Fake News Detection in Social Media:
A Survey

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Abstract – Contemporary communication technologies have revolutionized the way in which information is disseminated in the world, allowing unverified sources to generate "news"and influence the public opinionquite a bit. In recent years, reliability of information on the Internet has become a crucial issue of modern society, especiallythe content generated in social media. Fake news are even considered to have extremely negative effects on individuals and have a significant real-world political and social impacts. Because of the amount of disseminated information via social media, it is practically impossible to discern true from fake news. Thus, the possibilities for automated detection of fake news on social media has recently become an emerging research that is attracting tremendous attention.Since the issue of fake news detection in social media can be characterized as both challenging and relevant, in this paper we present a survey of the latest research covering this importantscientific field. We discuss the accomplishments of related research and their detection approaches and we conclude the paper with future expectations in automated fake news detection.

I. INTRODUCTION

"Fake news" is a relatively new term, but old phenomenon connected with false, inaccurate information. Prior to the emergence of rapid modes of communication and verification opportunities, in the 17th century, at the end of the text of unconfirmed news, some English newspapers added the "n.t." mark according to the Latin expression "Non Testatum", or in English "Not Testified", which meant that the source was not confirmed. The term "duck" was also long time connected with fake news. The "n.t." mark in Germany, according to the rules of the German language, was read as "ente", while"Die Ente" in German means duck. Yellow journalism and the yellow press are American terms for little or no legitimate well-researched news, with eye-catching headlines.Main characteristics of this kind of news are sensational, unprofessional and unethical information aimed mainly towards bigger sales.Through the history, every technological advancement, from the telegraph in the 19th century to contemporary social media systems in present times, opens a new possibilities for news fabrication [1].

"Fake news" can also be defined as news articles that are intentionally and verifiably false, and could mislead readers [2]. This definition includes intentionally fabricated news articles. According to the definition made by PolitiFact [3] fake news is made-up stuff, masterfully manipulated to look like credible journalistic reports that are easily spread online to large audiences willing to believe the fictions and spread the word.

The purpose of news is to provide the citizens with information they need to make the best possible decisions about their lives, their communities and their societies. Without accurate news citizens cannot make right decisions. Made-up news designed to mislead cause a great deal of confusion about the basic facts of current issues. Hence, false news inflicts multiple layers of damage on the all levels of society.

In modern time "Fake news" phenomenon received special attention since the win of Donald Trump in the U.S. presidential elections of 2016. The problem became even more serious when it was difficult to maintain control over the fake news that spread rapidly through social media. In the battle for click-baits content consumers were attracted virally to spread the false information or hoax news, mainly through social media.Getting news from the social media is easy, fast and inexpensive compared to traditional news media. But, on the other side, that is the main reasons for wide and extensive spreading of fake news through social media. Research shows that the quality of news on social media is lower than on traditional news organizations. Purposes for producing fake news vary from case to case and from financial to political aims.

There is a growing number of adults in the United States who follow news through the social media. In 2016, 62% followed the news on social media, while in 2012 only 49%. Most of them get the news on Reddit, Facebook and Twitter [4]. They are exposed on fake news risks every day. Therefore, fake news detection on social media is a primary step in the fight against fake news. According to the Pew Research Center survey [5] conducted between Feb. 19 and March 4, 2019, more Americans (50%) view made-up news as a very big problem for the country than identify violent crime (49%), climate change (46%), racism (40%), illegal immigration (38%), terrorism (34%) and sexism (26%).

Contrary to the historical prevention of fake news like the aforementioned "n.t." marking, today's societies are quite used to receiving news via user generated content, such as social media, where the control of the news source

is impossible. According to Brandwatch [6], there are nearly 2.5 billion Facebook users in the world that generate about four petabytes of data every day and 45% of them get the news from Facebook. This is only one of the most popular social networks, but if we include others like Twitter, YouTube, Instagram, LinkedIn etc. it seems that everyone is getting some news from social media. The problem that arises from this vast amount of user generated information is that people cannot distinguish between fake and real news, at least not for a certain amount of time that may be sufficient to fulfill the intended goal. In such situation, where no established source of news exist and where it is extremely hard to discern real from fake news, the only way to detect fake news is by the deployment of contemporary technologies. Fake news detection has gained quite a lot of attention in recent years, especially regarding information disseminated via social media.This research presents a survey of the latest research efforts in the field of fake news detection in social media, discusses their strengths and weaknesses and proposes future research directions.

The rest of the paper is organized as follows. In section 2 we present the latest research in the development of approaches and techniques for fake news detection. Section 3 discusses the performance of the most promising fake news detection approaches, while in section 4 we conclude the paper with summary of contribution and directions for future development of algorithms for fake news detection.

