify whether news, or social media news posts, are true or false (fake). LR can classify problems/s into multiple classes or binary [3]. In the literature, it has been shown that statistically, the LR classification algorithm is widely used to detect fake news on social media because of its ability, simplicity, and efficiency with large datasets
2) Naïve Bayes (NB) – Based on, Ahmed et al. [5], "a NB classifier can be used on classification tasks. The strategy behind NB classifiers is based on Bayes' theory that to trust that one function of predictors is not dependent on the function of others [25]. This classifier can be used to determine whether social media news is real and to test whether news is fake. Naïve Bayes is a probabilistic classifier that has been used in the detection of fake news on social media because of its simplicity and capability of handling large data sets. The algorithm is based on Bayes' theorem, which is based on probability in choosing between true and false. The algorithm will be able to learn and be adjusted based on available evidence in believing that the news has some other presence and features, for example, the independence of features of the news is calculated without any probabilities. As Naïve Bayes allows the features to be said to have

characteristics of independence, the probability of news can be analyzed in the detection of fake news on social media. Naïve Bayes can easily handle high-dimensional data like text. Zhang et al. [32] applied Naïve Bayes for detecting fake news on Twitter, and Naïve Bayes performed better than other classifiers." The classifier detects social media fake news using the following equation [24]:

$$p(x|x) = P(x|c)P(c) / P(x), \quad (1)$$

where $(c\ |X) = (x1|c) * (x2|c) * \ldots * (x2|\ c) * P(c), P(c|X)$ is the posterior Probability, $P(x|c)$ is the Likelihood, P(c) is the Class Prior Probability, and P(x) is the Predictor Prior Probability. The Naive Bayes Pseudo-code is given by:

Training dataset T,
$F = (f1, f2, f3, \ldots, fn)$ // value of the predictor variable in the testing dataset. Output:
A class of testing datasets.
Step:

a) Read Training Dataset T;
b) Calculate the mean and norm of each class's predictor variables,
c) Repeat
d) Calculating the likelihood of using the equation of gauss density in each class,
e) Until Pending the estimation of the likelihood of all predictor variables $(f1, f2, f3, \ldots, fn)$.
f) Calculated the likelihood for the respective class,
g) Get the highest likelihood

3) Artificial Neural network classifier is also used to detect social media fake news in studies such as the one conducted by Kaliyar et al [16]. As an ML model (classifier), it can assist in detecting fake news on social media because it can learn the complex relationship between input features and output labels. It has layers of connected nodes or neurons that can perform mathematical tasks on data input and another layer to output the product. A neural network has shown promising results in detecting fake news on social media, with the ability to learn automatically and extract meaning from the raw dataset, like images and text. However, the ability of neural networks depends on data quantity and quality.
4) Support vector machine (SVM) is the most used supervised ML algorithm that learns from a range of data sets. The classifier is trained through the process of a "binary classification problem" using different kernel functions [3]. The ability of the classifier to learn from a set of datasets makes it produce more relevant fake news detection results on social

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media. Through a binary classification problem process, the data points that can be separated are managed and used in detecting fake news. The SVM Pseudo-code simplifies the prediction process of news using this equation [24]:

4), $F(0 \ldots . i)$:
low = 0
high = N-1
value = accuracy(N-1)
IG_RFE_SVM(F[0...N-1], value, low, high) {
If (high } > low)
Return F[0...N-1] and value
mid = (low + high) / 2
value_2 = accuracy(mid)
if (value_2 < value)
return IG_RFE_SVM(F[0...mid], value_2, low, mid)
else (value_2 > value)
return IG_REF_SVM(F[0...high], value, mid, high).

