Arabic Fake News Detection In Social Media Using Readers' Comments: Text Mining Techniques In Action

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Abstract **–** Social networking sites are a fertile ground for the fake news production and dissemination. Just like real world, differences about various issues are numerous among social media users at individual and group level. In order to strengthen position with respect to certain issue, an ugly approach is to fabricate fake news. The rapid spread of news about the event that never took place, can play negative role in very crucial occasions like elections where voters make their mind in the light of available information. The extent of fakeness can differ varying from slight twisting of information to one hundred degree opposite reporting of the event. Verification of credibility of information is a challenge that is being faced by internet users. One of the steps towards attempting to solve the challenge is to detect potential fake news as early as possible. In this paper, we used text mining techniques that have proven themselves to be efficient in many domains, in order to detect fake news by analyzing comments of people responding after reading the news on social media. The experiments were performed in two environments namely RapidMiner and Python to tackle the binary-class problem of assigning "fake" or "real" to a news. Arabic news dataset was especially constructed for the purpose of the research work. The NB classifier in RapidMiner environment was the most promising classifier achieving accuracy of 87.18% whereas SVM classifier outperformed other classifiers attaining 87.14% accuracy in Python environment. The output of the research work is expected to help Government authorities to automatically detect Arabic fake news on social media with less man-power.

Index Terms **–** *Text Mining, Python, Rapid Miner, Arabic news, Machine Learning, social Media*

1. INTRODUCTION

The digitization of society and growth of multiple media platforms have led to the rise of fake news which has a direct impact on the community and trade. It is essential to introduce the reader to what fake news is; this will help them contemplate the social impacts it has on both trade and society. Fake news can be defined as fabricated content that has been presented to society through the media as real news. As already mentioned above, the contemporary information environment that is almost entirely based on the internet is indeed one of the main factors that contributes to the increase in fake news. This is due to its openness and the lack of active content control in its different platforms. However, in this introductory section, we will first focus on demystifying the impact that fake news has on society. Owing to its increased presence on most social platforms used today, researchers have begun exploring its impacts on society [1]. The first and perhaps the most obvious impact of fake news is that it polarizes society. Fake news is deceptive and tends to exploit the less informed members of society. When someone reads shocking or intriguing news on a media platform, it takes the quality judgment of content and research to establish whether the news is true or fake.

The impact of fake news can further increase in time of crisis. Thus timely and effective measures should be taken by authorities to minimize the risk of damage. Nowadays, the outbreak of the Covid 19 virus was accompanied by the circulation of many fake news through social media [2]. In Saudi Arabia, the authorities judged the possible harmful impacts of fake news including increased level of panic and fear in society. The Saudi Ministry of Health decided to provide all reliable information about the virus through their own media channels. The masses were informed about the number of cases recorded per day in Kingdom as well as different parts of kingdom and the public was educated about different issues related to virus including methods of prevention through its social media channels [3].

The fake news can be harmful in different manners. The harm can be psychological as well as financial in nature. For example, Saudi news website Al Arabiya English presented nine top fake news related to Saudi Arabia in its article titled "Facts vs fake news: The reality behind recent developments in Saudi Arabia [4]. One of the nine top fake news was related to collapse of Saudi stock market. Circulation of such type of fake news resulted in increased level of alertness and better performance from relevant authorities. The Saudi government showed its commitment to improve transparency in its stock market by sponsoring an anticorruption campaign. As a result of this move, the country's stock market has been significantly upgraded and made recognizable improvements [5]. Another example of fake news to destroy soft image of kingdom is presented in next few lines. When Saudi Arabia announced, that it had decided to award citizenship to its first female robot which should be considered as the positive initiative by the country to promote innovation and technology. However, fake news emerged in social media that Saudi Arabia had decapitated the female [6]. Such news can impact the reputation of any country. Based on these examples, it is clear that fake news has the potential of affecting relations in a society and among societies.

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2. RELATED WORK

In this section, few works related to Arabic text mining will be presented followed by discussion of few recent works to detect fake news.

