

Detection of Arabic and Algerian Fake News

Khaoula Hamadouche^{1*}, Kheira Zineb Bousmaha², Mohamed Yasmine Bahi Amar³, Lamia Hadrich-Belguith⁴

¹⁻³Computer Science Department, University of Oran 1, Algeria

⁴Computer Science Department, MIRACL laboratory, FSEGS, University of Sfax, Tunisia

Abstract – In an era characterised by the rapid dissemination of information through digital platforms, the proliferation of fake news has emerged as a pressing global concern. Misinformation, deliberately fabricated or misleading content presented as factual news, poses significant threats to public discourse, trust, and decision-making processes. The research highlights the significance of fake news detection in the Arabic language, with a specific focus on the Algerian dialect. The Arabic language exhibits great diversity and complexity, making the detection of false information, all the more crucial. The rapid spread of fake news through social media platforms has a significant impact on individuals and society as a whole. To address this challenge, this paper presents TruthGuardian, an innovative solution that combines machine learning and deep learning techniques with voting system for the last decision. This solution enables fast and accurate identification of fake news in the Arabic language, with emphasis on the Algerian dialect. It provides reliable and effective results in countering misinformation.

Keywords – Arabic language, Algerian dialect, deep learning, fake news detection, machine learning, social media.

I. INTRODUCTION

Fake news refers to deliberately created or disseminated false information with the intention of deceiving the public. This misinformation can be spread in the form of text, images, videos, or other types of media content, typically on social networks or online platforms [1], [2]. It can have negative consequences for the targeted individuals or organisations, often aiming to manipulate public opinion and political manipulation or to generate online clicks or advertising revenue, it can also be used to spread conspiracy theories, discredit individuals or groups, or drive online traffic [3], [4].

The proliferation of fake news has become an increasingly common phenomenon on social media networks. This can cause significant harm to society as a whole, sowing confusion and disseminating misinformation [5], [6]. Consequently, the detection of fake news has garnered the attention of numerous computer researchers who are striving to develop tools to combat this menace. In this context, the Arabic language has not been immune to the dissemination of false information. For instance, in Algeria, fake news has proliferated during recent political and social events [7].

Detecting these false pieces of information in Arabic and the Algerian Dialect (DA) has thus become a crucial challenge to

preserve the reliability and accuracy of information in this language. The advancement of natural language processing technologies has enabled the development of fake news detection solutions in multiple languages. Nevertheless, the Arabic language has received relatively less attention in this field compared to other languages such as English [7], [8]. Therefore, it is essential to conduct research on fake news detection in Arabic to propose tailored solutions for this language. This endeavour will contribute to safeguarding the integrity of information in Arabic and combating the risks associated with the spread of false information.

A majority of research efforts in the domain of Arabic fake news detection have primarily focused on Modern Standard Arabic (MSA) because they are considered high resource [9], which fails to address the unique linguistic challenges posed by regional dialects. This oversight is particularly concerning, given that the prevalence of fake news and misinformation is not confined to MSA but extends to dialectal content shared on various online platforms. Moreover, Algeria, as one of the largest Arab-speaking countries, boasts a vibrant online ecosystem with a substantial presence on social media platforms [10], [11]. The Algerian dialect, widely spoken and utilised in digital communication, presents its own set of linguistic and cultural features [10] that are susceptible to manipulation and misinformation.

Machine learning algorithms have demonstrated great promise in various natural language processing (NLP) tasks, like the field of fake news detection, as we will find in the section “Related Works”. Additionally, deep neural network architectures, specifically those employed in transfer learning approaches, have made notable strides in a multitude of NLP tasks [12] such as BERT, a sophisticated pre-training transfer learning model that ranks among the most substantial and impactful updates to NLP algorithms in recent years [13], [14].

In this article, we present an approach for detecting fake news in Arabic and the Algerian Dialect (DA) using natural language processing and machine learning techniques. Our approach is based on the utilisation of a pre-trained Arabic language model.

This paper underscores the significance of fake news detection and proposes effective solutions based on machine learning (ML) models: LinearSVC and Random Forest, as well as the deep learning (DL) model: Arabic-BERT [15]. These models were trained on datasets sourced from Echourouk,

* Corresponding author's e-mail: k.hamadouche@esi-sba.dz
Article received 2023-10-22; accepted 2024-10-04

Alarabiya, and No Rumors Twitter pages, achieving high accuracy levels, reaching 97 % for the machine learning models and 98 % for Arabic-BERT.

What sets our approach apart is the system output, which indicates whether the news is fake or not based on the hybrid prediction obtained from the ML and the Arabic-BERT models. The voting system we have adopted among the models ensures a robust and reliable final decision.

The structure of this article is divided into five sections: In the next section, we will delve into existing studies addressing Arabic fake news detection. The third section presents the design and development of TruthGuardian, our fake news detection solution and provides a detailed explanation of the hybrid approach used. It also elucidates the data pre-processing steps, model construction. The fourth section presents the results obtained and the performance evaluation, along with a discussion, concluding with a closing statement.