5) K-Nearest Neighbour (K-NN) is an unsupervised ML model that allows independent variables to predict the result in each data point [3]. Khanam et al. [24] see the classifier as a supervised algorithm to perform pattern recognition. This classifier is used to determine and solve the "classification problem". The classification problems are solved through the storage of data cases based on their similarity, data are matched against their similarity in the data set to determine and detect true or false news on social media. The model is trained to determine where a particular data point belongs and the outcome. According to Khanam et al. [24: 5], K-NN can detect a piece of fake news using the Pseudo-code/formulas:

Classify (X, Y, x) // X: training data, Y: class labels of X, x: unidentified sample
For i = 1 tom do
Calculate distance d (Xi, x)
end for
Calculate set I containing indices for the k smallest distances d (Xi, x).
return the majority label for $\{Yi$ where $i \epsilon I\}$.

6) Linear support vector machine (LSVM) – the classifier was proposed to maintain a significant comparison of the feature set. LSVM is the most used ML classifier in detecting fake news on social. It can organize linearly dissociable with high-quality accuracy [33]. The classifier works to determine the hyperplane that increases the margin between the positive

and negative feature examples [34]. The margin indicates the relationship between the hyperplane and closet training examples from different classes; then, LSVM focuses on maximizing the margin and minimizing training error.

7) Decision tree (DT) – this classifier is a supervised algorithm based on a flow chart form of structure that focuses on breaking down data sets into smaller data sets called "subsets. The dataset assists the classifier in detecting fake news on social media. According to Khanam et al. [24], each DT node has a specified condition based on the attributes provided. The final results are based on the results of computing all the attributes. A decision tree is a classification algorithm that has been used for detecting fake news on social media due to its ability to handle complex datasets and provide interpretable results. Decision trees are used in ML classifiers and may also be employed to classify fake news on social media. Decision tree algorithms use a series of if-else conditions to partition the feature space, which ultimately produces a set of cases for classification into various classifications. Decision trees can evaluate multiple characteristics, including the content of the news article, user engagement measures, and the authenticity of the news source in relation to identifying fake news.

The advantage of decision trees is that they are easy to comprehend as well, and the tree structure allows the user to visualize the decision-making process. By following the branches of the tree, it is easy to understand the characteristics that are most important for making distinctions between fake news and real news. Decision trees have been employed in previous studies to identify fake news, and this indicates their potential for classifying or identifying false information on social media platforms. The Pseudo-code of DT [24: 3]:

GenerateDecisionTree(Sample s, features F)

a) If stop _conditions(S,F) = true then
   a. leaf = create_Node()
   b. Leaf.lable= classify(s)
   c. Return leaf
b) root = create_Node()
c) root.testcondition = find_bestSplit(s,f)
d) v = { v l v a possible outcome of root.testconditions)
e) for each value vÎ V:
f) sv: = {s êroot.testcondition(s) = v and sÎ S};
g) child = Tree_Growth(Sv ,F) ;
h) Grow child as a descent of roof and label the edge (root→child) as V

Return root

8) Recurrent neural networks (RNNs) – This classifier is applied to detect social media fake news because of its ability to model complex relationships that can be found among features and to manage sequential data. According to Lahby, Aqil, Yafooz and Abakarim [26], RNNs have shown high performance in detecting fake news on social media because of their ability to handle multiple tasks by understanding and depending on previous data inputs and learning from a sequence of inputs.
9) Random forests (RF) – This classifier classifies news and any news with the most votes; those with the most votes are considered the real result. Random Forest is an ensemble learning method that has shown promising results for fake news detection due to its ability to handle noisy and incomplete data. According to Ahmad et al. [3], RF is an improved DT as part of a supervised machine-learning model to predict a result. RF depends on several decision trees to predict a result in an instance where the prediction receives the most votes. The Pseudo-code for RF is [24: 3]:

```
To make n classifiers:
For i = 1 to n do
Sample the training data T randomly with a replacement for Ti
output
Build a Ti-containing root node, Ni
Call BuildTree (Ni)
end For
BuildTree (N):
If N includes instances of only one class, then returns
else
    Select z% of the possible splitting characteristics at random in
    N Select the feature F with the highest information gain to
    split on
    Create f child nodes of N, Ni ,..., Nf , where F has f possible
    values ( F1, ... , Ff )
For i = 1 to f do
    Set the contents of Ni to Ti, where Ti is all instances in N that
    match Fi
    Call Buildtree (Ni )
end for
end if
```

10) Convolutional Neural Networks (CNN): CNN is a deep learning architecture that has been used for fake news detection on social media due to its ability to automatically extract meaningful features from unstructured data such as text and images. The ability of CNN will detect

fake news on social media by understanding the complex relationship among features and handling data sequentially.

