A Survey: Datasets and Methods for Arabic Fake News Detection

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ABSTRACT
Social media's fast-growing popularity and convenient approval of unknown accounts have promoted an environment where unidentified users can act maliciously, for instance, by spreading fake news. Even though these social networks have been motivating researchers to deter such occurrences, they have not overcome this dilemma due to the immense volume of posted messages that require processing. One of the essential solutions to detect fake news is to measure the credibility of users based on various features and how a particular message was circulated. This paper surveys studies on false news detection, specifically in Arabic, including current datasets and used methods.

Keywords: Arabic fake news detection, misinformation, misleading news, social media, natural language processing, machine learning, survey

1. Introduction
News is a vital part of communication that informs the public about trends, events, and issues in the external world. Since the advent of the internet, social media, such as Twitter and Facebook, has become a growingly essential means for journalists to discover news content and broadcast stories to their audience. Moreover, numerous users have tended to communicate via these networking sites due to their low cost and abundance. However, significant volumes of unreliable newscasts and misleading information are diffusing daily on social media for various purposes, significantly impacting communities. This kind of news, known as fake news, can get wider views and interactions than legitimate ones. Fake news fabricators sometimes believe they are doing it for sound and decent causes. For instance, they fudge information about climate change to mislead people and convince them to improve their environmental behaviors. Another example is that others may intentionally post false news for political aims to influence the overall perspective of a particular group of people. This dilemma can lead to a negative impact on individuals as well as societies. As a result, it is pivotal to recognize unreliable or unreal news before believing it. The main intention here is to survey the available Arabic datasets and the main methods used to help identify fake news. The second section describes the methodology used to conduct this literature. The main methods for detecting fake news are briefly demonstrated in the third section. The following section reviews the current Arabic datasets for fake news detection. After that, we present the used algorithms in these Arabic datasets studies and discuss the results in the fifth section. The final section of this paper concludes and provides possible directions.

1.1 Acronyms

The following phrases with their acronyms are frequently used in this paper interchangeably:

- **WE:** Word Embedding
- **CV:** Count Vector
- **WF:** Word Frequency
- **LR:** Logistic Regression
- **DT:** Decision Trees
- **RF:** Random Forests

- **XGB:** Extreme Gradient Boosting
- **MNB:** Multinomial Naïve Bayes
- **NLP:** Natural Language Processing
- **CNN:** Convolutional Neural Network
- **RNN:** Recurrent Neural Network
- **SGD:** Stochastic Gradient Descent

- **NB:** Naïve Bayes
- **GB:** Gradient Boosting
- **IR:** Information Retrieval
- **ML:** Machine Learning
- **DL:** Deep Learning
- **FND:** Fake News Detection

2. Literature methodology

This literature review follows multiple steps based on the systematic review procedure, which relies on the "Preferred Reporting Items for Systematic Reviews and Meta-analysis" protocol (PRISMA) (Moher et al. 2009). Here are the steps as follow:

a. Eligibility of Articles:
   Firstly, all selected papers must be written in English from a technical perspective and focus on analyzing techniques or approaches for detecting fake news on social media platforms. Moreover, to address the most advanced methodologies in this field, we selected the period from 2019 to 2022 in the search query.

b. Defining resource of information:
   We mainly utilize the University of Leeds library website to access articles and the Google Scholar scientific database, which includes findings from various scientific databases. In addition, some of the related studies were collected from the references of qualified articles.

c. Searching and collecting papers:
   To build up a general overview and understand the broad perspective of this domain and since studies related to Arabic fake news are still in their early stage (Al-Yahya et al. 2021; Elhadad, Fun Li, and Gebali 2019; Mouty and Gazdar 2018; Saadany, Mohamed, and Orasan 2020), we looked for all surveys without determining a specific language to guide us into various studies and then dive into according to particular interests. The second search query focused on papers studying Arabic text and extended queries, as shown in Table 1: Collected Papers. However, this results in scores of publications mostly containing only the "Arabic" word. To tackle this, we used the search operators (intitle: "Arabic") to ensure retrieving only the most related papers.

d. Selecting final papers:
   The filtered papers were retrieved after refining papers by titles and reviewing abstracts if needed. The substance of these publications is evaluated, and only the selected papers were thoroughly examined in this study.