II.   RELATED RESEARCH

Kai Shu et al. [7] analyze existing algorithms for detection of fake news in social media from a data mining perspective. They explore collection of contradicting sources that record the properties of objects. More specifically, they outline their research categorizing the existing methods based on their main input sources as News Content Models and Social Context Models. News Content Models mainly rely on news content features and existing news sources where the information whether fake or real is determined by comparison techniques. Social Context Models, besides news information, include relevant user social engagements to determine the veracity of the news. Determination of the source credibility and object truthfulness is the main aim of this truth discovery method. But, the obstacle to applying this method is when a fake news article is just launched and published by only a few news outlets, because at that point there are not enough social media posts that could be used as additional sources for truth detection. The authors elaborate the performance of these methods and also propose a future research directions in automated fake news detection.

Eugenio Tacchini et al. [8] present quite interesting and novel technique for detection of fake news in social media by analyzing the users' "likes". For this purpose they present two classification techniques, one based on logistic regression and the other based on an adoption of Boolean crowdsourcing algorithms. The main contribution of this research is the achieved accuracy of both techniques of above 90% where adopted Boolean Crowdsourcing achieves accuracy above 99%.

William Yang Wang [9] presents new dataset for fake news detection „LIAR", that is publicly available. Surface-level linguistic patterns are in the focus of this empirical model for automatic fake news detection.The author has designed a novel, hybrid convolutional neural network to integrate metadata with text, showing that this hybrid approach can improve a text-only deep learning model. This dataset rely on a large number of short statements (in a categories: news releases, TV/radio interviews, campaign speeches, TV ads, tweets, debates, Facebook posts, etc.) labeled for truthfulness, subject, speaker, state, party, context, venue, and prior history. In the process of fake news detection the labeler analyzes each judgment, providing the links to supporting documents. This research points out that main application of this dataset is to facilitate the development of machine learning models for automatic fake news detection.

Sebastian Tschiatscheket al. [10] introduce algorithmic tools through learning about users. Fake news detection is made via expert's verification of the flagging activity of users. This method relies on a Facebook tool that enable users to flag misleading news. Through aggregating users' flags, a small subset of news, which potentially is fake, is selected every day for expert analysis. They develop a novel algorithm, Detective, that performs Bayesian inference for detecting fake news and jointly learns about users' flagging accuracy. When expert labels the news as fake, that news could be blocked on the network or marked as disputed with aim to minimize the spread of misinformation making it appear lower in news-feed ranking.

According to Niall Conroy et al. [11] linguistic approaches with machine learning and network-based approaches together could significantly improve fake news detection process within limited domains. They suggest use of these approaches together for designing a hybrid fake news detection system that will improve, but not replace human judgement.

Veronica Pérez-Rosas et al. [12] contributed to the area of fake news detection by machine learning models using R language. Their models use a combination of lexical, syntactic and semantic information, as well as features representing text readability properties. For their experimental evaluations they also introduce two novel datasets that cover seven different news domains. The results obtained exhibit detection accuracy ranging from 50% to 91%, which is quite above the average of random guessing of 50%, but not sufficient to surpass the human ability to spot fake content.

Natali Ruchansky et al.[13] present rather complex model for fake news detection in social media based on neural networks. Their model takes into account both articles and users and they also incorporate group behavior of users who propagate fake news. Their experiments are conveyed using TWITTER and WEIBO datasets that provide real world scenarios. The authors reveal encouraging results, but emphasize that automatic fake news detection remains a challenging problem with many open questions.

FeyzaAltunbeyOzbayand Bilal Alatas [14]   consider fake news detection on social media as an optimization

problem.Two metaheuristic algorithms, the Grey Wolf Optimization (GWO) and Salp Swarm Optimization (SSO) have been adapted in the process of fake news detection, that consist of three stages: data processing,adapting GWO and SSO for construction of a novel fake news detection model and testing on real-world datasets. The results are compared with seven supervised artificial intelligence algorithms and the best accuracy is obtained from GWO within all datasets.One of the conclusions is that the use of adaptive and hybrid versions of the algorithms may improve the results.

Martin Potthast et al. [15] take a meta-learning approach known as Unmasking, originally intended for authorship verification, to analyze the writing style of hyperpartisan (i.e., extremely one-sided) news. This approach, based on publicly shared dataset, includes manual news fact-checking realized by professional journalists and identifying similarities between the styles of left-wing and right-wing news, i.e. two with significant stylistic similarities. They share a common style of extremism and claim that humor in the news articles can be distinguished well from other news. They point out that style analysis alone is not enough, but can help in the fake news detection process.

Yang Liu and Yi-Fang Brook Wu [16] propose classifying news propagation paths model for early detection of fake news on social media.In the fake news detection process, recurrent and convolutional networks are applied for identifying both global and local variations of user characteristics along propagation paths. Experimental results on three real-world datasets demonstrate that this model has high accuracy in the fake news detection of 85% on Twitter and 92% onSina Weibo,within 5 minutes after fake news starts to spread, which is significantly faster than state-of-the-art baselines.