CNN is a powerful tool for the task of identifying false information on social media. CNNs are exceptional in deciphering and extracting characteristics from visual data, such as photographs, which might be useful when detecting false news. CNNs may be used to evaluate the structural patterns and semantic relationships inside the text by considering textual information as pictures. This method enables CNNs to identify linguistic and contextual clues that are suggestive of bogus news. CNNs can automatically learn and discover key characteristics for classification using several convolutional layers and pooling operations, making them appropriate for spotting subtle patterns and changes in false news information.

11) Gradient Boosting Machines (GBM): GBM is an ensemble learning method that has been used for fake news detection on social media due to its ability to handle high-dimensional data and provide accurate predictions. GBM may be used successfully to identify fake news on social media. GBM is an ensemble learning technique that combines some decision trees, which are poor learners, to produce a powerful prediction model. It creates decision trees repeatedly, improving prediction accuracy by emphasizing the faults of prior trees in each new tree. GBM has been demonstrated to be capable of managing high-dimensional data, making it appropriate for examining intricate characteristics and trends in social media data. GBM is an effective method for recognizing instances of false news and separating them from real news information because of its capacity to handle unbalanced datasets and deliver precise predictions.
12) Multilayer Perceptron (MLP): MLP is a type of artificial neural network that has been used for fake news detection on social media due to its ability to handle non-linear relationships between features. An artificial neural network called a multilayer perceptron (MLP) can be used to identify bogus news on social media. MLPs are suited for assessing complicated textual data present in social media postings because they can manage non-linear connections between features. An MLP may learn patterns and underlying representations that discriminate between accurate and misleading information by being trained on labeled datasets of actual and fake news. In order to help with the automatic identification of false news, the MLP may then be employed as a classifier to predict the legitimacy of fresh social media postings based on the observed patterns.
13) Deep Neural Networks (DNN): By utilizing their capacity to discover intricate patterns and connections within textual and visual data, Deep Neural Networks (DNN) may be applied to the problem of identifying

fake news on social media. In order to identify patterns suggestive of false news, DNNs may be used to extract useful characteristics from social media information. For instance, local elements within textual data, sequential relationships, and the context in the form of text or user interactions may all be efficiently captured by DNNs. DNNs may be taught to recognize distinctive traits of false news by being trained on big datasets, improving the precision of detection algorithms.

RQ3: How can ML be trained to detect social media fake news?

Training classifiers determine the parameters of the ML classifier which can then be used to develop a classier that can be tested using testing datasets which enables one to evaluate the accuracy of the ML classifier in detecting social media fake news According to Ahmed et al. [5], some researchers use NLP models like the N-Gram model, term frequency-inverse document frequency (TF-IDF) model, and Bag of Words model to retrieve features when data set training is going on. The retrieved features of a dataset are then used to train the classifiers to detect fake news. Prior to performing training, data preparation methods such as the removal of unnecessary words and transforming similar words into single words are done [5]. The dataset training process in Figure 2 presents the process followed as recommended by Ahmed et al. [5] in training the classifier to detect social media fake news.

