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Combating Hoax and Misinformation in Indonesia Using Machine Learning: What is Missing and Future Directions

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Abstract – *Indonesia has already used machine learning and artificial intelligence to combat hoax and misinformation. But according to survey from several organizations in Indonesia to 10.000 respondents with age range from 13-70 years at 2022 and 2023, 56% respondents are mainly found hoax and misinformation on social media and online media platform with 45% respondents are hesitant with their ability to differentiate true information with hoax. Most of the hoax and false information researchers in Indonesia also still have some challenges such as on the detection method and the dataset creation method. This research will use the systematic literature review using Science Direct, ACM Digital Library, and IEEE as the chosen academic search engines, Population, Intervention, Comparison, Outcome, and Context (PICOC), inclusion-exclusion rules, and quality's checklist. The results based on 20 papers are data crawler's application usage, labelling, and text pre-processing are the major steps to improve the dataset with more than 10.000 data. There are also already some advance methodologies for hoax and misinformation detection in text form such as using graph-based learning and special architecture design, yet there's still a little number for the detection in media form. The recommendation includes the dataset improvement steps, literature, and methodologies in media form that can be implemented either by the Indonesia's researchers, communities, and the government.*

Keywords: *Hoax; Misinformation; Detection Process; Machine Learning*

I. INTRODUCTION

Hoax is the false information that can be seems convincing to people (Rashkin et al., 2017; Volkova et al., 2019). Hoax is also known as "a fake article to hide the fact and can make people do negative things that sometimes being called "Fake news". (KBBI, 2020; MAFINDO, 2018a, 2019; Prasetijo et al., 2017; Rasywir & Purwarianti, 2015). Misinformation is one of hoax type with the combination of "mis" as "wrong" and "information", which is the information that is spread with inaccurate and unvalidated information, but can spread without any intention because of the lack of knowledge (Harjule et al., 2022).

Hoax and misinformation are spreading at fast paced because of many reasons. The individual factors such as ego, intention to provoke, individual's advantage for profit, or even for entertainment; and the external factors such as use of technology for negative use are the common causes (Habib et al., 2019; Jamil et al., 2015; Wang et al., 2012; Wardle, 2017). When viewed from a technology perspective, technological developments in social media such as digital news portals are expected to provide reliable, accountable, and authentic information through communication tools connected to the internet. However, technological developments and ownership of these communication tools also make it easy for information to be hidden, falsified, duplicated, and supports anonymous accounts that can change a person's belief to be biased. This also can happen in Artificial Intelligence (AI) that has not been trained correctly, which increased the probability of false information to be generated and spread automatically (Harjule et al., 2022).

In Indonesia, there are already some preventions and measures to prevent these types of information. The most prominent action is creating government's constitution called "Undang-Undang Informasi dan Transaksi Elektronik (UU ITE)," verified news portals, and false information related communities called Masyarakat Anti Fitnah Indonesia (MAFINDO), Indonesian Hoaxes Busters, Forum Anti Fitnah, Hasut, dan Hoax (FAFHH), and Sekoci (CNN Indonesia, 2019; Fajri, 2023). Some activities that have been done related to hoax and misinformation in Indonesia by the government are distributed electronic book (e-book) and held the social events group information sharing on social media or face-to-face, which the information can be found on "Literasi Digital" (Literasi Digital, n.d.). Other than that, MAFINDO as the Indonesia's largest community related to hoax and misinformation also developed fact-checking websites called TurnBackHoax.id and CekFakta.com in collaboration with Indonesia's verified digital news portals (Detik.com, Kompas.com, and others) and distributed hoax and misinformation reports through "Turn Back Hoax" telegram channel (MAFINDO, n.d.-b).

In relation to artificial intellifence (AI), Indonesia is already used AI system to support the current hoax and misinformation detection process such as using Artificial Intelligence Systems (AIS), machine and deep learning, probabilistic model and reasoning, distributed AI, human-like AI, and chatbots. This is because AI implementation has become one of the main national's strategies to reach "Visi Indonesia 2045". (BPPT, 2020). AIS itself is an automatic negative content crawling machine, which implements sentiment analysis, hashtag analysis, profiling, and social media trends on its performance. On 2023, AIS can detect 1.615 hoax topics, including the hoax related to Indonesia's election (Kemkominfo, 2024).