Table 1: Collected Papers

Search Query	Found Papers	Filtered Papers	Selected Papers
Survey AND ("fake news detection" OR "detection of fake news" OR "identify fake news" OR "identifying fake news") AND ("on social media" OR "on twitter")	2,920	107	5
Arabic AND (("fake news" OR "false news" OR misinformation OR disinformation OR rumour) AND (detection OR detecting OR "identifying OR "identify) AND ("social media" OR "twitter"))	7710	87	22
Total			27

3. Fake news detection methods

Many studies have suggested ways to overcome the issue of detecting fake news. Also, different survey studies have attempted to explain these proposed approaches and effective methods and divided them into categories with varying points of view. For example, a study (Beer and Matthee 2020) lists fake news detection techniques in five categories: language-related method, topic-agnostic method, machine learning method, knowledge-based method, and hybrid method. The study discusses how these diverse techniques interlink and how they could be used jointly to obtain better findings.

Another critical study by (Zhou and Zafarani 2020) reviewed and assessed fake news detection approaches from four perspectives, summarized in Figure 1:
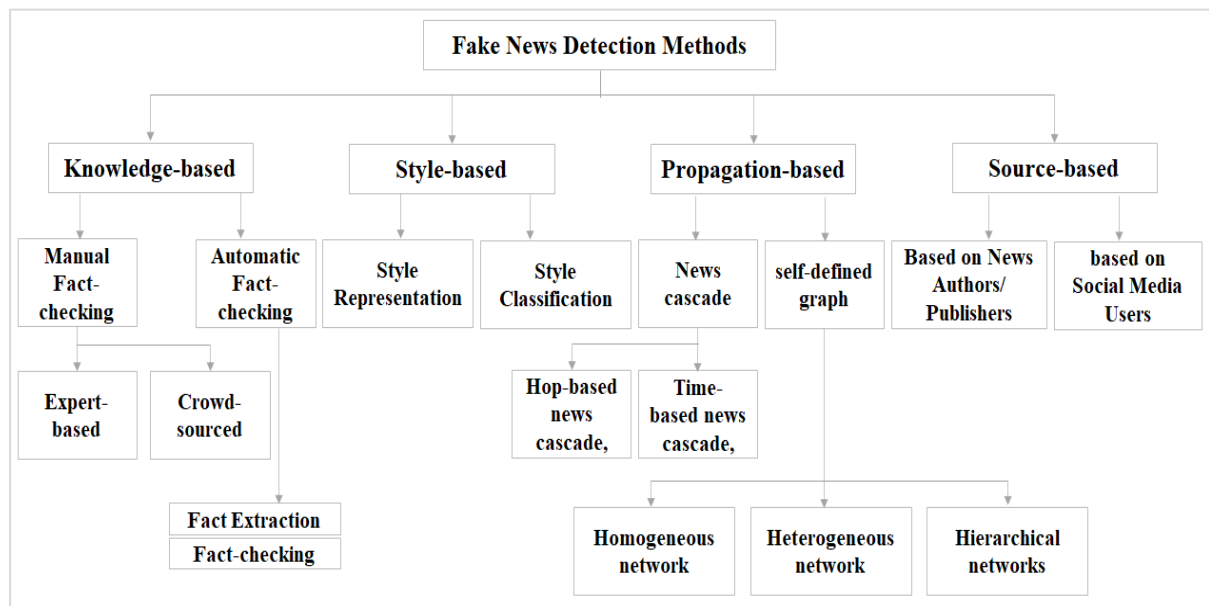
Figure 1: FND Methods from four different perspectives

