A Novel Taxonomy for Arabic Fake News Datasets

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Abstract: The proliferation of fake information on digital and social media platforms have become a surging concern for society. With the growing reliance on the internet as a source of information, it has become increasingly crucial to detect and mitigate the spread of fake news. To address this challenge, the field of Natural Language Processing and Machine Learning has directed considerable efforts toward the development of effective Fake News Identification (FNI) methods. However, the lack of comprehensive and balanced datasets for fake news (FN) detection in a low-resourced language such as the Arabic language remains a major obstacle in this field. To bridge this gap, this research proposes an effective taxonomy for Arabic FN datasets. The taxonomy provides insight of the characteristics and specifications of Arabic FN. The taxonomy is based on an extensive analysis of existing Arabic datasets and relevant literature in the field. This taxonomy can provide a useful framework for the building, categorization, and comparison of FN in the Arabic language and offer a clear understanding of the different types of fake news and how they can be differentiated. Furthermore, this taxonomy provides solid ground for the development of high-quality and balanced Arabic datasets that can effectively facilitate the development of FNI models in the Arabic language. In conclusion, this research paper offers a valuable contribution to the field of FNI by proposing an effective taxonomy for Arabic fake news datasets and support for building comprehensive and balanced datasets in the Arabic language.

Keywords: Fake News Detection, False News Identification, Social media, Arabic Datasets, Dataset Taxonomy, Dataset Requirements, Datasets Evaluation, Dataset Benchmarking.

1. INTRODUCTION

In today's world, the propagation of fake news becomes faster and speeder [1] on digital platforms [2]. Often, the lack of the ability to tell the difference between real and false news leads to major consequences on public perception and decision-making [3]. More importantly, previous studies have shown that fake news has a significant impact on political debate, potentially influencing election results such as the United States presidential election in 2016 [4]. Until today, no universal definition exists for fake news. A widely common definition expressed by any intentionally modified or manipulated information by humans or artificially would fall under false news [5] [6] [7] [8], and it can take different forms or fall under different terminologies: Satire [2], clickbait [9], hoax[10], and Rumors [11].

Given the growing interest, many attempts exist to detect fake news automatically through a numerous of approaches data mining, machine learning, computational intelligence, and deep learning [5]. Therefore, the need for a high quality labeled dataset is a significant obstacle to develop an effective model. A high portion of the studies have been focused on the English language and ignored low-resource languages such as the Arabic language due to its complexity [12] and the availability of NLP tools [13]. Numerous Arabic datasets exist for detecting fake news, but there are no standards or taxonomy in place to ensure data quality, making it difficult to compare datasets and evaluate their performance. Standards and taxonomy for building datasets are required to ensure the accuracy and reliability of data for detecting fake news [14].

This motivates us to present an in-depth detailed characteristics and requirements for developing and building Arabic datasets that can serve fake news detection, sentiment analysis, stance prediction, and natural language processing techniques. To the best of our knowledge, no previous work analyzed and present comprehensive study about Arabic datasets. The main contributions of the present work include the following:

- Propose a comprehensive and updated Fake news taxonomy.

- Provide set of characteristics for building effective dataset

- Apply the proposed taxonomy on 18 Arabic datasets since 2009 used for fake news in general.

- Highlight the effective datasets based on the proposed

taxonomy.

- Discuss the open issues and the opportunities about Arabic datasets construction and benchmarking purpose.

It is proceeded as follows. Section 2 outlines the related work for fake news characteristics and specifications. Section 3 propose updated fake news characteristics. Section 4 evaluates and discuss the findings. Section 5, discusses issues and opportunities. Finally, concludes the study with further future work.