Other than AIS, Apollo system has already been developed on 2020 by MAFINDO, Indonesia Association for Computational Linguistics (INACL), Institut Teknologi Bandung (ITB) AI Center, Prosa.ai, and Datasur.ai which include another hoax search engine and chatbot with the accuracy stated on its free sites reached 92,4%. MAFINDO has also developed Hoax Buster Tools (HBT), which is the hoax and misinformation detector in mobile application form that can be installed to smartphones. HBT gives the variety of choices to verify contents through Anti Hoax Search Engine (ASE), user's account, image, video, and social network by redirecting the application to another site. (Cekfakta, n.d.; MAFINDO, n.d.-a, 2018b; Soleman & Sabila, 2020).

But, people in Indonesia still easily found hoax and misinformation on social media. According to the statistics by Statista on 2022 to 10.000 respondents with age range from 13-70 years, Facebook is the social media with the most fake news and hoax encountered with 56 percent of respondents in Indonesia encountered them. The rank was followed by the online media platform and WhatsApp (Statista, 2023). Also, from knowledge perspective based on survey by Databoks to 10.000 respondents with age range from 13-70 years at Indonesia, 45% respondents are hesitant with their ability to differentiate between false information and true information because of their incapability (Annur, 2023). These survey results can be supported based on several evidences on several platforms such as the e-book's download values on the "Literasi Digital" site only reached around 116 until 306 times, the latest information on "Turn Back Hoax" channel on Telegram is at 10th March 2024, and the lack of popularity of HBT, which is only installed for around 1.000 times as per April 2024 (Sekarhati, 2024).

As for HBT, it only provides a third-party sites or tools such as Jeffrey's Image Metadata Viewer (JIMF), foller.me, and etc. Hence there's only little of machine learning adaption on it. AIS and Apollo also have their own limitation, which are AIS only can detect public social media account, give around 8 to 16 confirmed hoax and disinformation per day, and unable to do any automatic prevention such as the negative contents on instant application; and the Apollo system will either can't be accessed or gave an error page, especially on hyperlink experiments which showing irrelevant information for the testing on image and hyperlink format (Daon001, 2019; Mth, 2020).

Based on previous studies in Indonesia, most of the hoax and false information researches are using classification method such as Naïve Bayes, support vector machine (SVM), and Stochastic-Gradient Diagram (SGD). These methods are mostly combined with sentiment analysis to detect whether the information is negative hoax or not with the evaluation results reached around 66% until 95%. For image detection, the used techniques are NOI4 with Gaussian noise, Error Level Analysis (ELA), Scale-Invariant Feature Transform (SIFT), and Demosaicing with the excellent evaluation result; accuracy reached 72% until 91,36% on fake image detection. The used dataset mostly is text articles or images with the retrieval process of the dataset is from crawling using a crawler engine or by keyword; and using public data from other websites or the modified one (Bachtiar et al., 2018; Lumoindong et al., 2020; Prasetijo et al., 2017; Pratiwi et al., 2017; Rahutomo et al., 2019; Rasywir & Purwarianti, 2015; Santoso et al., 2020; Zaman et al., 2020).

However, most of the tasks are still focused on the binary classification process, hence the methods are still cannot be considered the specific type of information other than "true information" and "false information". The current methods for the fake image detection process also have several limitations, such as could not detect all the duplicate patches and challenging to detect in low-resolution images. As for the dataset, the dataset are mostly from local storage with the most number of data is 600. There are also some public dataset that has been stated in the research. Although the accessibility and the numbers are not the issues, some of the public datasets are already can't be accessed and some of them hasn't being standardized before usage, so it is hard to compare with the others globally. There are also other mentioned challenges such as lack of human resources, hard to define the dataset's credibility, a little time on the labelling process, and the anonymity of the dataset, hence the probability of producing inaccurate result is increasing. (Bachtiar et al., 2018; Lumoindong et al., 2020; Prasetijo

et al., 2017; Pratiwi et al., 2017; Rahutomo et al., 2019; Rasywir & Purwarianti, 2015; Santoso et al., 2020; Zaman et al., 2020).

Because of those reasons, this research will review and discuss previous studies to know the best practices results for hoax and misinformation detection that has been implemented in other countries. Then, the comparison with Indonesia's current condition will be discussed. The result will be in a report form that includes the recommendation for hoax and misinformation detection method and dataset improvement that can be applied in Indonesia's practice and research and enable to improve the hoax and misinformation detection process in Indonesia, either by the researchers, communities, or the Indonesia's government.