II. RELATED WORKS

In this section, we delve into some of research and development efforts dedicated to addressing the pressing issue of Arabic fake news detection. By exploring the scholarly endeavours, innovative methodologies, and technological advancements in this domain, we gain valuable insights into the evolving landscape of fake news detection within the Arabic-speaking world. This section provides a comprehensive overview of the key studies, methods, and trends that have shaped the current state of the art, setting the stage for our own contributions in this important field. In the state of the art for fake news detection, various approaches have been developed and refined over time. Many of these methods mainly rely on machine learning and deep learning [16], [17] with the help of natural language processing.

In the paper of [7], researchers aimed to identify Arabic fake news tweets and categorise them into six distinct categories: sport, health, entertainment, politics, social and religious. The authors aimed to uncover patterns related to the dissemination of Arabic fake news during the Covid-19 pandemic. They developed a dedicated Arabic dictionary and employed a text classification approach based on a rule-based system. Their methodology was applied on a dataset encompassing 5 million tweets, gathered between 1 March 2020 and 30 April 2020, sourced from the Twitter platform. To ensure the inclusion of pertinent tweets, Arabic hashtags linked to the coronavirus disease were utilised, such as “#كورونا”, “#covid19”, and “#كورونا_فيروس”. The resultant model achieved an impressive overall accuracy rate of 78.1 %.

In the study of [16], authors used machine learning and deep learning algorithms to detect Arabic fake news including conventional neural nets (CNN), long short-term memory (LSTM), bidirectional LSTM (BiLSTM), CNN+LSTM, and CNN + BiLSTM. They utilised three datasets of Arabic articles and they pre-processed them before the classification. Their model achieved an impressive detection accuracy of 84.82 % with the BiLSTM model. In another research work [18], the authors introduced a novel system designed for the detection of Arabic fake news, which harnessed the power of machine

learning algorithms. They used the Arabic dataset, comprising 206 080 tweets, through diligent API search on the Twitter platform. Their algorithm employed term frequency-inverse document frequency (TF-IDF) techniques for the extraction of features from this dataset. They applied nine diverse machine learning classifiers. These classifiers, namely naïve Bayes, K-nearest neighbours, support vector machine, random forest (RF), J48, logistic regression, random committee (RC), J-Rip, and simple logistics. Following their comprehensive experimentation, the system achieved its highest level of accuracy, an impressive 97.3 %, when harnessing the capabilities of the random forest and random committee classifiers. One of recent works is done by Awajan [19], he introduced an intelligent classification model designed to detect fake news within Arabic tweets. Furthermore, the research includes a comparative analysis between deep learning and shallow learning techniques. The author constructed an Arabic Twitter dataset, encompassing 206 080 tweets. The outcomes of this investigation showed a distinction in performance between pre-trained deep learning models and shallow models in the context of Arabic fake news identification. Specifically, when applied to the pre-processed dataset, the shallow learning approach achieved an accuracy rate of 95.92 %. In contrast, the LSTM model yielded a higher accuracy rate of 96.71 %, and the employment of the Bert model resulted in an exceptionally high accuracy rate of nearly 99 %. Maysaa ALSAFADI [20] employed deep learning models, specifically CNN-BiLSTM with stochastic gradient descent (SDG) optimisation for Arabic Fake News Detection. The study used a substantial Arabic dataset known as AFND [21], comprising 606 912 publicly available news articles. Furthermore, the researcher pre-processed the dataset (word encoding, tokenization, removal of punctuation marks, Arabic stop words, and special characters and stemming). The experimental outcomes, based on the AFND dataset, demonstrate highly promising performance, with an accuracy rate of 87.7 %.

These studies highlight the diverse array of techniques and methodologies employed in the detection of fake news in the Arabic text. Deep learning models, such as CNNs and LSTMs, as well as traditional machine learning algorithms like Random Forest, have been applied effectively to address the challenge of identifying fake news in the Arabic language content across various platforms, including social media. Despite the growing body of research in this field, it is noteworthy to mention a significant gap that requires attention. A striking limitation in the existing literature is the scarcity of studies that delve into the intricacies of Arabic dialects, with a particular emphasis on dialects such as the Algerian dialect. Addressing these dialectal nuances is vital for enhancing the accuracy and relevance of fake news detection systems in Arabic-speaking regions, where the impact of misinformation can be substantial.

III. METHODOLOGY

A. TruthGuardian Architecture

TruthGuardian is a system for detecting fake news, specifically designed for the Arabic language and the Algerian

dialect. It employs machine learning techniques and natural language processing to thoroughly analyse online content and identify deceptive information. Leveraging predictive models and algorithms, TruthGuardian assesses source credibility,

detects disinformation patterns, and provides accurate assessments of information veracity. An overview of TruthGuardian architecture is presented in Fig. 1.