Machines can use content of the document and the content about "content of document" to help society in number of ways. In an interesting study, classifiers were constructed in order to correctly attribute authorship for famous Arabic poems. The Alfalahi et al [7] trained the algorithms on a set of poem texts for a well-known poet and identified the author's characteristics. As a result, researchers were able to construct classifiers with high accuracy. Baraka, et al. [8], discussed the ability to identify the author of the Arabic text using the SVM algorithm. The identification of the author of the text classification required feature extraction from the input text that was done through five phases: document collection, data group processing, extraction of features, identification of optimization features, and construction of the classification model. The input for the study was various political and literary texts which contribute to training of classifiers that can discover true authors and support discovery of the literary theft. An algorithm that can accurately capture the writer style has capacity to reach 100% accuracy in identification. NB classifier that succeeded in determining the author of the poetry with 98.63% accuracy. This experiment confirms the ability of text mining techniques to deal with the Arabic content efficiently.

AlZamil and Al-Radaideh [9], conducted a study using text mining techniques in the automatic extraction of semantic relations that connect concepts in Arabic texts for the purpose of modeling the models of the presence. This study proved the ability of text mining algorithms to extract the semantic features of Arabic texts and to create a proposal for patterns linking concepts.

The classification of texts is the most critical field on which many articles and papers have been written. However, Arabic content is still lacking in this field despite the proliferation of Arabic texts on the Internet. Humeidi et al [10], discussed the performance of the RapidMiner and Weka programs and evaluated on a collection of articles received by e-mail and categorized according to the correct categories such as Arts, Politics, Economy, Sport and others. The SVM algorithm achieved high accuracy compared to others classifiers where SVM reached 98.40%.

In the field of Social Media analytics, text mining classifiers also have high results in determining the gender of a Twitter's author. Alsukhni and Alequr [11] discussed the Knn, SVN, NB and J84 performance on a set of tweets to extract the gender of the tweet. The findings of this experiment showed a high accuracy which was higher than 98% without the use of text pre-processing features. Their use of pre-processing features on these tweets gave negative results compared to other data.

The field of event extraction is a challenge and the most useful where it can benefit from word processing in social networks. There are many systems that deal with the extraction of the event in English that is highly effective. In contrast, there are not many systems that target the Arabic text, especially the historical texts. Baradaran and Minaei [12] discussed the performance of artificial intelligence algorithms in the correct diagnosis of the historical event and the evaluation of the performance of classifications. According to their findings, the SVM classifier reached an accuracy of 97.96% to extract the historical event.

In terms of emotion detection in textual data, text mining techniques have achieved excellent results as discussed in the Rabie and Sturm study [13], which targeted textual parts of social networking sites. Through their experiment, they concluded that text mining could detect emotions automatically at high degree of accuracy after pre-processing of the Arabic text. The SVM classifier achieved high accuracy results, and the use of text pre-processing features improved the results of classifiers.

In one of the recent works in field of fake news detection by Ratna, Sumanth M.V [14], Naïve Bayes algorithm showed 96% accuracy whereas Support Vector Machine achieved 98% accuracy. Random Forest in their experiments achieved 97% accuracy. Similarly, Ei wynne H and Win Z [15], attempted to detect fake news using content and reached 96% accuracy using character N-Gram with TF-IDF and gradient boosting classifier [15]. Ensemble method can detect fake news with an accuracy of up to 95.45% as reported by Harita A et al [16]. Very few attempts are made to detect Arabic fake news.

The fundamental difference between our work and previous studies is the usage of readers' comments to detect fake Arabic news. Therefore, input data for this work is the Arabic news and their comments that were collected from online news website. a range of ml classifiers available in Rapidminer and python environments were used to perform the experiments

3. METHODOLOGY

People spend most of their time surfing the social networking sites around 135 minutes per day [17]. Social networking sites are a more accessible and faster source to browse political social, technical and artistic news regardless of the source of this information and the extent of its credibility. In this work, we relied on the dataset that was constructed during research work and contained the replies/comments of readers for 100 news items published in the Arabic languages. There were 50 real news and 50 fake news items in our dataset with hundreds of comments by readers. The collected comments are the input to detect fake news using text mining techniques.