II. METHODS

This research is using systematic literature review (SLR) method by Kitchenhamm (Kitchenham, 2007). The first step of the methodology is the planning process which has been done to define the research question by using Population, Intervention, Comparison, Outcome, and Context (PICOC) method. For this research, the population is "hoax and misinformation detection research", the intervention is "task, method, model, definition, dataset, hoax, false information, and misinformation", the comparison is "comparison of definition, task, dataset, and application of hoax and misinformation detection", the outcome is "collected definitions and methods including task, model, dataset, application", and "recommendation of improvement on definition understanding, task, model, dataset, and application"; and the context is "social media".

From the PICOC, the research questions have been determined. The research questions are what are the mentioned/evaluated definitions and methods (task, dataset, application) on hoax and misinformation detection process based in locations other than Indonesia (as RQ 1) and what are the new improvements and development on hoax and misinformation detection process based on SLR (as RQ2). The searching process were done using Science Direct, ACM Digital Library, and IEEE Xplore. These academic search engine were chosen because they are the most used on previous research; and with boolean query by title and abstract filtering. The keywords that have been used are "false information", "hoax", "misinformation", "false information detection", "hoax detection", and "misinformation detection".

The second step of the methodology is conducting multiple process which includes identification, selection, scoring the paper's quality, extraction, and synthesis. This step will follow the inclusion-exclusion rules from previous research that has been done by Cardoso Durier da Silva et al. (2019) and Habib et al. (2019). There are three categories which are the initiation (include the paper or article published on journal, workshop, and conference within 2018 until 2024; and exclude the paper or article is not published on journal, workshop, and conference & not within 2018 until 2024), title & abstract filtering (include title or abstract is relevant to PICOC and written in English; and exclude the title or abstract that is not relevant to PICOC, in a SLR form, does not have an abstract, or written in other language than English), and the full-text filtering (include the paper that can be accessed using public access, explain the definition or methods such as task, dataset, and application related to hoax and misinformation detection, and written in English; and exclude the paper with inaccessible content, not explaining definition or methods such as task, dataset, and application related to hoax and misinformation detection, or not in English even though the abstract is in English).

The topic's exclusion also has been conducted by excluding the topic related to cognition changes, medical and social perspective, IT infrastructure related to cyberattack, and the actor of false information. The included paper's quality will be checked using the checklist's question:

- Is there any description about the research's purpose on the article? (C1)
- Is the article describing the study literature, research's background, and research's context? (C2)
- Is the article showing the related work from previous researches? (C3)
- Is the article describing the research's architecture/methodologies? (C4)
- Is the article showing the research's result? (C5)
- Is the article showing the relevant conclusion? (C6)
- Is the article recommending any future work? (C7)

Lastly, the third step of the methodology is reporting process which includes writing the analysis, comparison, and the recommendation for hoax and misinformation detextion in Indonesia.

III. RESULTS AND DISCUSSION

Based on SLR process, there are 20 papers from 1.313 papers that can be analyzed. Most papers that has detail information about the dataset creation are related to health issues such as COVID-19 pandemic, monkeypox, and Zika virus. There are also some researches that compiled the dataset related to political condition and overall general topics. These datasets can be in various forms such as text (retrieved from tweets or comments) as the most used in previous research, image, video, audio, and hyperlink.

In research related to COVID-19, there are several ways to create the dataset. In one research, the dataset is crawled by the architecture design with four different parts including API connection layer that connects to the Instagram official platform, proxy layer, the modules for retrieve the post, reaction, prodile, social connection, and story information; and the dataset layer using MongoDB. After that, the features are extracted and trained the dataset using Contextual Long-Short Term Memory (LSTM) Neural Network and Keras Tokenizer Class. In total, 829K comments and 3.2 M likes from 25.7 K public posts are gathered and can accessed publicly from github (Zarei et al., 2021). Other researchers used Twitter API by using keyword

#covid and defined 17 misinformation target sources. filtered using Locality Sensitive Hashing to removed near-duplicate tweets in large collection, 100 permutations, and a Jaccard threshold of 50%. In total, 1.452 data are standardized and ready to use (Weinzierl & Harabagiu, 2021).