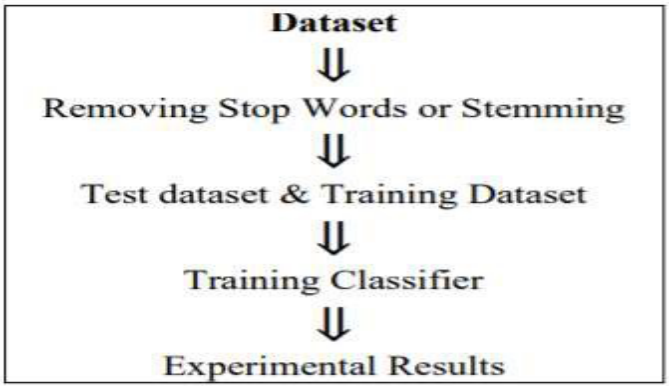

Figure 3. Training dataset, adopted from Ahmed et al. [5]

4.1. Contributions To the Body of Knowledge

The detection of fake news on social media should be an intentional effort for researchers, practitioners, government and non-governmental institutions, and many other stakeholders. In reference to the above frameworks discussed, the study contributed to proposing a practical model or framework to assist in applying ML classifiers in detecting fake news on social media.

4.2. Proposed Conceptual Framework

The proposed Information Behavioural Driven Social Cognitive Model (IBDSCM), a conceptual framework, suggests a way to improve fake news detection on social media using ML classifiers. The conceptual framework is a combination of content and features of two distinct models, Information Motivation Behavioural Skills (IMB) and Social Cognitive Theory (SCT). The framework is a novel component in addressing the challenges in detection and confronting fake news on social media (Figure 1). The proposed framework bridged the research gap in amplifying the lacks in IMB and SCT models in foregrounding a solid confidence in identifying social media information sources and detecting misleading and fake news. The components of the framework were discussed in providing a meaningful insight into the application of the framework in practice, towards using ML classifiers to fight the growing fake and misleading news on social media.

In practical terms, the proposed framework (IBDSCM) makes it possible for anyone or organisations who want to detect fake news on social media means as each component should be fed into any of the ML classifiers as listed above, as well as training users for the detection process to be possible.

Figure 1. Information Behavioral Driven Social Cognitive Model (IBDSCM) (Authors' concept)

1) Information: Information is an enabling factor in fighting against social media fake news. To this study, one's knowledge of sources of fake news and the ability to understand the origin of the news is known as information. The information consists of knowledge, understanding the operation ML classifiers and algorithms, and how they can be used in the fight against fake news in detection, as well as original sources of knowledge. It involves equipping people with the correct information in regards the attribute of false news as well as how machine learning can be applied in detecting using educational programmes, training, and media campaigns.
2) Trust in information sources: In deals on individuals' belief in the accuracy and reliability of information sources is regarded as "trust in information sources." The capacity and ability of people to distinguish between dependable (reliable) and undependable (unreliable) information sources promotes confidence in information sources in spotting false news. The people's ability to assess information sources and origin may be developed, and the adoption of reliable sources of information can be encouraged through continuous educational training and programmes, and wide media campaigns.
3) Behavioral skills: People's talents, like the capacity and ability to assess reliable (accurate) online information, are referred to as behavioral skills. The machine learning algorithms can be used to identify false news and evaluate the reliability of the information sources is one example of a behavioral skill that is relevant to the detection of fake news. Behavioural skills are essential in detecting fake news on social media in facilitating information reliability. To this study, the development of people's skills to use machine learning algorithms to analyze information and its sources is achieved through skill-building efforts.
4) Motivation: Internal variables that affect actions and behavior, like attitudes and beliefs, are known as motivation. Motivation is an intrinsic factor that involves people's opinions towards false news and their conviction that it is crucial to identify it. To improve users' (people's) motivation, motivational interventions like training, educational programmes can be developed to stress the significance of spotting fake news, promoting positive attitudes towards doing so, and increasing people's confidence in their ability to do so.
5) Self-efficacy: Self-efficacy is the impression (belief) indicating the ability of a person to successfully carry out a behaviour in achieving some tasks. Self-efficacy in the context of fake news detection refers to people's confidence in their capacity to recognize fake news using machine learning algorithms. Initiative ideas such as educational training, skill acquisition, and development are processes that can improve an individual's confidence, which empowers their ability to spot and understand fake news using ML.