3.1 Knowledge-based

The false information included in the news is called knowledge-based. This method evaluates genuineness by extracting knowledge and comparing it with facts. One way to verify news is to assign a fact-checker to check the credibility of news content manually. This method is divided into either expert fact-checking or crowdsourced fact-checking. Assigning an expert person to check the news yields highly reliable outcomes but is costly. An alternative method is crowdsource-based, which depends on many ordinary people acting as fact-checkers. It saves time and money by collecting information or opinions from individuals, usually sourced via online media. Although it provides higher scalability than the expert-based method, it is more complex and less credible due to unreliable crowdsource users.

3.2 Style-based

The second perspective is the style-based method, which attempts to capture false news by catching the writing style of the posted misleading information. Because manipulators and fabricators usually have an adversarial purpose of distributing distorted posts intentionally to influence a wide range of users or communities (Zhou and Zafarani 2020). This can be done by representing features and then classifying content style. Many studies have adopted machine learning and deep learning models in various languages, including Arabic. They use both ML algorithms and deep learning for this method. ML method tries to capture the writing style within the content, while DL methods attempt to learn the content representation.

3.3 Propagation-based

Another vital aspect of identifying fake news is analyzing how posts are prevalent within a social media network. For example, many examinations investigated how users exchange info with each other. The path of these diffused posts composes propagation structures containing significant details and attributes such as the cascade's depth and breadth. These included features help classification models categorize news as false or not.

3.3.1 News cascade

A news cascade structure looks like a tree that immediately captures the distribution of a specific post on a social network; see adopted Figure 2 and Figure 3. This method can be guided by two perspectives: hop-based or time-based (Zhou and Zafarani 2020) . This captured propagation includes different features, such as depth, breadth, and size in the hope-based method and lifetime, real-time heat, and overall heat in the time-based method. These features are used to draw the overall cascade, which assists in predicting news credibility.
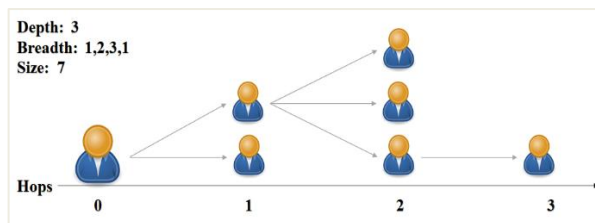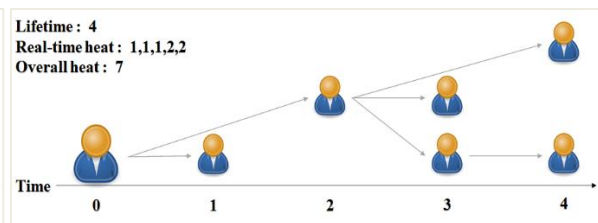

Figure 2: Hop-based news cascade   Figure 3: Time-based news cascade

3.3.2 Self-defined graph

Another way to recognize misinformation using the propagation-based method is by constructing homogeneous, heterogeneous, or hierarchical self-defined networks to capture fake news indirectly. The adopted Figure 4 (Zhou and Zafarani 2020) explains the structure of the three types.
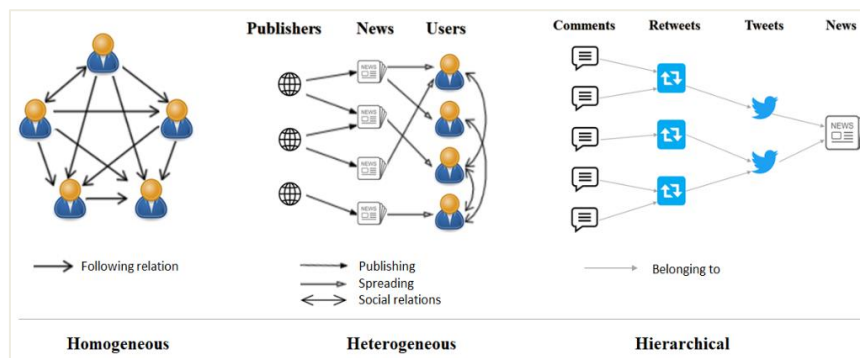