In other research, the dataset is crawled by using Twitter API and Tweepy library with keyword "#monkey-pox". The features also have been extracted including text, timestamp, author, source, and language. Then, the data is standardized by doing emoji conversion into textual formal, retweet, hashtag, numeral, puctuation, and stopword removal; tokenization, stemming, and lemmatization (to convert the similar word with the same meaning into one word or dictionary). After that, the word's frequency is calculated & the labeling process is done by using Valence Aware Dictionary and Sentiment Reasoner (VADER) and TextBlob. In total, 107K unique tweets with 103 languages are ready to use for training (Bengesi et al., 2023).

As for one research, there were another challenges related to the language because the researchers wanted to detect the hoax and misinformation in Arabic text that include out-of-vocabulary (OOV) lingual text. The researchers crawled the text from the pre-defined hyperlink with Arabic embedding corpus (crawl from six prominent Arabic newspapers with Scrapy), text preprocessing by removing non-arabic & digits with null value, white space, tags, hashtags, punctuation, and URL; and Arabic text identification corpus with the expert verification. The final dataset contained 9.099 COVID-19 related data (Hossain et al., 2024).

Other than topics related to health issues, there were some researchers that discussed the dataset on political condition. One of the research compiled the dataset that includes the data retrieved from Facebook and Twitter social media posts related to Rusia-Ukraine Invation. For this, the researcher used CrowdTangle and manually crawled using a set of over 40 keywords for Facebook & over 30 keywords for Twitter in English, Russian, and Ukrainian for Facebook posts. Then, the data is labelled using the Iffy Index of unreliable sources; and removed tweets using the compliance/jobs end-point with twarc. In total, the dataset contained 80.066 from Facebook and more than 1.4 million tweets linked low-credibility news websites and Russian propaganda outlets (Pierri et al., 2023). In one research related to general topic dataset, the methodology for dataset creation is a little bit different than the others because this research's methodology used the crawling of publisher's ranks, domain owners, medium page per visit, and news disappearing patterns from three various fake news sites and some major news outlets from America. From this dataset, hoax and misinformation can also been defined by people not just only from the content, but also from the publishers (Xu et al., 2020).

The dataset can also in media forms such as image, video, and audio. There were several image dataset that are still available for usage such as CASIA 2.0 image tampering detection dataset. For the creation process, the image dataset can be created by manually screenshoted and tampered such as cropping and alignment of faces from video frames using facial landmark and Spatial Transformer Network (STN); or using two computer graphic-based (FaceSwap and Face2Face), two learning based approaches such as NeuralTextures and Deepfakes, and compressed the image with H.264 codec. From this methods, the collected images are vary from around 1.000 to 500.000 (Rossler et al., 2019; Sabir et al., 2019; Wei et al., 2019).

For video form, the video were manually crawled from Youtube using "zika virus" keyword, sorted by relevance, and the video's URL are being scanned. The video's characteristic are defined as feature such as the length of the video, number of views, comments, and the upload date. Then, the reliability of the information are scored using DISCERN tool and the quality are also being assessed by two reviewers using the Global Quality Scale. In total, 101 videos are ready to be trained (Bora et al., 2018).

As for the audio form, the challenges for the hoax and misinformation detection on audio form were still vary, hence the number of the research were not as much as the others. On one research, the dataset was created using CLEF-2018 CheckThat as reference, which only covered the audio transcript of 94 claims from three debates as a training set and 192 claims from seven debates & speeches as a test set with “2016 U.S. Presidential Campaign” as the topic, then the researcher combined the dataset with the corresponding video. The transcript's features were extracted using LIWC, TF.IDF, and Bert; and the audio's features were extracted using ComParE and i-vector (to extracted the speech signal by large Gaussian Mixture Model). Here, the audio's features includes 6.733 features (such as spectral sharpness, voice quality, psycho-accoustic, and etc) and the i-vectors results were 600-dimensional (Kopev et al., 2019).

As for the hoax and misinformation detection method, there were several ways. One is using graph-based link, which scanned the relation of the misinformation targets using nodes calculation, relevant tweets, and the knowledge embedding using TransE, TransD, TransMS, and TuckER. For the classification, binary classification with BERT, LSTM, K-Nearest Neighbor (KNN), Support Vector Machine (SVM), Random Forest, Logistic Regression, Multilayer Perceptron (MLP), and Naive Bayes were mostly mentioned as a single method or as the combination. Several factors also being calculated to determine the best-practice such as F1-score, accuracy, precision, and recall. As the result, one research found that the graph-based link method is proven to have more than 10% of F1-score (Weinzierl & Harabagiu, 2021).