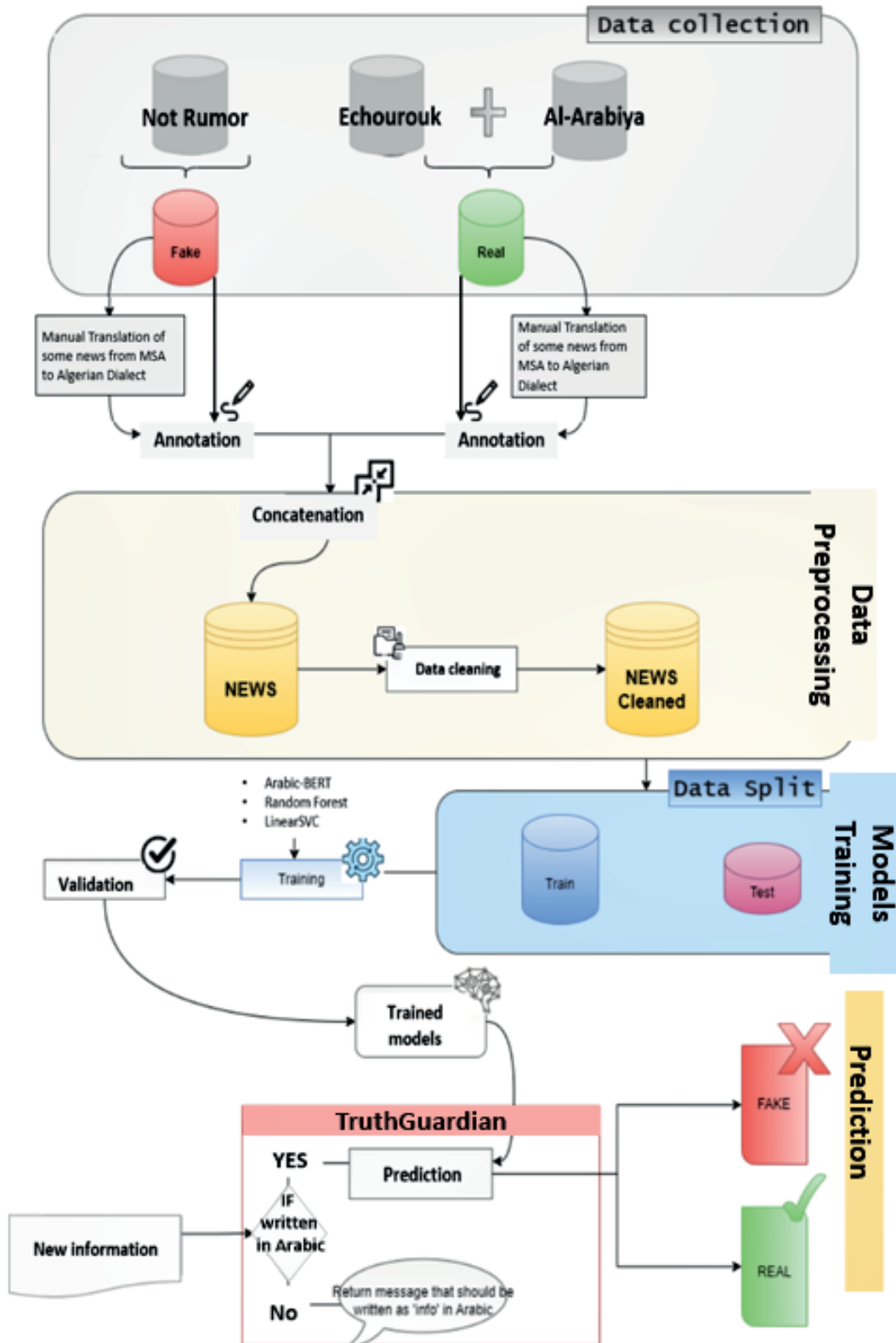


Fig. 1. TruthGuardian architecture.

B. Data Collection

We collected our original dataset, which differs from that of Alkhair et al. [22] and other existing dataset in terms of both content and time period. Their dataset comprises Arabic dialects (such as Algerian and Egyptian) and Modern Standard Arabic (MSA) texts, whereas our dataset consists of only Algerian and MSA with new events. In addition, the fake news dataset is constantly updated, which required us to keep it up to date.

MSA Dataset. In the development of TruthGuardian, data collection was a crucial and enriching step. The data collection process aimed to gather news in the Arabic language from both real and fake news sources to create a diverse and representative corpus. Among the datasets used, two reputable sources, Echourouk² and Alarabiya³, were selected to represent real news from the Arab world written in MSA. Our dataset of real news is the result of concatenating the datasets from Echourouk and Al-Arabiya. It represents a combination of real news from two different sources with 907 examples from Echourouk, and 850 examples from Alarabiya, to get in total 1754 real texts. Additionally, a datasets from “No Rumor”⁴ was extracted to provide examples of fake news. The dataset of fake news comprises 1699 instances. We performed this process for period from 25 January 2023 to 25 May 2023. We concatenated both of the two dataset and labelled with 0 for real and 1 for fake.