Figure 4: Self-defined networks

3.4 Source-based

This method mainly depends on the primary source, such as the news author, the post publisher, or the most recent source transmitting the published information.
- **Author (A):** the original person who wrote the particular news.
- **Publisher (P):** the source that publishes or posts certain information written by author A.
- **User (U):** The person who conveys a post reported by publisher P or received from another user U.

4. Arabic Datasets

A vital factor for automated fake news identification is the presence of adequate and appropriate quality training data. Numerous studies in different languages harvest data from social media, news sites or fact-checking websites to perform various tasks. Here are some of the most recently published Arabic datasets that can be used for fake news detection. Since this research focuses on recent advances and published papers, it is expected to come across COVID-19-related topics. Therefore, this subsection categorizes the latest Arabic datasets into two main categories: COVID-19-related or general misinformation datasets.

4.1 COVID-19 Arabic FND datasets

Many Arabic datasets related to the COVID-19 pandemic are available for studies, mostly collected from Twitter. Recent research introduced a dataset called ArCOV19-Rumor (Haouari et al. 2020b). This dataset holds 9400 human-annotated tweets, targets to detect Arabic rumours on Twitter. It was derived from about 138 claims verified by popular fact-checking websites. The dataset contains the following categories: health, sports, religions, social, politics, and entertainment, and they employ tweets content, account profiles, and propagation networks on the tweet-level verification, which showed benchmark outcomes. According to a study (Haouari et al. 2020b), future experiments can employ this dataset to detect misinformation on both the claim level and tweet level. In terms of the tweet level, they describe it as a given tweet and its propagation networks. This level, which no Arabic study has ever addressed (Saadany et al. 2020), will help identify the trustworthiness of a particular tweet using its source. Similarly, a reasonable number of contributions published COVID-19-related datasets, such as (Alqurashi et al. 2021)–(Mubarak and Hassan 2020). According to this search findings, more than half of these studies relate to this pandemic. A study (Alqurashi et al. 2021) manually annotated 8786 tweets into misinformation or not and then applied five machine learning models and three deep learning models using different features such as word frequency and word embeddings. A study (Alsudias and Rayson 2020) utilized the same features but only experimented with these features with three ML models. They collected about a million, annotated only 2000 samples and labelled them into three classifications. Also, they cluster their work into five topics, namely (statistics, prayers, infection locations, education prevention, and advertising). COVID-19-FAKES (Elhadad, Li, and Gebali 2020) is another dataset for misinformation detection. They applied 13 different algorithms on seven feature extraction methods. It helps researchers analyze both the propagation of spread information and users' behaviors. Likewise, the dataset (Mahlous and Al-Laith 2021) has used six classifiers on four feature extraction techniques.

Some researchers have explored transformer-based methods in parallel with ML and DL methods in their experiments, such as ArCorona (Mubarak and Hassan 2020) and ARACOVID19-MFH (Hadj Ameur and Aliane 2021), including BERT, AraBERT, and mBERT. ArCorona annotated a collection of Arabic tweets for 13 classifications containing 8000 tweets. Only one class can help in this study: the label "RUMOR" represents fake or unreal information. ARACOVID19-MFH is another multi-label dataset that includes ten labels manually annotated and has about 11000 Arabic tweets. Due to regulations from Twitter, the texts of these tweets are unavailable. As a second option, they provided the IDs to help future researchers to collect the text of these tweets and implement further experiments. The other features are the ten labels, and it is distributed as follow: Does a tweet contain hate? Is it about a COVID-19 cure? Does it give advice? Does it raise morale? Is it news or opinion? What dialect? Does it include blame and negative speech? Is it factual? Does it worth fact-checking? And does it contain fake information?