On the other hand, TextBlob combination, annotation, lemmatization, and vectoring with CountVectorizer for the dataset that has been trained with SVM has the accuracy of 93% (Bengesi et al., 2023). Although, there was also the method when the researcher used temporal-pattern method using Mann-Kendall & Mann-Whitney or used the hashtag frequency that combined with Follower-Friends Rasio calculation. But these method are mainly used to see the relation of the text to the sources (Pierri et al., 2023; Zarei et al., 2021).

For the hoax and misinformation in media form, the image dataset are being learned using Convolutional Neural Network (CNN) or recurrent convolutional model as the primary method. Then, other methods such as SVM, neural network, structured random forest that has been optimized by ADAM tool, and XceptionNet tools usage will be combined. The result of image detection mostly has the accuracy rate from 70% to 97% percent, even though the image is in low-resolution form (Rossler et al., 2019; Sabir et al., 2019; Wei et al., 2019).

As for video and audio, the hoax and misinformation detection used Mann-Kendall & Mann-Whitney (also can be used fro text detection method as mentioned on previous paragraph), multiple logistic regression, Kruskall-Walis test, and human-centered computing. This research's result is the video that contained hoax & misinformation tended to shared & viewed massively at initial pace (Bora et al., 2018). For the audio, the dataset trained with logistic regression classifier and neural networks. The evaluation measurement use Mean Absolute Error (MAE), accuracy, Macro-average Mean Absolute Error (MMAE), Macro-average F1, and Macro-average Recall (MAR). The result of the research is the method can detect hoax and misinformation with accuracy range from 35% until 51% with MAE 67% (Kopev et al., 2019).

Hoax and misinformation detection in Indonesia can be improved by several ways. Based on the SLR result, there are tools such as Twitter API as the most popular one, twarc, and Scrapy. Manual queries also can be performed, although the keywords have some language limitations such as the mixture of different language or non-formal words. However, Indonesia's researcher should not limit the language for the text because the text pre-processing, especially the lemmatization and standardization can be done for the non-formal words such as "gw" and "lo" and the difference of the Indonesia's local language (such as sundanese, javanese, and more). Also, the dataset can contain the information of major Indonesia's publisher news sites and the fake news publishers for the information's credibility. The ranks of these sites can be found on several SEO sites such as SimilarWeb or TurnBackHoax.id. Then, the features can be defined based on the site's ranks, domains, medium page per visit, and others. The data labelling process can be done with automatic code as previously mentioned by Bengesi et. Al. (2023) if there's a challenge in the human resources.

As for the dataset in media form, the image and video dataset can use the already provided one such as CASIA 2.0 image tampering detection dataset, extracted the media from Facebook since it is the most popular social media in Indonesia, or create the initial dataset by tamperring with the previously mentioned methods, although it will be time-consuming. As for the audio, the dataset can be created by record the transcript by the researcher itself or create the multi-modal dataset such as the combination of the video recording and transcript. Collaboration with experts can support the researcher for dataset's quality checking to avoid any missing results that were being overpublicized, do cross-standardize, and do the overall quality assessment.

As for the methodology, the binary classification can still be used, but it can be improved with the combination of supervised and unsupervised learning. This is to support the dataset with large numbers or even in multimodal form. Graph-based learning also can used for hoax and misinformation in text form. Public tools usage also can be used such as ADAM, XceptionNet, and more can be used as a supporting tools for hoax and misinformation detextion in image and video forms. However, the hoax and misinformation detection in audio form's methodolofy still needs to be elaborated further by experimenting other deep learning globally, since the audio is the most challenging one to do automatically.

Other than the recommendation from the dataset and detection method, there are some previous research that stated the literature's improvement recommendation. Since the most common names are "hoax" and "misinformation", there are also other types of false information such as "disinformation", "propaganda", "satire", "clickbait", and more. If the definitions of these proverbs are defined even though it's not being validated by authorities such as KBBI, These definitions can be used as an initial literature supplement to people, especially for the government's authorities, communities, crowds on crowdsourcing systems, and academic researchers. Literature improvements also can be done by using visualization and collaborated with information providers and information technology experts. These activities can improve the sharing process and accountability of the information, including the information about characteristics of media social contents and differentiation on the labelling process (Kılınç & Sayar, 2019).