We found a limited number of texts, and we annotated them using official sites to confirm the information. Subsequently, we began collecting news directly from official sites, such as Echourouk and Al Arabiya, without the need for an annotation process, as these news sources are reliable. The same approach applies to the fake news retrieved from the official site of Rumor News.

Algerian Dataset. Regarding news in the Algerian dialect, there are limited specific datasets available for fake news and real news. Consequently, various scraping techniques were employed, based on platforms such as Twitter and Facebook; however, unfortunately, the results were not sufficiently promising. To address this limitation, a translation approach was considered, involving the translation of some news articles from the previous Arabic dataset (real and fake) into Algerian dialect. Significant efforts were made to manually translate news and add other Algerian texts (real and fake). This approach may not capture all the linguistic nuances and cultural context because we translate a small dataset.

In Table I, there are some Algerian examples with their labels (0 for real, 1 for fake) and their English translation.

We obtained, finally, an equilibrate dataset of 3563 texts, 1809 real and 1754 fake.

TABLE I
ALGERIAN DATASET EXTRACT

Text	Label
زلزال لي ضرب في ايران كان بشده 5.5 Earthquake hit Iran with a magnitude of 5.5	0
شخص يهدد بالتفجير مقر السفارة السعودية بالجزائر بصبح الأمن الجزائري حبسه A person who threatened to bomb the Saudi embassy in Algeria was arrested by the Algerian security.	0
تذاكر السفر لي ما خدموش بهم في وقت الكورونا غادي يعوضولهم الثمن تاعها Travel tickets that were not used during the time of COVID-19 will be compensated.	0
الكبار راهم بخلصو مليون They will increase the pension for the elderly to 10 000 Algerian dinars	1
الجزائر غادي تحتضن كان 2025 Algeria will host the 2025 African Cup of Nations in football.	1
المساعدات الجزائريه ما وصلتش لسوريا Algerian aid did not reach Syria.	1

C. Data Pre-processing

Data pre-processing plays a crucial role. Its purpose is to clean, normalize, and prepare textual data before utilising it in machine learning models.

The pre-processing steps we have followed include:

- Removal of emojis;
- Elimination of stopwords: In our study, we used the NLTK library to import Arabic stopwords and removed them from the text;
- Normalization: This step involves standardising certain specific features of the Arabic language that may vary in their graphical representation;
- Removal of URLs: Eliminating URLs ensures that models focus on analysing the textual content of the news rather than external references that may not be relevant for fake news detection [23];
- Removal of special characters: Latin characters, punctuation, and extra spaces were removed from the text;
- Tokenization.

D. Models Training

In TruthGuardian, model training is a crucial step to ensure their performance and their ability to generalise to new data. This step is carried out for both types of models: Machine Learning and Deep Learning.

Training with Machine Learning Models. We trained and evaluated five different models: Logistic Regression, Decision Tree Classification, Random Forest, SVM, and LinearSVC. Each of these models has specific features and capabilities. After

² <https://twitter.com/echoroukonline>

³ <https://twitter.com/AlArabiya>

⁴ https://twitter.com/To_Rumors

a thorough analysis of the performance of each model, we ultimately chose Random Forest and LinearSVC for their higher accuracy and more reliable predictions. We used a vector representation of words using the TF-IDF (Term Frequency–Inverse Document Frequency) method [24] to encode the texts.

Fine-Tuning Transformer-Based Models. BERT, an acronym for Bidirectional Encoder Representations from Transformers, is a pre-trained language model developed by Google [25]. It is based on the Transformer architecture, which is a type of neural network used for NLP. BERT is designed to understand and generate high-quality representations for words and sentences.

In our study, we trained Arabic-BERT based model [15] specifically designed for the Arabic language. After comparing their performances, we ultimately chose Arabic-BERT due to its higher accuracy and better predictions. The model, named “asafaya/bert-base-arabic”⁵, was pre-trained on a large corpus of Arabic texts and is capable of capturing the specific semantic and syntactic relationships in the Arabic language. During the training of the BERT model, we used a pre-processed dataset containing Arabic news and their corresponding labels (real or fake).

E. Prediction with TruthGuardian

The operation of the TruthGuardian application relies on a hybrid prediction approach that combines ML models and the Arabic-BERT based model we trained. This hybrid approach utilises a voting system to make the final decision. When new data is submitted to the application, the first step is to check if it is written in the Arabic language. If that is the case, we proceed to the hybrid prediction using the ML models and the Arabic-BERT model.

Each model makes an individual prediction on the new data, and then a voting system is used to make the final decision. Each model carries equal weight in this voting process since they all demonstrated good performance with high precision scores during training. The vote is cast in the majority vote: the predictions of the three models are combined by taking the rounded average of the predicted values (0 for real and 1 for fake). For example, if the prediction values of information are: 1 of LinearSVC, 0 for RF and 1 for Arabic-BERT, the final output is 1 based on the majority vote, indicating fake news.