2. RELATED WORK

A massive effort has been done to investigate the literature regarding previous specifications, characteristics, taxonomies to categorize false news. The study of fake news detection is a rising trend in the field of Natural Language Processing (NLP) and Machine Learning (ML). recently, academicians have suggested a variety of models to detect FN in multiple languages, including English, Spanish, Portuguese, and Chinese [1] [2] [3] [4]. However, the Arabic language still lacks comprehensive studies and datasets that could be used to develop and evaluate fake news detection systems. The construction of new datasets for FN detection is a complex and time-consuming process that requires significant effort and knowledge [7]. The process typically involves using digital tools to scrape news articles and then verifying the claims made in these articles. This verification can be performed either manually by human annotators or by using machine learning methods to assess the accuracy of each claim. Each method has its own level of complexity and accuracy, and it can take a considerable amount of time to complete [12]. Despite the availability of various datasets for detecting fake news, there is no standard or guidelines in place to ensure the quality and consistency of the data collected. This lack of standardization can result in inconsistencies in the data, making it difficult to compare datasets and accurately benchmark their performance [14]. To address this issue, it is essential to establish standards and taxonomy to ensure the accuracy and reliability of the data collected. Such taxonomy and standards will be helpful in benchmarking and comparing datasets, and will help to ensure the quality and consistency of the data used for fake news detection. A detailed study [1] provides a complete details of online FN and its characteristics. The authors examine various definitions, and discuss the reasons why FN spreads, as well as its consequences on society. They analyze its various forms, such as satire, hoax, propaganda, and misinformation. The authors also examine the challenges associated with detecting fake news, including the difficulty in defining the concept, the complexity of the content, and the difficulty in determining the source. The authors propose a comprehensive taxonomy for the characterization of FN and discuss various methods for detection. They also analyze existing research on FN detection and classify the methods into (1) the creator/spreader, the identity of the creator of the news, it can be human/non-human. (2) the target victims,

based on the type of the victim, the technic of spreading or creating fake news can differ. (3) the news content, is the content of fake news. (4) the social context, refers to the way of spreading the news in social media. The study [15] provides full overview of the datasets that are used for evaluating FN detection systems and to highlight the main challenges associated with them. The authors found that the datasets' quality used for FN detection has a meaningful influence on the performance of the detection systems. Moreover, they concluded that there is a need for benchmark datasets to allow for the comparison of different systems. They also discussed the challenges associated with creating fake news datasets, such as the limited availability of high-quality and balanced datasets, the difficulty in obtaining annotated data, and the need for ongoing updates to keep up with the changing nature of fake news. The authors then present a comprehensive taxonomy of the datasets including: "News domain, Application purpose, Type of disinformation, Language, Size, News content type, Rating Scale, Media Platform, Spontaneity, Availability, Extraction period". On the other hand, the paper [2] explores the concept of fake news and categorizes it into three types: serious fabrications (uncovered in mainstream or participant media, yellow press or tabloids), large-scale hoaxes, and humorous fakes (news satire, parody, game shows). The authors suggest that these three types of FN differ in their purpose, target audience, and impact and therefore need to be treated differently in terms of detection and prevention. The paper provides a new perspective on the classification of fake news and highlights the need for a nuanced approach to deception detection in news content. The survey [4] aims to address the problem of fake news detection using data mining. The authors introduced a unique work that defines the basic concepts and characterizations of FN in both psychological and social aspects: "News Content (Linguistic-based, Visual-based) and Social Context (User-based and Post-based, Network-based)". While [16] presents a framework for categorizing FN detection methods based on the type of information they target, such as news veracity, user behavior, and content style. The authors also highlight the need for a common taxonomy of fake news to support the development of effective and comparable fake news detection methods. They argue that such a taxonomy should be based on clear and well-defined definitions, and should take into account the evolving nature of fake news. Additionally, the authors [17] present a comprehensive survey of techniques for identifying and mitigating fake news. They analyze various approaches, including content-based methods, network-based methods, and hybrid methods. The authors also discuss challenges in fake news detection and the limitations of existing methods. They conclude by outlining future research directions in this area. Another huge efforts has been done on the paper [18], the authors propose a taxonomy of fake news detection methods based on the type of modality used (text, image, video, audio, and multi-modal). They also discuss the challenges and limitations of existing datasets, and propose a dataset taxonomy based on their type (real, synthetic, or
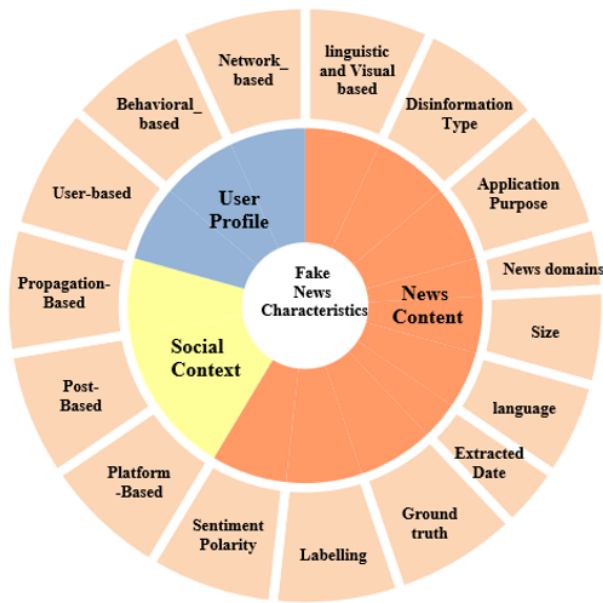
Figure 1. Fake news Taxonomy