IV. CONCLUSION

Hoax and misinformation still have been commonly spread in social media. Based on the comparison result and analysis, all related parties to Indonesia's hoax and misinformation detection process still can improved. It is recommended to conduct and deepen the understanding of definitions, dataset creation from the initiation until the standardization process, implement the appropriate machine learning methodologies based on the dataset type, and give the more detailed evaluation results. The usage of public dataset, public tools, and help from the expert also can be done for reducing experiment's effort and time. Although based on the SLR, the hoax and misinformation detection in media form, especially audio, are still need human's effort & still a little number of research for it. On this research, the steps of the dataset creation and standardization with the advanced methodologies has been reviewed and can be used as the reference for future research related to hoax and misinformation detection in Indonesia.

However, this paper has several limitations, such as only analyzed from the dataset and detection methodology with machine learning. This research also only provide initial solustion from the theoretical side & not discussed the detection method by human such as crowdsourcing.

The future research could improve the review by modifying the keyword for SLR process such as including the "disinformation", "propaganda, "satire", or other keywords; and giving more detail on crawling protocols according to the new hoax and misinformation detection condition.

REFERENCES

Annur, C. M. (2023, May 30). Mayoritas Warga Indonesia Ragu dalam Memilah Berita Hoaks. Databoks.

Bachtiar, M. R., Gusti, D. N., Wijaya, I., & Hidajat, M. (2018). Web-Based Application Development for False Images Detection for Multi Images Through Demosaicing Detection. Proceedings of 2018 International Conference on Information Management and Technology, ICIMTech 2018, September, 277–280. https://doi.org/10.1109/ICIMTech.2018.8528175

Bengesi, S., Oladunni, T., Olusegun, R., & Audu, H. (2023). A Machine Learning-Sentiment Analysis on Monkeypox Outbreak: An Extensive Dataset to Show the Polarity of Public Opinion From Twitter Tweets. IEEE Access, 11, 11811–11826. https://doi.org/10.1109/ACCESS.2023.3242290

Bora, K., Das, D., Barman, B., & Borah, P. (2018). Are internet videos useful sources of information during global public health emergencies? A case study of YouTube videos during the 2015–16 Zika virus pandemic. Pathogens and Global Health, 112(6), 320–328. https://doi.org/10.1080/20477724.2018.1507784

BPPT. (2020). Strategi Nasional Kecerdasan Artifisial Indonesia 2020 - 2045.

Cekfakta. (n.d.). Cekfakta - Media. Cekfakta. Retrieved April 27, 2020, from https://cekfakta.com/media

CNN Indonesia. (2019). Kebebasan di Era Jokowi dan Jerat Lima Pasal "Panas" UU ITE. CNN Indonesia. https://www.cnnindonesia.com/teknologi/20191018171905-185-440771/kebebasan-di-era-jokowi-dan-jerat-lima-pasal-panas-uu-ite

Daon001. (2019). Hingga Februari, Mesin Ais Jaring 11 Ribu Konten Terorisme. Kominfo. https://www.kominfo.go.id/content/detail/17296/hingga-februari-mesin-ais-jaring-11-ribu-konten-terorisme/0/sorotan_media

Fajri, N. (2023, February 24). Hoaks Merajalela? Jangan Sampai Kamu Jadi Korbannya! Kemenkeu.

Habib, A., Asghar, M. Z., Khan, A., Habib, A., & Khan, A. (2019). False information detection in online content and its role in decision making: a systematic literature review. Social Network Analysis and Mining, 9(1), 50. https://doi.org/10.1007/s13278-019-0595-5

Harjule, P., Manva, M. T., Mehta, T., Gurjar, S., & Agarwal, B. (2022). Analysing Misinformation Sharing Amongst College Students in India during COVID-19. Procedia Computer Science, 218, 671–685. https://doi.org/10.1016/j.procs.2023.01.048

Hossain, Md. R., Hoque, M. M., Siddique, N., & Dewan, M. A. A. (2024). AraCovTexFinder: Leveraging the transformer-based language model for Arabic COVID-19 text identification. Engineering Applications of Artificial Intelligence, 133, 107987. https://doi.org/https://doi.org/10.1016/j.engappai.2024.107987