Figure 2 shows the process.

However, if the new data is not written in Arabic, the application displays a return message indicating that the information needs to be written in Arabic for the prediction to be made correctly. The voting system between the models we designed and programmed ensures a robust and reliable final decision to determine whether the news is fake or real.

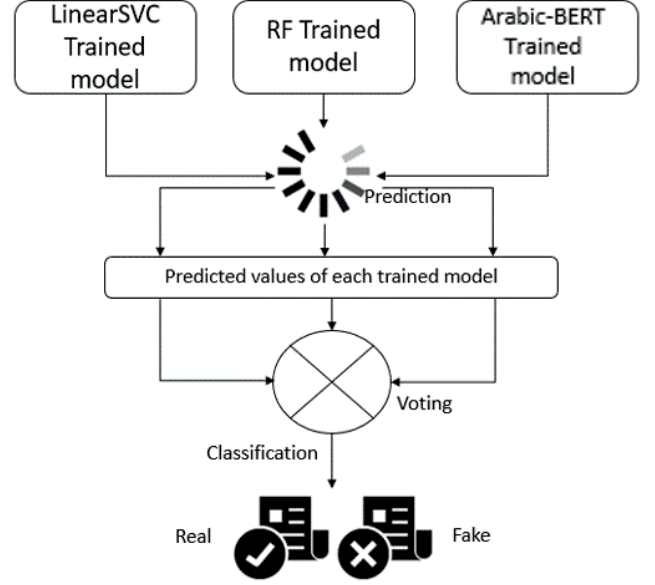


Fig. 2. Voting system process.

IV. EXPERIMENTS SETUP

A. Development Machine

The machine used for the development of TruthGuardian is a DELL Attitude 3350 equipped withan Intel(R) Core(TM) i5-5200 CPU running at 2.20 GHz, with 8 GB of RAM. For the datapre-processing and model training phases, we utilised Google Colab, including a generous amount of RAM (12 GB in our case).

B. Data Split

The data-splitting step involves dividing the dataset into two sets: 80 % for training and 20 % for testing using scikit-learn library.

C. Bert Model-based Hyperparameters

BERT model was fine-tuned for our fake news detection task. We specify a batch size of 32, the number of epochs as 10, the learning rate of $2e-5$ and a maximum length of 128 tokens for model training.

V. EVALUATION AND RESULTS

A. Performance Evaluation

In this section, we evaluate the performance of theML and deep learning models using accuracy metric as shown in Table II.

As observed in Table II, our Arabic-BERT model outperforms the other models, with significantly better results. In comparison, the other models, Random Forest (RF) and LinearSVC, exhibit a slight decrease in accuracy. We integrated a voting system that utilises these three models to enhance our system’s performance and make collective decisions. This approach achieved an overall accuracy of 97.72 %, which is the average of the three individual model accuracies.

⁵ ArabicBERT: <https://github.com/alisafaya/arabic-bert>

In Table III, we report more performance metrics of LinearSVC and RF for each class (fake and real).

TABLE II
PERFORMANCE EVALUATION RESULTS

Model	Accuracy, %
Logistic Regression	94.55
Decision Tree Classification	96.29
SVM	96.71
Random Forest	97.26
LinearSVC	97.06
Arabic-BERT	98.84

TABLE III
MORE PERFORMANCE METRICS

Model	Class	Precision	Recall	F1-score
LinearSVC	0	0.96	0.99	0.97
	1	0.99	0.96	0.97
RF	0	0.97	0.97	0.97
	1	0.96	0.97	0.97

LinearSVC and Random Forest each have strengths that address the weaknesses of the other. LinearSVC provides higher precision, which helps reduce false positives when classifying fake news, while Random Forest offers better recall, allowing it to capture more fake news instances.

By using a voting system that combines the predictions of LinearSVC, Random Forest, and Arabic BERT, you can effectively leverage the strengths of all these models. This approach avoids relying on just one model and helps mitigate the impact of any individual model's errors.

If one model misclassifies an instance, the correct predictions from the other models can counterbalance those errors, leading to improved overall performance.

In Table IV, we tested new Algerian texts and rephrased some of our previously used dataset (0 for real and 1 for fake).