6) Social norms: A group or community's common attributes, belief system, attitudes, and actions are referred to as social norms. Individuals' cultural values, beliefs, standards, and shared interests are components of social norms. Concerning the identification of fake news on social media can involve a general belief and acceptance to do so and the use of ML classifiers.
Amplified social norms can be an important behaviour in promoting the identification of false news on social media. To detect false news properly with the use of machine learning, this method places an emphasis on how significant it is to integrate important elements like IMB and SCT models with confidence in information models. Through the use of these factors, there can be an achievement and creation of several interventions which encourage the change of behaviors in the online space, as well as identifying fake news.

4.3. Limitations of The Study

This study acknowledges several limitations that may have influenced its scope and outcomes. One of the primary limitations was the focus on the positive aspects of machine learning (ML) classifiers in detecting social media fake news, without delving into the challenges or potential drawbacks associated with their application. The research predominantly highlighted the strengths of these algorithms in detecting fake news, which may have created a somewhat one-sided perspective.
Another limitation of the study was that it did not involve the actual training of ML classifiers to detect fake news on social media. While the theoretical application of various ML models was discussed, no empirical data was collected to test their effectiveness in real-world settings. As a result, the practical implications of these models in detecting social media misinformation remain untested within the scope of this study.

Additionally, the study did not focus on training ML classifiers specifically for African languages, which are central to the region's social media landscape. Given that many social media platforms in Africa feature content in indigenous languages, it is critical to explore how ML classifiers can be adapted to identify fake news in these languages. The lack of focus on this area may limit the broader applicability of the findings in African contexts, where language plays a significant role in shaping information flow.

Furthermore, the proposed conceptual framework for addressing fake news—referred to as the "Information Behavioral Driven Social Cognitive Model (IBDSCM)"—was not tested in the actual detection of fake news. While the framework offers valuable theoretical insights, its practical application remains unexplored. Therefore, future research should aim to implement and evaluate this

framework in real-world settings to assess its effectiveness in combating misinformation.

Lastly, the study did not involve the collection of primary data. Instead, it relied on secondary sources and existing literature, which means the findings are based on previously published research rather than firsthand data. The absence of primary data may have limited the study's ability to provide more nuanced and context-specific insights into the issue of fake news on social media in Africa.

4.4. Recommendations and Future Studies

Building upon the limitations and insights from this study, several recommendations can guide future research into the use of machine learning (ML) for detecting fake news on social media in Africa. First and foremost, there is a critical need for further studies to develop and evaluate ML algorithms tailored specifically to African languages and cultural environments. Given the linguistic diversity across the continent, ML classifiers must be adapted to understand and process the nuances of various African languages in order to effectively detect fake news in these languages.

Second, the proposed conceptual framework, the "Information Behavioral Driven Social Cognitive Model (IBDSCM)," should be incorporated into future ML models designed to combat the spread of fake news. By integrating this framework, researchers can create models that not only focus on technological solutions but also address the underlying behavioral and social factors that contribute to the spread of misinformation. This holistic approach could lead to more effective interventions for stopping the dissemination of fake news on social media.

Third, future studies should focus on identifying the specific factors that drive the spread of misinformation in Africa. This includes examining the role of political and social divides, which can significantly influence the propagation of fake news. Understanding these factors is essential for developing targeted strategies to mitigate the impact of fake news, particularly in politically sensitive contexts.
Moreover, research should be conducted to identify the limitations of the ML classifiers discussed in this study, as well as other potential classifiers that could be more effective in detecting fake news. This includes assessing the strengths and weaknesses of different ML models in various social media environments. The development of more robust and accurate ML classifiers could significantly improve the ability to identify and prevent fake news on social media platforms.