Jamil, N. B. C. E., Ishak, I. Bin, Sidi, F., Affendey, L. S., & Mamat, A. (2015). A Systematic Review on the Profiling of Digital News Portal for Big Data Veracity. Procedia Computer Science. https://doi.org/10.1016/j.procs.2015.12.154

KBBI. (2020). Arti kata Hoax. KBBI. https://kbbionline.com/arti/gaul/hoax

Kemkominfo. (2024, January 2). Hingga Akhir Tahun 2023, Kominfo Tangani 12.547 Isu Hoaks. Kemkominfo. https://www.kominfo.go.id/content/detail/53899/siaran-pers-no-02hmkominfo012024-tentang-hingga-akhir-tahun-2023-kominfo-tangani-12547-isu-hoaks/0/siaran_pers

Kitchenham, B. (2007). Guidelines for performing Systematic Literature Reviews in Software Engineering. https://www.researchgate.net/publication/302924724

Kılınç, D. D., & Sayar, G. (2019). Assessment of reliability of YouTube videos on orthodontics. Turkish Journal of Orthodontics, 32(3), 145–150. https://doi.org/10.5152/TurkJOrthod.2019.18064

Kopev, D., Ali, A., Koychev, I., & Nakov, P. (2019). Detecting Deception in Political Debates Using Acoustic and Textual Features. 2019 IEEE Automatic Speech Recognition and Understanding Workshop, ASRU 2019 - Proceedings, 652–659. https://doi.org/10.1109/ASRU46091.2019.9003892

Literasi Digital. (n.d.). Koleksi Buku Literasi Digital. Literasi Digital. Retrieved May 15, 2020, from https://literasidigital.id/koleksi-buku-literasi-digital/

Lumoindong, C. W. D., Aryadi, M. A., Wilyani, I. T., & Suhartomo, A. (2020). Effectiveness of Probabilistic Image Sampling Techniques to Identify Hoax-related Images in Indonesia. International Journal of Innovative Technology and Exploring Engineering, 9(3S), 125–131. https://doi.org/10.35940/ijitee.c1029.0193s20

MAFINDO. (n.d.-a). Lapor Hoax - TurnBackHoax. MAFINDO. Retrieved May 16, 2020, from https://turnbackhoax.id/lapor-hoax/

MAFINDO. (n.d.-b). Lapor Hoax - TurnBackHoax. MAFINDO. Retrieved May 16, 2020, from https://turnbackhoax.id/lapor-hoax/

MAFINDO. (2018a). Tool Kit Penanganan Hoaks dan Disinformasi.

MAFINDO. (2018b). Tool Kit Penanganan Hoaks dan Disinformasi.

MAFINDO. (2019). Terminologi & Penggunaan Format Baru untuk Post di FAFHH. Facebook Post. https://www.facebook.com/groups/fafhh/permalink/814386372227233/

Mth. (2020). Mau Tahu Cara Kerja Mesin AIS dalam Tangani Konten Negatif? Kominfo. https://www.kominfo.go.id/content/detail/24497/mau-tahu-cara-kerja-mesin-ais-dalam-tangani-konten-negatif/0/berita_satker

Pierri, F., Luceri, L., Jindal, N., & Ferrara, E. (2023). Propaganda and Misinformation on Facebook and Twitter during the Russian Invasion of Ukraine. Proceedings of the 15th ACM Web Science Conference 2023, 65–74. https://doi.org/10.1145/3578503.3583597

Prasetijo, A. B., Isnanto, R. R., Eridani, D., Soetrisno, Y. A. A., Arfan, M., & Sofwan, A. (2017). Hoax detection system on Indonesian news sites based on text classification using SVM and SGD. Proceedings - 2017 4th International Conference on Information Technology, Computer, and Electrical Engineering, ICITACEE 2017, 2018-Janua, 45–49. https://doi.org/10.1109/ICITACEE.2017.8257673

Pratiwi, I. Y. R., Asmara, R. A., & Rahutomo, F. (2017). Study of Hoax News Detection Using Naive Bayes Classifier in Indonesian Language. In International Conferenve on Information & Communication Technology and System (ICTS) (pp. 73–78). http://ieeexplore.ieee.org/abstract/document/8265649/

Rahutomo, F., Yanuar, I., Pratiwi, R., & Ramadhani, D. M. (2019). NAÏVE BAYES'S EXPERIMENT ON HOAX NEWS DETECTION IN INDONESIAN LANGUAGE. Jurnal Penelitian Komunikasi Dan Opini Publik, 23(1), 1–15.