TABLE IV
ALGERIAN SAMPLES WITH PREDICTED AND ACTUAL CLASSES

Text	Predicted Class	Actual Class
ماشي كاين ماتش ودي بين دزاير ومصر There is no friendly match between Algeria and Egypt	0	0
لاعين من تشيلسي مرشحون للانتقال الى الدوري السعودي Chelsea players are candidates to move to the Saudi league	0	0
مغاديش يفوتو ماتش الجزائر اوغندا في الأرضية They won't broadcast the Algeria vs. Uganda match on the Al-Ardiya channel	0	0

صدام مزاله حي Saddam is still alive	1	1
عطلة الامومة ولات 6 اشهر Maternity leave is six months	1	1
التمر الجزائري حرام Algerian dates are prohibited	1	1
العلامة الشيخ ايت علجي مات Sheikh Ait Alji has passed away	0	0
الديسار والخضرة قلالت في بريطانيا وزيرة تاع البيئة تاعهم قالتهم كولوا لفت. The quantities of fruits and vegetables in stores are decreasing. The British Minister of the Environment is urging citizens to consume "turnips."	1	0
الباك هاذ العام غادي يتعاود The baccalaureate exams will be held again this year	0	1

B. Discussion

As we observed in Table IV, TruthGuardian has demonstrated its ability to make accurate predictions in fake news detection. Our model was trained with claims circulating from 25 January 2023 to 25 May 2023, which could be a limitation for detecting fake news outside of this period, as the last example, it was shared in social media after the baccalaureate exams period (June 2023).

In some cases, the information exists in our Arabic dataset but one tested in Algerian dialect the system could not recognise it because of the difficulty and the complexity of this dialect so it classified this news as either real or fake. The penultimate example exists in our dataset in MSA:

تناقص كميات الفاكهة والخضار بالمتاجر.. وزيرة البيئة البريطانية تدعو المواطنين إلى تناول اللفت

Our system found difficulty in distinguishing the example and identifying it when we rephrased it in the Algerian dialect.

C. Comparative Analysis

Next, we will provide a detailed comparison between a set of recent research studies on Arabic fake news detection and our work. This comparison is based on some factors, including the dataset, the used technique (model), and the accuracy achieved as illustrated in Table V.

TABLE V

COMPARATIVE ANALYSIS OF ARABIC FAKE NEWS DETECTION WORKS AND OUR PROPOSED SOLUTION

Article	Dataset	Used Model	Accuracy, %
[6]	1098 Arabic and Arabic dialects articles	RF, NB, SVM	Random Forest: 79
[16]	3 MSA dataset (9119)	ML and DL techniques	BiLSTM: 84.82
[26]	16 000 Arabic texts (MSA)	ARBERT	98.8
[27]	Arabic Fake news dataset [28]	mini-BERT	98.43
[22]	4895 Arabic and Algerian texts	ML and DL techniques	SVM: 92.09
Our work	3563 Arabic (MSA) and Algerian texts	ML algos Arabic-BERT	97.72

We mentioned that we did not use the same dataset as the various previous works. However, these works share a common focus on the language used, particularly Modern Standard Arabic (MSA) and Arabic dialects, including the Algerian dialect.

VI. CONCLUSION

Social media plays a central role in the rapid dissemination of false information, significantly affecting both individuals and society. This research introduces TruthGuardian, an innovative fake news detection solution tailored to the Arabic language and Algerian dialect. TruthGuardian leverages both ML and DL approaches, supported by a voting system. It underscores the growing importance of fake news detection in light of the linguistic diversity and complexity of the Arabic language. Our model's training data spans from 25 January 2023 to 25 May 2023, potentially limiting its ability to detect fake news outside this timeframe. Nonetheless, our system has demonstrated remarkable accuracy (97.72 %). Our proposed solution can be generalised to other Maghrebi dialects, such as Moroccan and Tunisian. This adaptability is facilitated by the linguistic proximity shared among the Algerian dialects and other Maghrebi variations.

To ensure the ongoing relevance of TruthGuardian, we plan to regularly update our dataset. This update will include all events occurring outside of this period, based on significant events in the country or globally. Our fake news detection models may need to be continuously updated to remain effective in combating evolving disinformation. Improving the quality of training data is essential for optimising system performance. Additional efforts are needed to ensure the collection and annotation of high-quality data that represents the diversity of content in the Arabic language and Algerian dialect. Other future perspectives for this paper are promising. First, we plan to expand TruthGuardian to other important languages and dialects to better combat disinformation on a global scale. This expansion will require adaptation and

ongoing adjustment of the solution to account for the linguistic and cultural specificities of each context. Next, we are committed to exploring deep learning techniques and incorporating active learning into our system. Using more models and leveraging human expertise to annotate challenging examples will contribute to improving the accuracy and performance of fake news detection. Finally, continuous monitoring of emerging disinformation techniques and regular updates to TruthGuardian will allow us to stay up-to-date with the constant evolution of disinformation. We are committed to remaining at the forefront of the fight against disinformation by adapting our solution to emerging trends. The prospects for improvement and expansion offer exciting opportunities to continue the fight against disinformation and promote a reliable and transparent information environment on social media.