ArCOV-19 (Haouari et al. 2020a) is the only Arabic dataset related to the pandemic with the propagation path. Although this dataset is designed to facilitate examinations under different domains, including NLP tasks, it is not limited to fake news detection. Consequently, this dataset opens opportunities to help study the spread of information.

4.2 General Arabic FND datasets

Although COVID-19 has been the dominant trending topic on social media in the last two years, some published general-topics datasets have been published. AraFacts (Ali et al. 2021) and ANS (Khouja 2020), for instance, were mainly collected to identify misinformation, including 6222 and 4547 claims, respectively. Moreover, one study (Saadany et al. 2020) published a political-issue-related dataset that collected 6895 news articles from satirical or official websites. Because the sources of these datasets are from various reliable mainstream news and fact-checking websites, it may not help detect fake news published by the public, such as posts on social media. Additional Arabic datasets are collected by CLEF (Conference and Labs of the Evaluation Forum) at CheckThat! Lab (Althabiti, Alsalka, and Atwell 2021, 2022; Barrón-Cedeño, Elsayed, Nakov, Da San Martino, et al. 2020; Barrón-Cedeño, Elsayed, Nakov, da San Martino, et al. 2020; Elsayed et al. 2019; Kːohler et al. 2022; Nakov et al. 2021; Shahi, Struß, and Mandl 2021), an annual conference focused on collecting data from Twitter and providing different tasks, including fake news detection in multiple languages for competitors. Collecting Arabic news is not limited to Twitter but to other social media, such as information posted on YouTube. Study (Alkhair et al. 2019) presented a new Arab corpus to examine misinformation on YouTube, encompassing rumoured themes. Table 2 summarizes these Arabic datasets, including their topics, sources, sizes, annotation criteria, used features and classification techniques.

Table 2: Arabic datasets and used models in each study

Dataset	Topic	Source	Labelled/Size	Annotation	Label
(Haouari et al. 2020b)	COVID19	Twitter	9400	Manual	Fake | Real
(Alqurashi et al. 2021)	COVID19	Twitter	8786	Manual	Misinform | not
(Alsudias and Rayson 2020)	COVID19	Twitter	2000/1M	Manual	False | Correct | Unrelated
COVID-19-FAKES (Elhadad et al. 2020)	COVID19	Twitter	220,000	Automatic	Real | Misleading
(Saadany et al. 2020)	Political issues	Satirical / official news sites	6,895	Labelling based on the source	true or satirical
ARACOVID19-MFH (Ameur and Aliane 2021)	COVID19	Twitter	10,828/ 300k	Manual	Fake | Not
(Mahlous and Al-Laith 2021)	COVID-19	Twitter	2500 /34,529	Manual/automatic	Fake | genuine
ArCOV-19 (Haouari et al. 2020a)	COVID19	Twitter	3M	Not annotated	Not labelled
(Alkhair et al. 2019)	Rumours	YouTube	--	--	Rumour | not
CLEF	COVID19 / political issues	Twitter/web pages	7500 /14742	Manual	False | True | partial false | other
(Barrón-Cedeño, Elsayed, Nakov, Da San Martino, et al. 2020; Elsayed et al. 2019; Nakov et al. 2021; Shahi et al. 2021)					
ArCorona: (Mubarak and Hassan 2020)	COVID-19	Twitter	8000/30M	Manual	--
AraFacts: (Ali et al. 2021)	Claims	5 Arabic fact-checking sites	6,222 claims	Unified label form claims	--
ANS (Khouja 2020)	Different topics	From multiple news media	4,547	--	False | True

5. Results and discussion

After investigating the selected studies in this literature, we concluded that most collected datasets related to fake news detection were harvested during the pandemic period. Table 3 shows the duration of data collection. Since most of the studies were conducted during the outbreak and were mainly collected from Twitter, as presented in Table 2, most trending hashtags are related to the COVID-19 topic. This shows the need to consider other topics, such as political and economic hashtags.