Rashkin, H., Choi, E., Jang, J. Y., Volkova, S., & Choi, Y. (2017). Truth of varying shades: Analyzing language in fake news and political fact-checking. EMNLP 2017 - Conference on Empirical Methods in Natural Language Processing, Proceedings, 2931–2937. https://doi.org/10.18653/v1/d17-1317

Rasywir, E., & Purwarianti, A. (2015). Eksperimen pada Sistem Klasifikasi Berita Hoax Berbahasa Indonesia Berbasis Pembelajaran Mesin. Jurnal Cybermatika, 3(2), 1–8. https://www.mendeley.com/import/

Rossler, A., Cozzolino, D., Verdoliva, L., Riess, C., Thies, J., & Niessner, M. (2019). FaceForensics++: Learning to detect manipulated facial images. Proceedings of the IEEE International Conference on Computer Vision, 2019-Octob, 1–11. https://doi.org/10.1109/ICCV.2019.00009

Sabir, E., Cheng, J., Jaiswal, A., AbdAlmageed, W., Masi, I., & Natarajan, P. (2019). Recurrent Convolutional Strategies for Face Manipulation Detection in Videos. Interfaces (GUI), 1, 80–87. http://arxiv.org/abs/1905.00582

Santoso, H. A., Rachmawanto, E. H., Nugraha, A., Nugroho, A. A., & Basuki, R. S. (2020). Hoax classification and sentiment analysis of Indonesian news using Naive Bayes optimization Hoax classification and sentiment analysis of Indonesian news using Naive Bayes optimization. Telkomnika, 18(2), 799–806. https://doi.org/10.12928/telkomnika.v18i2.14744

Sekarhati, D. K. S. (2024, April 24). Turn Back Hoax Telegram - April 2024.

Soleman, S., & Sabila, Y. (2020). Blog Prosa.ai - Berkenalan dengan Apollo Anti Hoax. Prosa.Ai. https://blog.prosa.ai/id/berkenalan-dengan-apollo-anti-hoax/

Statista. (2023, March 15). Media platforms that present hoaxes and fake news in Indonesia in 2022. Statista. https://www.statista.com/statistics/1316006/indonesia-media-with-hoaxes-and-fake-news/

Volkova, S., Ayton, E., Arendt, D. L., Huang, Z., & Hutchinson, B. (2019). Explaining multimodal deceptive news prediction models. Proceedings of the 13th International Conference on Web and Social Media, ICWSM 2019, Icwsm, 659–662.

Wang, G., Mohanlal, M., Wilson, C., Wang, X., Metzger, M., Zheng, H., & Zhao, B. Y. (2012). Social Turing Tests: Crowdsourcing Sybil Detection. ArXiv.

Wardle, C. (2017). Fake news. It's complicated. - First Draft - Medium. First Draft. https://medium.com/1st-draft/fake-news-its-complicated-d0f773766c79

Wei, B., Yu, M., Chen, K., & Jiang, J. (2019). DeepBIF: Blind Image Forensics Based on Deep Learning. 2019 IEEE Conference on Dependable and Secure Computing, DSC 2019 - Proceedings, 1–6. https://doi.org/10.1109/DSC47296.2019.8937712

Weinzierl, M. A., & Harabagiu, S. M. (2021). Automatic detection of COVID-19 vaccine misinformation with graph link prediction. Journal of Biomedical Informatics, 124, 103955. https://doi.org/https://doi.org/10.1016/j.jbi.2021.103955

Xu, K., Wang, F., Wang, H., & Yang, B. (2020). Detecting fake news over online social media via domain reputations and content understanding. Tsinghua Science and Technology, 25(1), 20–27. https://doi.org/10.26599/TST.2018.9010139

Zaman, B., Justitia, A., & Sani, K. N. (2020). An Indonesian Hoax News Detection System Using Reader

Feedback and Naïve Bayes Algorithm. Cybernetics and Information Technologies, 20(1), 82–94. https://doi.org/10.2478/cait-2020-0006

Zarei, K., Farahbakhsh, R., Crespi, N., & Tyson, G. (2021). Dataset of Coronavirus Content From Instagram With an Exploratory Analysis. IEEE Access, 9, 157192–157202. https://doi.org/10.1109/ACCESS.2021.3126552