Finally, there is a pressing need for greater interdisciplinary collaboration between computer scientists, social scientists, and policymakers. Effective interventions to combat fake news on social media require a comprehensive understanding of both

technological and social factors. Collaborative efforts will ensure that solutions are not only technically sound but also socially and culturally appropriate for the African context. By working together, these experts can develop strategies that address the complexities of fake news in Africa's unique social, political, and cultural environment.

Detecting fake news on social media in Africa is a complex challenge that requires multidisciplinary approaches. While ML has demonstrated potential in identifying fake news, further research is needed to create and test models specifically designed for the African context. A deeper understanding of the factors contributing to the spread of misinformation, combined with the integration of the proposed conceptual framework into ML models, could pave the way for more effective solutions to this pressing issue.

4.5. Implications of The Study

The findings of this study on using machine learning (ML) to detect fake news on African social media carry significant implications for both research and practice. One of the key implications is the potential for ML-based approaches to help curb the spread of harmful misinformation that could negatively impact individuals and communities. Fake news can have far-reaching consequences, influencing public opinion on critical issues such as politics, health, and social matters. By developing effective ML models to detect fake news, the spread of misleading information can be reduced, thereby promoting more accurate and trustworthy content across social media platforms.

Furthermore, the study emphasizes the importance of incorporating the "Information Behavioral Driven Social Cognitive Model (IBDSCM)" into future research and interventions. This framework provides a comprehensive understanding of the factors that contribute to the spread of fake news, taking into account behavioral, cognitive, and social influences. By incorporating this model into the design of ML algorithms, researchers and practitioners can create more nuanced and context-sensitive interventions that address the root causes of misinformation in African social media environments.

The development of effective measures to detect and prevent fake news also holds significant implications for African democracy, public health, and social cohesion. In many African countries, the internet and social media serve as vital sources of information for the population. Therefore, ensuring that the information disseminated through these platforms is accurate and reliable is crucial for fostering informed public discourse and maintaining social stability. By curbing the spread of false information, ML-based approaches can contribute to the strengthening of

democratic processes, the improvement of public health outcomes, and the promotion of social harmony.

The study also highlights the need for interdisciplinary collaboration between social scientists, computer scientists, and policymakers. Addressing the issue of fake news requires a multifaceted approach that considers not only technological solutions but also the social, cultural, and political factors that drive the spread of misinformation. Collaborative efforts between these diverse fields will ensure that interventions are both effective and contextually relevant, ultimately leading to more sustainable solutions for combating fake news on social media in Africa.
In conclusion, the implications of this study extend beyond the development of ML algorithms for fake news detection. The findings underscore the need for a holistic, interdisciplinary approach to tackling misinformation on social media, with a particular focus on the African context. By combining technological innovations with a deeper understanding of social dynamics, this study offers valuable insights into how fake news can be more effectively detected and prevented in Africa's rapidly evolving digital landscape.

5. CONCLUSION

In summary, the issue of false news on social media in Africa is serious and may have harmful consequences for individuals, groups of people, and society as a whole. The potential use of ML-based techniques to identify false news on social media is promising. Nevertheless, more research is warranted to build and evaluate a model specifically for the African continent. The NLP models and ML classifiers discussed in this paper can be used as reference material for further research in developing fake news detection algorithms in the context of Africa. In addition, the suggested conceptual framework, Information Behavioural Driven Social-Cognitive Model (IBDSCM), could also be integrated to provide a comprehensive analysis of the factors that contribute to the dissemination of fake news and to inform effective counteractions to fake news.

Potentially, effective actions to contain the spread of fake news could benefit democracy, public health, and social cohesion on the African continent. Developing effective responses that are appropriate to Africa's unique linguistic, cultural, and socio-political environment will require an interdisciplinary approach involving computer scientists, social scientists, and policymakers. The application of ML to identify fake news on social media in Africa provides valuable insights into the development of policies and actions to contain the spread of false news and improve people's, communities', and society's well-being in Africa. In sum, for an effective application of this study's contributions, for example, practitioners and policymakers should train ML classifiers on the IBDSCM components as well as users for the detection of fake news on social media.

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