REFERENCES

- [1] S. R. Sahoo and B. B. Gupta, "Multiple features based approach for automatic fake news detection on social networks using deep learning," *Applied Soft Computing*, vol. 100, Mar. 2021, Art. no. 106983. <https://doi.org/10.1016/j.asoc.2020.106983>
- [2] K. Shu, A. Bhattacharjee, F. Alatawi, T. H. Nazer, K. Ding, M. Karami, and H. Liu, "Combating disinformation in a social media age," *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, vol. 10, no. 6, Nov./Dec. 2020, Art. no. e1385. <https://doi.org/10.1002/widm.1385>
- [3] E. C. Tandoc, Z. W. Lim, and R. Ling, "Defining 'fake news': a typology of scholarly definitions," *Digital Journalism*, vol. 6, no. 2, pp. 137–153, Aug. 2018. <https://doi.org/10.1080/21670811.2017.1360143>
- [4] G. Pennycook, A. Bear, E. T. Collins, and D. G. Rand, "The implied truth effect: Attaching warnings to a subset of fake news headlines increases perceived accuracy of headlines without warnings," *Management Science*, vol. 66, no. 11, pp. 4944–4957, Nov. 2020. <https://doi.org/10.1287/mnsc.2019.3478>
- [5] T. Murayama, "Dataset of fake news detection and fact verification: a survey," *arXiv preprint arXiv:2111.03299*, 2021. <https://doi.org/10.48550/arXiv.2111.03299>
- [6] P. N. Petratos and A. Faccia, "Fake news, misinformation, disinformation and supply chain risks and disruptions: risk management and resilience using blockchain," *Annals of Operations Research*, vol. 327, pp. 735–762, Mar. 2023. <https://doi.org/10.1007/s10479-023-05242-4>
- [7] F. L. Alotaibi and M. M. Alhammad, "Using a rule-based model to detect Arabic fake news propagation during Covid-19," *International Journal of Computer Science and Applications*, vol. 13, no. 1, 2022. <https://doi.org/10.14569/IJACSA.2022.0130114>
- [8] H. Himdi, G. Weir, F. Assiri, and H. Al-Barhamtoshy, "Arabic fake news detection based on textual analysis," *Arabian Journal for Science and Engineering*, vol. 47, no. 8, pp. 10453–10469, 2022. <https://doi.org/10.1007/s13369-021-06449-y>
- [9] F. A. Alqahtani and M. Sanderson, "Generating a lexicon for the Hijazi dialect in Arabic," in *Arabic Language Processing: From Theory to Practice: 7th International Conference, ICALP 2019, Nancy, France, Proceedings 7*, Oct. 2019, pp. 3–17. https://doi.org/10.1007/978-3-030-32959-4_1
- [10] L. Moudjari, K. Akli-Astouati, and F. Benamara, "An Algerian corpus and an annotation platform for opinion and emotion analysis," in *Proceedings of the Twelfth Language Resources and Evaluation Conference*, Marseille, France, May 2020, pp. 1202–1210. <https://hal.science/hal-03102495/document>
- [11] R. Saddek, *Internet and Social Media in Algeria*. Rowman & Littlefield Publishers, 2022.
- [12] A. Virtanen, J. Kanerva, R. Ilo, J. Luoma, J. Luotolahti, T. Salakoski, F. Ginter, and S. Pyysalo, "Multilingual is not enough: BERT for Finnish," *arXiv preprint arXiv:1912.07076*, Dec. 2019. <https://doi.org/10.48550/arXiv.1912.07076>