3.1 Data collection:

The data collection phase went through various steps to build the dataset used in this study. The sequence of steps is shown in the figure 1:

Figure 1: Data collection steps

Step one: Collection of published news from Twitter, Facebook, and some news websites to develop corpus of news.
Step two: Verification of the credibility of the collected news in a number of ways such as:

1. Usage of fighting rumors webisites such as No rumors for Arab news [18].
2. The validated accounts for celebrities or organizations deny fake news that has been published about them.

Step three: Based on information from previous step, the news was classified as real or fake.
Step four: Collection of all comments and replies for that news was performed.
Step five: Manual cleaning of collected comments from dates, mentions, usernames and web links was performed.
Step six: Information for each real and fake news was recorded in Excel file that contained many features such as: news ID, news platform, news info, news comments

3.2 Preprocessing features:

In all our experiments reported in this study, the data passed through three major pre-processing stages in both RapidMiner and Python environments. Figure 2 shows these three preprocessing phases.

Figure 2 Preprocessing phases

3.2.1 Tokenization:

Data that contained natural language texts is needed to be converted into a readable form that supports machine learning techniques. Tokenization process turns text into a series of symbols and words separated by white space. This process is easy and simple for English texts. In contrast, Arabic language texts consider this process complex due to the complexity of the Arabic language and its many combinations [19].

3.2.2 Removal of Stop Words:

The sentences in Arabic language contain many pronouns and prepositions that, most of times, do not contribute to machine learning classifiers. The removal of these pronouns and prepositions improves the performance of the classifiers.

3.2.3 Stemming:

Texts consist of multiple forms of words for grammatical reasons and to illustrate the intended meaning. There are many word families derived from similar words that increase the size of data pairs and reduce the efficiency of text extraction. It is very useful to return those words to their origin as one meaning to improve the performance of text extraction, and this is called the stemming process [20].
The ISRI algorithm contributes to the extraction of the stem of words from the Arabic texts without the use of root dictionaries[21]. If the root of the word is not found, it returns the word in normalized form. Another algorithm for the stemming process in Arabic is the light stemmer [22], which in turn removes the letters that are at the beginning of the word root (prefixes) and the words at the end of the root word (suffixes). Unfortunately, the light stemmer does not deal with the added letters in the center of the root word.

3.3 Machine Learning classifiers:

Machine Learning is one branch of Artificial Intelligence (AI) that provides the ability to computers to learn. Machine learning contributes to the design and development of many algorithms and technologies that support the computer with the "learning" feature. RapidMiner provide a huge number of ML algorithms to extract data to perform programming. It also provides users with graphical interface for designing processes and displaying results.
In Python, there are many libraries that support machine learning classification such as NLTK and Scikit-learn which we have used to apply ML classifiers.

The Scikit-learn Library of machine teaching libraries in Python contains many algorithms and methods used in the field of machine learning such as classification, clustering and regression. In addition, it has uses in the data processing and models evaluation phase. Moreover, it focuses on data modeling and does not focus on the way of data load which is mainly the role of the pandas and numpy libraries [23].

4. Results: Analysis and Discussion

In this section, we will present the results of the experiments performed in Rapid Miner and Python environments in different preprocessing settings.

4.1 Experiments Series 1: Comparison of performance of different ML Classifiers in RapidMiner environment

In this series of experiments, RapidMiner environment functionalities were used to construct classifiers. The experiments used Arabic news comments. The dataset with all comments comprised of 5500 words. Usually, the first step of the analysis and classification of the texts is the dismantling of text into a series of the token. Therefore, in the first stage, we tested using the Tokenization operator only that divides the text into a sequence of tokens. The default mode for the Tokenization operator was 'non-letter' which means the operator will split each sentence into one word which is the most appropriate mode in our study. Table 1 and figure 4 shows the results of the different classifiers in RapidMiner environment.