mixed) and modality (text, image, video, audio, and multi-modal). The paper [19] the authors discuss FN classification and analyze various taxonomies based on various attributes such as source, content, and spread. The authors conclude that taxonomies are important for a better understanding of the problem and for developing effective solutions. In conclusion, previous studies have shown the importance of developing a taxonomy for Arabic fake news datasets and the need for comprehensive and balanced datasets to train and evaluate fake news detection systems. However, there is still a gap in the literature that needs to be filled in terms of providing a systematic taxonomy and guidelines for building Arabic fake news datasets.

3. METHODOLOGY

A. Proposed Fake News Taxonomy

To identify the key specifications and characteristics of FN, our methodology merged and summarized the essential key characteristics from the previous literature studies and adopted a well-structured FN taxonomy designed in two layers as depicted in figure 1. The first main layer is composed of Three components, and the second layer represents the content of the main layers:

- News-content-based: are obvious indicators for detecting FN, and they are the most frequently employed characteristics for FN representation prediction and identification evaluation. Given the fact that FN seeks to promote misleading information by falsifying the content of news by specific writing style or using sensational titles, it can be divided into 11 features:
  - Linguistic-based: It refers to false information

presented in written or spoken language, often in the form of articles or broadcasts which includes: "News title" refers to the header of the news, the "News Body" is intentionally created to mislead and provide wrong claims.
- Visual-based: It refers to misleading information presented in images or videos, such as manipulated photos or deep fakes, which exploits the sensational of the individuals and their vulnerabilities to provoke their feelings or change opinions [4].
- Disinformation Type: it includes the type of false information such as Rumors, Satire, stance, Fake Advertising, Fake recommendations, Fake reviews, and clickbait.
- News domains: It represents the topic of the news: Politics, COVID, Health, Finance and so on. Most of the datasets consider only one domain which limits the fake news detection efficacy.
- Sentiment Polarity: Sentiment polarity refers to the direction of a sentiment expressed in a piece of text, whether it is positive, negative, or neutral. There is a relationship between sentiment polarity and fake news in that fake news often seeks to elicit strong emotional reactions in its audience. Negative sentiment polarity is often used in fake news to generate anger, fear, or mistrust, while positive sentiment polarity can be used to generate hope, joy, or support. By manipulating sentiment polarity, fake news can be made more appealing and persuasive, making it more likely to spread. It is an important factor to consider when evaluating the credibility of a piece of news. The manipulation of sentiment polarity can make fake news more appealing and persuasive, increasing the likelihood of its spread.
- Language: Most of datasets contains one primary language, however, fake news detection can be investigated on multi-language, translated or multi-dialects datasets as new opportunity for low-resources languages or to extend dataset application and more specifically to apply different Machine learning models on Multilanguage datasets.
- Size: is an important attribute that represent the collection dimensions, it is considered while choosing the appropriate machine learning model or during benchmarking datasets.
- Extracted Date: refers to when the data has been extracted.
- Application Purpose: refers to the aim of dataset built for, such as: fake detection, fact-checking, veracity classification, and rumor detection.
- Labelling: refers how the dataset has been annotated or how many class (True/ False, True/ False/I don't know, Agree /disagree, . . .).