- [13] A. S. Karnyoto, C. Sun, B. Liu, and X. Wang, "Transfer learning and GRU-CRF augmentation for COVID-19 fake news detection," *Computer Science and Information Systems*, vol. 19, no. 2, pp. 639–658, 2022. <https://doi.org/10.2298/CSIS210501053K>
- [14] M. Das, S. Banerjee, and P. Saha, "Abusive and threatening language detection in Urdu using boosting based and BERT based models: A comparative approach," *arXiv preprint arXiv:2111.14830*, 2021. <https://doi.org/10.48550/arXiv.2111.14830>
- [15] A. Safaya, M. Abdullatif, and D. Yuret, "KUISAIL at SemEval-2020 task 12: BERT-CNN for offensive speech identification in social media," *arXiv preprint arXiv:2007.13184*, 2020. <https://doi.org/10.48550/arXiv.2007.13184>
- [16] K. M. Fouad, S. F. Sabbeh, and W. Medhat, "Arabic fake news detection using deep learning," *Computers, Materials & Continua*, vol. 71, no. 2, 2022. <https://doi.org/10.32604/cmc.2022.021449>
- [17] A. R. Mahlous and A. Al-Laith, "Fake news detection in Arabic tweets during the Covid-19 pandemic," *International Journal of Computer Science and Applications*, vol. 12, no. 6, pp. 778–788, 2021. <https://doi.org/10.14569/IJACSA.2021.0120691>
- [18] M. Alazab, A. Awajan, A. Alazab, A. Khreisat, A. Alhyari, and R. Saadeh, "Fake-news detection system using machine-learning algorithms for Arabic-language content," *Journal of Theoretical and Applied Information Technology*, vol. 100, no. 16, pp. 5056–5069, 2022.
- [19] A. Awajan, "Enhancing Arabic fake news detection for twitters social media platform using shallow learning techniques," *Journal of Theoretical and Applied Information Technology*, vol. 101, no. 5, Mar. 2023. <https://www.jatit.org/volumes/Vol101No5/12Vol101No5.pdf>
- [20] M. Alsafadi, "Stance classification for fake news detection with machine learning," *The Eurasia Proceedings of Science Technology Engineering and Mathematics*, vol. 22, pp. 191–198, Sep. 2023. <https://doi.org/10.55549/epstem.1344457>
- [21] A. Khalil, M. Jarrah, M. Aldwairi, and Y. Jararweh, "Detecting Arabic fake news using machine learning," in *2021 Second International Conference on Intelligent Data Science Technologies and Applications (IDSTA)*, Tartu, Estonia, Nov. 2021, pp. 171–177. <https://doi.org/10.1109/IDSTA53674.2021.9660811>
- [22] M. Alkhair, A. Hocini, and K. Smaïli, "Spotting fake news in Arabic with machine and deep learning techniques," *International Journal of Scientific Development and Research*, vol. 8, no. 2, pp. 605–611, 2023.
- [23] S. Khan, S. Hakak, N. Deepa, B. Prabadevi, K. Dev, and S. Trelova, "Detecting Covid-19-related fake news using feature extraction," *Frontiers in Public Health*, vol. 9, Jan. 2022, Art. no. 788074. <https://doi.org/10.3389/fpubh.2021.788074>
- [24] G. Salton and C. Buckley, "Term-weighting approaches in automatic text retrieval," *Information Processing & Management*, vol. 24, no. 5, pp. 513–523, 1988. [https://doi.org/10.1016/0306-4573\(88\)90021-0](https://doi.org/10.1016/0306-4573(88)90021-0)
- [25] J. Devlin, M.-W. Chang, K. Lee, and K. Toutanova, "BERT: Pre-training of deep bidirectional transformers for language understanding," *arXiv preprint arXiv:1810.04805*, Oct. 2018. <https://doi.org/10.48550/arXiv.1810.04805>
- [26] A. B. Nassif, A. Elnagar, O. Elgendy, and Y. Afadar, "Arabic fake news detection based on deep contextualized embedding models," *Neural Computing and Applications*, vol. 34, no. 18, pp. 16019–16032, May 2022. <https://doi.org/10.1007/s00521-022-07206-4>
- [27] H. M. Alawadh, A. Alabrah, T. Meraj, and H. T. Rauf, "Attention-enriched mini-BERT fake news analyzer using the Arabic language," *Future Internet*, vol. 15, no. 2, Jan. 2023, Art. no. 44. <https://doi.org/10.3390/fi15020044>
- [28] R. Assaf and M. Saheb, "Dataset for Arabic fake news," in *2021 IEEE 15th International Conference on Application of Information and Communication Technologies (AICT)*, Baku, Azerbaijan, Oct. 2021, pp. 1–4. <https://doi.org/10.1109/AICT52784.2021.9620228>

Khaoula Hamadouche earned her Master's degree in Computer Systems Engineering from ESI-SBA in 2021. She began her PhD studies in 2022 at the University of Oran 1, Computer Science Department, within the RIIR Laboratory.

E-mail: k.hamadouche@esi-sba.dz

ORCID iD: <https://orcid.org/0000-0002-0873-6384>

Kheira Zineb Bousmaha is a Senior Lecturer (Maître de Conférences A) at the Department of Computer Science of the University of Oran 1. She is a member of the research team "Methods and Tools for Information Systems Security" at the RIIR Laboratory, University of Oran 1. Additionally, she is a permanent member of the ANLP_RG (Arabic Natural Language Processing Research Group) within the MIRACL Laboratory (Multimedia, Information Systems, and Advanced Computing).

E-mail: kzbousmaha@gmail.com

ORCID iD: <https://orcid.org/0000-0001-8252-3291>

Mohamed Yasine Bahi Amar was a student at the Computer Science Department of the University of Oran 1, Algeria. He completed his Master's degree in 2023, specializing in Information Systems and Web Technology.

E-mail: yasinebahi5@gmail.com

ORCID iD: <https://orcid.org/0009-0002-5246-183X>

Lamia Hadrach-Belguith is a Full Professor of Computer Science at the Faculty of Economics and Management of Sfax (FSEGS), University of Sfax, Tunisia. Since 1992, she has been teaching at the Department of Computer Science of the FSEGS. She currently serves as the Director of the Doctoral School in Economics, Management, and Computer Science (EGI) at the FSEGS. Professor Hadrach-Belguith is the Head of the Arabic Natural Language Processing Research Group (ANLP-RG) within the Multimedia, Information Systems, and Advanced Computing Laboratory (MIRACL), where she also serves as co-director of the lab.

E-mail: lamia.belguith@fsegs.usf.tn

ORCID iD: <https://orcid.org/0000-0002-4868-657X>