Table 3: Data Collection duration

Study	Data Collection Period
(Haouari et al. 2020b)	27th January till the end of April 2020.
(Alqurashi et al. 2021)	(4 months) January 1, 2020, to April 30, 2020
(Alsudias and Rayson 2020)	September 2019 to April 2020
COVID-19-FAKES (Elhadad et al. 2020)	February 04, 2020, to March 10, 2020
(Mahlous and Al-Laith 2021)	January 1, 2020, until May 31, 2020
ArCOV-19 (Haouari et al. 2020a)	27th of January 2020 till 31st of January 2021
ArCorona: (Mubarak and Hassan 2020)	Feb 21 until March 31, 2020
AraFacts: (Ali et al. 2021)	Since 2016

In terms of the utilized experimental methods, we summarize and discuss them in this section for each study. (Alqurashi et al. 2021) used machine learning (RF, XGB, NB, SGD, SVM) and deep learning (CNN, RNN, CRNN). The Used features are WF and WE (FASTTEXT and word2vec). The results illustrate that optimizing under the curve (AUC) enhances their model performance and the XGB model outperforms other algorithms. Another study by (Alsudias and Rayson 2020) used LR, SVC, and NB and Used only the features WF and WE. They found that ML algorithms can predict the rumours tweets with an accuracy of 84 per cent. This study also clustered topics such as COVID-19 statistics, prayers for God, COVID-19 locations, advice for preventing education, and advertising. The COVID-19-FAKES by (Elhadad et al. 2020) employed the following models: DT, Multinomial NB, Bernoulli NB, LR, KNN, Perceptron, MP, Linear SVM, RF, bagging meta-estimator, XGBoost, AdaBoost, and GB in their experiments using the following features: TF, TF-IDF (unigram, bigram, trigram, N-gram, CL), and WE. This research help studies to understand the dynamics behind the recent outbreak on Twitter (Elhadad et al. 2020). (Saadany et al. 2020) They conduct several exploratory analyses to distinguish the linguistic Arabic fake news that includes satirical content and employ pre-trained word embedding models with different ML models that can predict satirical fake news with an accuracy of up to 98.6%. (Alkhair et al. 2019) and (Mahlous and Al-Laith 2021) also used ML and DL methods in their experiments with promising results. While fewer Arabic studies have investigated pretrained and transformer-based models. For instance, in ArCorona study (Mubarak and Hassan 2020) used BERT and AraBERT using TF-IDF (character and word n-gram) and Mazajak embeddings (WL, skip-gram embeddings). Also, in the dataset ARACOVID19-MFH study by (Hadj Ameur and Aliane 2021), they used Arabic preprocessing methods, several deep learning models, and five transformer models, including (AraBERT and mBERT). Their observation shows that these two models achieved high performance with an f-score of 0.92.

6. Conclusion

Many news publishers propagate their news through social media. With the growth of online information, users tend to communicate using their language. This means fake news and disinformation spread in all languages, such as English and Arabic. Although Arabic is considered one of the under-represented languages in this field, various studies have emerged and discussed practical methods. This survey presented an overview of studies correlated to this problem, including the existing datasets and methods. Consequently, several limitations

have emerged that researchers should consider in future work. In terms of datasets, small datasets with noises, such as the imbalance or unavailability of data and unclassified data, usually yield inadequate performance. Hence, such limitations should be intensified using a manually annotated or automatically generated gold-standard dataset (Al-Yahya et al. 2021; Haouari et al. 2020b). Moreover, applying model ensemble and different techniques to explore modern model architectures. Another critical factor to consider is linguistic characteristics. Although some studies, such as (Saadany et al. 2020), have proven the pre-trained models' effectiveness in capturing Arabic satire, analyzing linguistic features provides a more profound insight into the fake news phenomenon. Therefore, some studies, e.g., (Jardaneh et al. 2019), plan to perform additional feature engineering by utilizing Twitter responses. Finally, after reviewing these promising considerations in detecting fake news, what will prevent this dissemination? Indeed, this is an extraordinary potential work that artificial intelligence solutions can tackle.