- Ground truth: provides information about how the false claims have been collected from social media or fact-checking websites, or artificially manipulated using ML to automatically generated false claims from real or manually using annotators.

- Social Context: This layer provides additional features about the distribution or the pattern of the news source. It can be divide into:
    - Platform-Based: provides information about the media platforms used to share and spread false information (Facebook, Twitter, blogs, Instagram, Newspapers, TV,).
    - Post-Based: refers to the spread pattern of the information (post, re-tweet, repost, comments, replay, response between users, review, feedback) which can include their emotions or opinions on social media platforms.
    - Propagation-Based: refers to the spread of false information through networks of people, who may not even be aware that the information is false. It considers the interconnection between social posts to predict the credibility of the news.

- User Profile: This layer refers to who created the fake news, it aims to capture suspicious and anomaly user, accounts or non-human accounts as many researchers believe finding the source of the fake news is more powerful than detecting the claims itself it can be categorized in three features:
    - User-based: include user information such as " account name, geo-location information, verification, has description or not, and so on.
    - Behavioral-based: using psychology aspects to capture the pattern of user behavior for deceptive users and legitimate users.
    - Network-based: refers to suspicious users work in groups or echo-chambers and friendship relations to spread the false news.

B. Data Collection

In order to apply the proposed methodology, it is important to gather trustworthy datasets for FND which is not easy process, as it requires tremendous effort and knowledge. This section explains the process used to identify recent studies that include Arabic datasets, these studies are published between 2015 and 2022 in reputable digital libraries: IEEE, ACM, Springer, Wiley, and Elsevier. The Systematic literature searches followed 5 steps according to the guidelines Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). A combination of keywords was developed to narrow the pool of research papers as follows: "Arabic dataset" AND "fake news detection" OR "fake news identification" OR "false news detection" OR "Satire" OR "rumor detection" OR "misinformation detection" OR "stance detection" OR

"Credibility". Only peer-reviewed articles in peer-reviewed-journals were analyzed. The result was a total of 184 articles peer-reviewed, then excluding 22 duplicated articles. After screening and reading carefully all the papers a total of 100 articles were returned as relevant articles to our aim of study. A total of 52 articles identified that use only Arabic datasets. Last filter applied to extract the datasets used in 52 articles and eliminate the duplicated and non available datasets, some datasets were inaccessible due to the copyright or because the owners did not answer the access request. At the end, 18 datasets were selected per the table I, the full details are included in annexe 1.

4. RESULTS AND DISCUSSIONS

According to II, The results indicate that there has been a growing interest in developing Arabic datasets for FN in recent years, particularly between 2019 and 2020. The increase in the use of social media during the COVID pandemic in the Arabic world appears to be a major factor in this trend, as researchers seek to study the phenomenon of fake news in the Arabic language. According to the data, the first Arabic datasets [24], [30], [37] for fake news were developed in 2019, with a further increase in the number of datasets [20]–[23][25][27][28] constructed in 2020. There was a continued trend in the development of these datasets [29][31][33][35] into 2021, and while many studies have been published in 2022, they often utilize or merge old datasets from previous years.

The results in Table III suggest that misinformation in the political and health domains is more widespread compared to false information in other topics. The authors attribute this to the prevalence of these topics on social media, which facilitates faster dissemination of information. As a result, researchers have focused on developing and studying datasets related to these domains. The study found that 9 corpora contain information about health and COVID-19, while 5 corpora cover multidisciplinary domains and 3 datasets are focused on the political domain. These results highlight the need for continued research and development of datasets in these domains, given the high spread of misinformation in these areas. Further studies can also explore the reasons for the concentration of research efforts in these areas and investigate the possibility of developing datasets in other domains.

Table IV shows that the majority of the datasets were collected from Twitter, which is a popular social media platform with 330 million active users. Twitter's API provides a convenient way for researchers to collect data, and the platform also offers rich features for the data collected. The second largest source of datasets is online articles, while YouTube is the least frequently used platform in the surveyed datasets. These results indicate that Twitter is the most commonly used platform for collecting datasets for fake news detection research, while online articles and fact-checkers are also important sources. The use of YouTube is less frequent, but still relevant in this research area.

TABLE I. 18 Arabic datasets extracted.