	Classifiers	Fake Precision	Real Precision	Fake Recall	Real Recall	Fake F-Measure	Real F- Measure	Accuracy
Tokenize	DT	88.89	81.82	80.0	90.0	84.21	85.71	85.60
	NB	76.92	79.17	80.0	76.0	78.43	77.55	78.00
	SVM	62.82	95.45	98.0	42.0	76.56	58.33	70.00
	K-NN	63.77	80.65	88.0	50.0	73.95	61.73	69.00
Stop Words removal	DT	97.00	76.56	71.4	82.0	82.27	79.19	77.00
	NB	77.78	82.61	84.0	76.0	80.77	79.17	80.00
	SVM	64.10	100.0	100.	44.0	78.12	61.11	72.00
	K-NN	74.19	89.47	92.0	68.0	82.14	73.29	80.00
Stemming	DT	79.63	86.67	87.7	78.0	83.5	82.11	83.00
	NB	72.73	79.55	81.6	70.0	76.92	74.47	75.78
	SVM	70.59	72.92	73.4	70.0	72	71.43	71.67
	K-NN	71.43	88.89	91.8	64.0	80.35	74.41	77.89

Table 1 Rapid Miner Classifiers results after different stages of text preprocessing

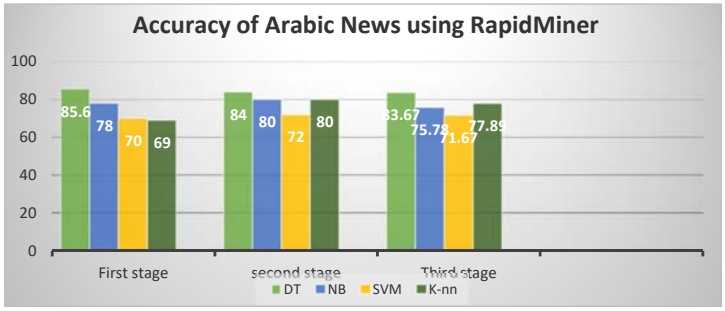

Figure 4: Comparison of accuracies of different ML classifiers in RapidMiner

4.1.1. Results

As can be seen in the above tables and the chart, the decision tree (DT) classifier outperformed other classifiers in all settings of preprocessing. In experiments where only tokenization was performed, DT classifier yield accuracy of 85.60%. The second best classifier was NB that gave a good result of 78% accuracy.

In the second stage, after removal of stop words features, the result of DT classifier decreased significantly as a result of the removal of stop words feature to become 77%. However, NB and K-NN classifiers showed improved performance reaching accuracy of 80%.

In the third stage, Stemming with the exception of DT, impacted negatively on all classifiers where the results are less than the results achieved in the second stage. That means the stage of the stemming does not positively affect the results of the classification of the Arabic texts.

It seems that stop words are used in comments as indicator of fake-ness of a news. Most of the words in the Arabic replies that indicate fake news contain stop words. Therefore, the highest result in terms of accuracy that was achieved in the three stages and five classifiers was the result of the experiment in first stage with DT classifier reaching accuracy of 85%.

For example, an expression in the Arabic dataset is " هذا الخبر غير صحيح" meaning "This news is not true" and if we remove "غير " meaning "not" by treating it as stop word, the meaning will be different and indicates that this news is real. One of the comments analyzed is "هذا الخبر لا أساس له من الصحة" which means "This news has no basis in truth", and if we remove the stop word in the sentence "لا, له, من ", correct meaning will be lost. Moreover, the word "الصحة" meaning "truth" in the above sentence due to combination of some words, has another meaning if it comes unaccompanied and it means "health" and with removal of stop words, the sense of the sentence will be "This new has healthy base" that is contrary to the true meaning of that sentence. There are many sentences in the corpus that come in the same way and contain many stop words and if they are removed, the process will change the true meaning of the sentence.