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References

Ali, Zien Sheikh, Watheq Mansour, Tamer Elsayed, and Abdulaziz Al-Ali. 2021. "AraFacts: The First Large Arabic Dataset of Naturally Occurring Claims." Pp. 231–36 in Proceedings of the Sixth Arabic Natural Language Processing Workshop.

Alkhair, Maysoon, Karima Meftouh, Kamel Smaïli, and Nouha Othman. 2019. "An Arabic Corpus of Fake News: Collection, Analysis and Classification." Pp. 292–302 in International Conference on Arabic Language Processing. Springer.

Alqurashi, Sarah, Btool Hamoui, Abdulaziz Alashaikh, Ahmad Alhindi, and Eisa Alanazi. 2021. "Eating Garlic Prevents Covid-19 Infection: Detecting Misinformation on the Arabic Content of Twitter." ArXiv Preprint ArXiv:2101.05626.

Alsudias, Lama, and Paul Rayson. 2020. "COVID-19 and Arabic Twitter: How Can Arab World Governments and Public Health Organizations Learn from Social Media?"

Althabiti, S., Mohammad Ammar Alsalka, and E. Atwell. 2022. "SCUoL at CheckThat! 2022: Fake News Detection Using Transformer-Based Models." Pp. 428–33 in CEUR Workshop Proceedings. Vol. 3180. CEUR Workshop Proceedings.

Althabiti, Saud, Mohammad Alsalka, and Eric Atwell. 2021. "SCUoL at CheckThat! 2021: An AraBERT Model for Check-Worthiness of Arabic Tweets." in CEUR Workshop Proceedings.

Al-Yahya, Maha, Hend Al-Khalifa, Heyam Al-Baity, Duaa Alsaeed, and Amr Essam. 2021. "Arabic Fake News Detection: Comparative Study of Neural Networks and Transformer-Based Approaches." Complexity. doi: 10.1155/2021/5516945.

Barrón-Cedeño, Alberto, Tamer Elsayed, Preslav Nakov, Giovanni Da San Martino, Maram Hasanain, Reem Suwaileh, and Fatima Haouari. 2020. "CheckThat! At CLEF 2020: Enabling the Automatic Identification and Verification of Claims in Social Media." in Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics).

Barrón-Cedeño, Alberto, Tamer Elsayed, Preslav Nakov, Giovanni da San Martino, Maram Hasanain, Reem Suwaileh, Fatima Haouari, Nikolay Babulkov, Bayan Hamdan, and Alex Nikolov. 2020. "Overview of CheckThat! 2020: Automatic Identification and Verification of Claims in Social Media." Pp. 215–36 in International Conference of the Cross-Language Evaluation Forum for European Languages. Springer.

Beer, Dylan de, and Machdel Matthee. 2020. "Approaches to Identify Fake News: A Systematic Literature Review." Pp. 13–22 in International Conference on Integrated Science. Springer.

Elhadad, Mohamed K., Kin Fun Li, and Fayez Gebali. 2019. "Fake News Detection on Social Media: A Systematic Survey." in 2019 IEEE Pacific Rim Conference on Communications, Computers and Signal Processing, PACRIM 2019 - Proceedings.

Elhadad, Mohamed K., Kin Fun Li, and Fayez Gebali. 2020. "COVID-19-FAKES: A Twitter (Arabic/English) Dataset for Detecting Misleading Information on COVID-19." Pp. 256–68 in International Conference on Intelligent Networking and Collaborative Systems. Springer.