Ref	Title	Name
[20]	ArCOV19-Rumors: Arabic COVID-19 Twitter Dataset for Misinformation Detection	ArCOV19-Rumors
[21]	COVID-19-FAKES: A Twitter (Arabic/English) Dataset for Detecting Misleading Information on COVID-19	Covid-19-Fakes
[22]	Machine Generation and Detection of Arabic Manipulated and Fake News	AraNews
[23]	Stance prediction and claim verification: an Arabic perspective	ANS corpus
[24]	COVID-19 and Arabic Twitter: How can Arab world governments and public health organizations learn from social media?	-
[25]	ArCorona: Analyzing Arabic Tweets in the Early Days of Coronavirus (COVID-19) Pandemic	ArCorona
[26]	Large Arabic twitter dataset on covid-19.	COVID-19 Arabic-Tweet
[27]	Fighting the COVID-19 Infodemic: Modeling the Perspective of Journalists, Fact-Checkers, Social Media Platforms, Policy Makers	Not Mentioned
[28]	Fake News Detection in Arabic Tweets during the COVID-19 Pandemic	Fake News Detection
[29]	AraStance: A Multi-Country and Multi-Domain Dataset of Arabic Stance Detection for Fact Checking	AraStance
[30]	An Arabic corpus of fake news: Collection, analysis and classification.	Personalities Death
[31]	AraCovid19-MFH: Arabic COVID-19 Multi-label False News and Hate speech Detection Dataset	AraCovid19-MFH
[32]	Arabic Corpora for Credibility Analysis	-
[33]	Detecting Arabic Fake News Using Machine Learning	AFND
[34]	An Experimental System For Measuring The Credibility Of News Content In Twitter	-
[35]	ArCOV-19: The First Arabic COVID-19 Twitter Dataset with Propagation Networks	ArCOV-19
[36]	Integrating Stance Detection and fact checking in a unified corpus	-
[37]	An Arabic Corpus for Covid-19 related Fake News	-

TABLE II. Datasets creation year

Years	Datasets
2009	[34]
2016	[32]
2018	[36]
2019	[24], [30], [37]
2020	[20]–[23][25][27][28]
2021	[29][31][33][35]

TABLE III. Datasets News Domain

News Domain	Datasets
Health(COVID-19)	[20] [21][24] [25] [26] [27] [31] [35] [37]
Multidisciplinary	[22] [23] [28] [29] [33]
Personalities death	[30]
Politic	[32] [34] [36]

TABLE IV. Datasets platform sources

Platform	Datasets
Twitter	[20] [21][24] [25] [26] [27] [28] [31] [32] [35]
YouTube	[30]
Fact-Checker and Online article	[29] [33] [36] [37] [22] [23] [34]

Table V provides an overview of textual and visual datasets. According to the table, most of the known datasets only focus on textual content and only three datasets [25] [30] [35] have collected both images and videos in addition to the news. This indicates the focus of the research is on textual content, as many textual features can be easily extracted such as emotion features, polarity features, and POS and linguistic features. While collecting visuals is considered as a labor-intensive process, and there is a gap in the research area to develop new natural processing techniques and tools to focus on both text and visuals.

TABLE V. Textual and Visual Datasets

Platform	Datasets
Textual Dataset	[20] [21] [22] [23] [24] [26] [28] [29] [31] [32] [33] [34][36] [37]
Textual and Visual Dataset	[25] [30] [35]

Observing the type of annotations and labeling, All mentioned datasets are manually annotated except [23][28][29] which have been manipulated automatically to produce fake news. Manual annotation involves humans between two or three experts to verify the labels and avoid errors. Considering the dataset's size as shown in table VI, it varies