4.2 Experiments Series 2: Comparing ML Classifiers Using Python:

In this sub-section, series of experiments were performed in Python programming environment to construct classifiers. The experiments passed through the same three stages of pre-processing text which started from converting text to tokens tokens was performed. Finally, conversion of the words to their stems was performed using ISRI stem in order to remove prefixes and suffixes from tokens to get the root word.

Before we build the classifier models, we split the data using cross Validation into 10-folds for the purpose of verifying the efficiency of the classifiers. In the table 2, we have presented the results achieved by the classifiers at all three stages of the pre-processing in our experiments. Figure 6 presents bar chart comparing the performance of four difference classifiers in

three pre-processing stages. The four classifiers were decision trees, naïve Bayes, support vector machine and K-NN.

	Classifiers	Fake Precision	Real Precision	Fake Recall	Real Recall	Fake F-Measure	Real F- Measure	Accuracy
Tokenize	DT	71.00	81.00	77.0	76.0	74	79	71.13
	NB	68.00	100	100	65.0	81.00	79.00	85.89
	SVM	72.00	100	100	71.0	84.00	83.00	75.18
	K-NN	59.00	100	100	08.0	74.00	14.00	47.08
Stop Words removal	DT	79.00	88.00	85.0	82.0	81.00	85.00	75.60
	NB	81.00	100	100	82.0	90.00	90.00	80.54
	SVM	86.00	94.00	92.0	88.0	89.00	91.00	72.50
	K-NN	61.00	100	100	15.0	76.00	27.00	48.99
Stemming	DT	92.00	94.00	92.0	94.0	92.00	94.00	76.79
	NB	72.00	100	100	71.0	84.00	83.00	86.73
	SVM	87.00	100	100	88.0	93.00	94.00	87.14
	K-NN	63.00	100	100	23.0	77.00	38.00	51.85

Table 2: Python Classifiers results after different stages of text preprocessing

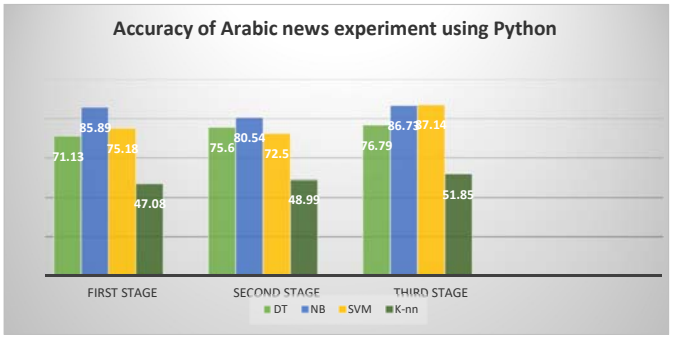

Figure 5 Comparison of accuracies of different ML classifiers in Python

4.2.1 Results

The Figure 6 above shows the result of the three stages of the preprocessing features. In the first stage (only simple tokenization), NB classifier achieved highest accuracy of 85.89% even though the text was not fully processed as we converted it into a series of tokens only. The SVM classifier was second in terms of accuracy reaching accuracy of 75.18% following by DT with 71.13% accuracy. The KNN classifier was unable to achieve satisfactory results as its accuracy reached 47.08% and is considered lowest compared to other classifiers.
In the second stage (removal of stop words), accuracies of all classifiers decreased with the exception of KNN that has insignificant increase. Although the NB accuracy is lower than the previous stage by 5.35%. NB classifier still achieves a higher accuracy even after removal of the stop words and was followed by the DT classifier which achieved 75.60% accuracy. For the SVM classifier, its result has decreased compared to the previous stage by 2.68%, while the KNN is still achieving the lowest results with a 48.99% but its accuracy was increased from the previous stage by 1.91%.

In the third stage, we noticed the results of all classifiers are higher than the previous stages. The highest two results at this stage were achieved by SVM and NB with accuracy up to 87.14% and 86.73% respectively.