Elsayed, Tamer, Preslav Nakov, Alberto Barrón-Cedeño, Maram Hasanain, Reem Suwaileh, Giovanni Da San Martino, and Pepa Atanasova. 2019. "Overview of the CLEF-2019 CheckThat! Lab: Automatic Identification and Verification of Claims." in Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics).

Hadj Ameur, Mohamed Seghir, and Hassina Aliane. 2021. "AraCOVID19-MFH: Arabic COVID-19 Multi-Label Fake News & Hate Speech Detection Dataset." in Procedia CIRP.

Haouari, Fatima, Maram Hasanain, Reem Suwaileh, and Tamer Elsayed. 2020a. "Arcov-19: The First Arabic Covid-19 Twitter Dataset with Propagation Networks." ArXiv Preprint ArXiv:2004.05861.

Haouari, Fatima, Maram Hasanain, Reem Suwaileh, and Tamer Elsayed. 2020b. "ArCOV19-Rumors: Arabic COVID-19 Twitter Dataset for Misinformation Detection." ArXiv Preprint ArXiv:2010.08768.

Jardaneh, Ghaith, Hamed Abdelhaq, Momen Buzz, and Douglas Johnson. 2019. "Classifying Arabic Tweets Based on Credibility Using Content and User Features." in 2019 IEEE Jordan International Joint Conference on Electrical Engineering and Information Technology, JEEIT 2019 - Proceedings.

K¨ohler, Juliane, Michael Shahi, Gautam Kishore Struß, Julia Maria Wiegand, Melanie Siegel, Thomas Mandl, and Mina Sch¨utz. 2022. "Overview of the CLEF-2022 CheckThat! Lab Task 3 on Fake News Detection." in Working Notes of CLEF 2022—Conference and Labs of the Evaluation Forum. Bologna, Italy.

Khouja, Jude. 2020. "Stance Prediction and Claim Verification: An Arabic Perspective." ArXiv Preprint ArXiv:2005.10410.

Mahlous, Ahmed Redha, and Ali Al-Laith. 2021. "Fake News Detection in Arabic Tweets during the COVID-19 Pandemic." International Journal of Advanced Computer Science and Applications. doi: 10.14569/IJACSA.2021.0120691.

Moher, David, Alessandro Liberati, Jennifer Tetzlaff, Douglas G. Altman, and and the PRISMA Group. 2009. "Reprint—Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement." Physical Therapy 89(9):873–80. doi: 10.1093/ptj/89.9.873.

Mouty, Rabeaa, and Achraf Gazdar. 2018. "Survey on Steps of Truth Detection on Arabic Tweets." in 21st Saudi Computer Society National Computer Conference, NCC 2018.

Mubarak, Hamdy, and Sabit Hassan. 2020. "ArCorona: Analyzing Arabic Tweets in the Early Days of Coronavirus (COVID-19) Pandemic." ArXiv Preprint ArXiv:2012.01462.

Nakov, Preslav, Giovanni Da San Martino, Tamer Elsayed, Alberto Barrón-Cedeño, Rubén Míguez, Shaden Shaar, Firoj Alam, Fatima Haouari, Maram Hasanain, and Nikolay Babulkov. 2021. "The CLEF-2021 CheckThat! Lab on Detecting Check-Worthy Claims, Previously Fact-Checked Claims, and Fake News." Pp. 639–49 in European Conference on Information Retrieval. Springer.

Saadany, Hadeel, Emad Mohamed, and Constantin Orasan. 2020. "Fake or Real? A Study of Arabic Satirical Fake News." ArXiv Preprint ArXiv:2011.00452.

Shahi, Gautam Kishore, Julia Maria Struß, and Thomas Mandl. 2021. "Overview of the CLEF-2021 CheckThat! Lab: Task 3 on Fake News Detection." in CEUR Workshop Proceedings.

Zhou, Xinyi, and Reza Zafarani. 2020. "A Survey of Fake News: Fundamental Theories, Detection Methods, and Opportunities." ACM Computing Surveys. doi: 10.1145/3395046.