from 779 to 30M. The size of the dataset is critical to the accuracy of the fake detection process. In particular, a large dataset is required to train a machine learning-based FN detection method because the method's performance improves with increasing training dataset size. However, giant datasets scales tend to be not reliable in matters of manual labeling due to human error in classification and also time-consuming. The results of the study show that the size of the datasets used for fake news detection is a critical factor in the accuracy of the detection process. Larger datasets are preferred for training machine learning-based fake news detection methods as they tend to produce better results. However, large datasets also pose challenges in terms of manual labeling, which can lead to human errors in classification and can be time-consuming. According to Table 6, the size of the datasets used in the study varies greatly, ranging from 779 records to 30 million records. The smallest datasets have sizes ranging from 0 to 5000 records, and they are used in studies [22] [23] [29] [30] [32] [36][37] and [34]. Datasets with sizes ranging from 5000 to 100k are used in studies [28] and [31]. Finally, the largest datasets, with sizes over 100k records, are used in studies [20] [21] [24] [26] [25] [35] and [33]. In conclusion, the results of the study highlight the importance of selecting appropriate datasets for fake news detection and the trade-off between dataset size and accuracy. A larger dataset may improve accuracy, but the process of manual labeling can become impractical.

TABLE VI. Dataset scales

Size	Datasets
0-5000 records	[22] [23] [29] [30] [32] [36] [37] [34]
5000-100k	[28] [31]
100k and more	[20] [21] [24] [26] [25] [35] [33]

Reflecting on the dataset language, it is remarkable that only [21] [27] are dual-lingual. that collected news in both Arabic and English language, it is considered a challenging task to build parallel language dataset as it requires either experts in translation or experts' annotators to search for the equivalent text from Arabic to English. It is notable that, Twitter and News streams are the most commonly used platforms to share fake news.

The most frequent Arabic datasets application purpose is fake detection, followed by Claim and credibility verification, stance Detection, and sentiment analysis as depicted in table **??**. Few datasets serve multi-application purposes such [18] built for FN and Credibility verification and network-propagation purpose. While [31] built for FN, stance, and Sentiment analysis. Similarly, the dataset [36] built FN stance and claim verifications.

TABLE VII. Dataset Application Purposes

Dataset Name	Application purpose
Fake News detection	[20] [24] [26] [25] [27] [28]
Stance Detection	[23] [29]
Sentiment Analysis	[21] [30]
Claim and credibility verification	[23]
Machine Manipulation	[23]

5. OPEN ISSUES AND OPPORTUNITIES

Several challenges and open issues have been identified in the previous sections to be addressed during the evaluation and construction of new datasets for fake news detection:

- Multimedia datasets: Creating datasets that incorporate non-textual elements like images and videos is a significant challenge. While some datasets [25] [30] [35] have both text and images, they have limited labeled data, limiting their impact on fake news research.

- Multi-language datasets: Most existing datasets are in Arabic, which restricts their effectiveness in fact-checking other languages. Having multi-lingual datasets for fake news would allow for detection in languages with limited resources, or expand the usefulness of the dataset to other language models.

- Cross-domain datasets: It's recommended to gather datasets from various news domains to enhance the effectiveness of detection models and address limitations in fact-checking. However, specialized datasets such as those for COVID-19 or politics are frequently used due to the accuracy of pattern detection and the quality of the data.

- Sentiment Analysis and Polarity: Previous discussions show attempts to use Sentiment Polarity in fake news detection. Therefore, future datasets should include attributes that support this.

- Multi-class labeling: Few datasets use multi-class labeling during annotation, but this method has been shown to provide better accuracy in modeling. This type of dataset will have a wide range of uses, including Sentiment Analysis, Stance, fake news detection, and veracity verification.

6. CONCLUSION

In conclusion, the study aimed to address the challenge of constructing high-quality Arabic fake news datasets and creating accurate Arabic datasets' taxonomy. The key contribution is to provide detailed specifications and characteristics for fake news. As result, (1) Collect dataset of FN

articles mainly concerning COVID or multidisciplinary and notably are extracted recently between 2019 and today, (2) most datasets are multi-purpose applications with a focus on fake news, claim verification, stance classification, and sentiment analysis, (3) most of the datasets are relatively large collecting mainly the text of the news, (4) the majority of the datasets use a multi-labeling class with more interest in multi-lingual. This study provides valuable insights and recommendations for future researchers and practitioners in constructing textual and visual-based Arabic datasets with a focus on multi-purpose applications, multi-class labeling, and multi-lingual for fake news identification. The findings of this study contribute to advancing the field of fake news detection and promoting the use of high-quality Arabic datasets for reliable benchmarking and evaluation.

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