The performance of classifiers was affected after application of the pre-processing stages on text. KNN classifier was the least performing classifier. The NB classifier's accuracy in the three stages was not less than 80%, demonstrating its ability to effectively classify Arabic news. DT classifier accuracy in the three stages ranged from 71% to 76%. SVM in python environment performed best in terms of accuracy.

Classifier	Rapid Miner	Python
DT	83%	76.79%
NB	75.78%	86.73%
SVM	71.67%	87.14%
KNN	77.89%	51.85%

Table 3 Classifiers accuracies after third stage (Stemming)

Table 3 shows the accuracies of the classifiers after we applied all three preprocessing steps. In general, we noticed a number of the following outputs after we applied the news classification in different platforms or environments:

1. Using the RapidMiner platform is easier and faster to perform experiments and to analyze and classify because it has a simple user interface. Furthermore, many options are available to improve text analysis and can clearly display the results.

2. On the other hand, analyzing text using Python is more difficult and complex because it is a programming language that needs to be dealt with accurately. Each process must be coded and it needs to import for the libraries that support that process.
3. RapidMiner has a limited number of pre-processing features of the text and its modification is also limited by the available options. While in Python, we can develop our own code according to the requirements we need to improve classifiers performance.

4. The analysis steps in Python require us to write detailed instructions for each step starting from the

import data to display the results as required. It is needed to memorize the programming statements without the slightest error. Therefore, Python requires double effort and time to analyze the data and text. Add-on Packages which are written by others can be used to reduce the effort to analyze but we still need to do some coding.

5. The RapidMiner platform is more flexible than Python as it is going through the steps of the workflow and provides the needed operators. In addition, we can use the operator that we need in simple ways by dragging and dropping it on the workflow window. It also shows us where the error is by its pop-up warning window. Further, the same steps are allowed to be used on new datasets without resorting to modifications that require more effort.

6. Although the nature of the text analysis process differs in the two platforms, the highest accuracy reached in the three experiments was 87.14% in Python and 83 % in the RapidMiner with a difference of 3.47%. The difference lies in better pre-processing abilities available in Python environment. However we also found too much difference in same classifier performance when they were used in different platforms. One can see table 3 and observe the huge differences in same classification algorithm performance in terms of accuracy.

5. CONCLUSION AND FUTURE WORK

The amount of the text data has become inflated due to use of social media platforms because of their ease-of-access and easiness of their use for all users. People have tended to discuss most aspects of social, political, economic and other life aspects through those platforms as well as follow up on new trends at any time and from anywhere. It is worth considering that the massive flow of information and news through social media has placed the issue of credibility at the forefront of the debate. One of the most important reasons that contribute to the growth of the credibility issue is the easy content sharing that is created by users before verifying its credibility.

In this paper, different text mining classifiers were applied to analyze people's comments on the news, with the aim of discovering fake news patterns based on people's interactions. At first, the corpus of comments from many real and fake news was developed. After that, news was classified using different supervised machine learning classifiers with different pre-processing settings.

In our experiments, the Rapid Miner platform and Python programming environments were used so that results can be cross-checked. Highest accuracy of 87.14 was achieved by SVM classifier in Python environment after stemming stage whereas the highest accuracy in RapidMiner was 83% by NB classifier after stemming phase. Text-processing stages seemed to play positive role for some classifiers.

There is still a lot to be investigated in this field of analyzing people's interactions to detect fake news in particular, such as:

1. The dataset size should be increased and more experiments should be carried out with other classifiers especially ensembles, in order to discover more relationships and patterns. In addition, rule-based classifiers should be used in experiments to discover more relationship and patterns in the generated models.

2. More preprocessing features such as n-grams should be used to check their impact on the performance of classifiers.

3. Addition of more classes to the news corpus will make the task further complex but can be helpful in generation of patterns for new classes like “almost fake “and “almost real”. This may unveil interesting insights how people comments about the news for which they are not too sure.

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