Julio CS Reis et al. [17] worked on several types of features extracted from news stories that can be used to discriminate true and fake news. Fully labeled dataset is used for testing of the effectiveness of a variety of supervised learning classifiers. They point out that mix of true and false facts may mislead readers. From this point, source and posts from social media, language processing techniques, reliability and environment (e.g., social network structure), are in the focus of their analyses.

III. FAKE NEWS DETECTION APPROACHES: PERFORMANCE AND REQUIREMENTS

The advantage of automatic fake news detection is the speed of detection of misleading news, which is crucial to prevent them to spread through social networks and reach larger audiences.But, the automatic detection efficiency is high when the fake news detection process is based on a datasets that provide a well prepared quality information connected with the topic of potential fake news. Without relevant datasets, level of efficiency of the automatic fake news detection process is lower. This highlights the importance of using adequate datasets as a base for development of automatic fake news detection techniques. Experiences reveal that no existing public dataset can provide all possible features of interest. Each dataset is unique and does not have all the characteristic of any other

dataset. It means some of them (for example BuzzFeedNews) contains headlines and text of news articles, other (such as LIAR) mostly contain only short statements collected from various speakers, rather than news publishers, and may include some claims that are not fake news. In order to overcome such weaknesses there is an ongoing project to develop a usable dataset for fake news detection on social media, called FakeNewsNet20 that should include all needed news content and social context features with reliable ground truth fake news labels [7].

One of the promising automatic fake news detection methods is crowdsourcing-oriented fact-checking approach, based on the "wisdom of the crowd", which provides an opportunity to users to discus and annotate the accuracy of the news content. For example, there is a Facebook tool that enables users to flag misleading news. Through aggregating users' flags, a small subset of news, which potentially is fake, is selected every day for expert analyses. The other similar technique for detection of fake news in social media is analyzing the users' "likes". If we analyze these techniques in the light of the media literacy it means that from the level of media literacy of the public depends how many articles will be identified/flagged as potentially fake news. This indicates that media literacy is an important prerequisite for successful detection of fake news. If no reader reports that something is wrong with certain news article, then the process of checking that news article will not even begin.

Media literacy is defined as a capacity to access, analyze and critically assess and create new media contents. At the same time it has three dimensions: technical competencies, practical skills for critical thinking and producing contents. From the media literacy, by which technical, critical and practical skills are developed, it depends how much the individual will have a formed critical thought to distinct facts from propaganda.These facts one more time confirm that human factor cannot be left out of fake news detection process.

Part of the fight against the fake new is using algorithms to fight algorithms, since algorithms are part of what spreads the fake news, so now they are also part of the solution by identifying fake content and validating the information sources. But, they still lack the necessary robustness to perform a reliable verification of which information is false or not [18]. The use of adaptive and hybrid versions of the algorithms may improve the results.

The hostile media phenomenon can negatively affect the automatic fake news detection. Some of the users who already have an opinion on a given subject can interpret the same content (regarding that subject) in different ways. Because of that, this user can classify that news article as fake news, even if it is not. Deep learning approaches and some machine learning algorithms are black-box systems that, given an input (in this case, a social media post), they output a score or a label (in this case a credibility score or a fake/true label). This emphasizes the need for expert fact-checking, which also points to the importance of the human factor in

overcoming the deficiencies of automatic detection of fake news.

Considering that different techniques have their advantages and disadvantages, additional screening researches are needed towards solution that combines all the strengths and outweighs all the weaknesses in order to achieve the greatest possible efficiency in the fake news detection process.A new fake news detection model is needed in which automation, fact-checking on an expert level and the public as a participant in the process will be combined.

IV. CONCLUSION

Even though fake news detection is a relatively new paradigm, the interest for research that propose novel techniques for automated detection of fake news grows with a rapid pace, in parallel with the seriousness of the problem. Existing techniques are constantly improved, while new ones are tested and implemented. The main emphasis on this development trend is the early detection of false news, quite soon after publication, in order to prevent their dissemination to a larger number of recipients.

Because of this "race" to quickly detect and prevent fake news, contemporary technologies such as Artificial Intelligence, Big Data analyses, Machine Learning and Neural Networks are commonly employed. Nevertheless, the automated techniques accelerate the fake news detection problem, but cannot replace the human factor completely. The experiences gained from the latest research in this field reveal that for full functionality of a fake news detection process, detected potential fake news should be sent to specialized experts for fact-checking. This is because the basic nature of the problem does not allow complete automation, but rather necessitates human involvement to a certain extent.On the other hand, research on the impact of human fact-checking is relatively recent but the existing research suggests that fact-checking does indeed correct misperceptions among citizens, as well as discourage politicians from spreading misinformation.

Additionally, to increase the efficiency of fact-checking it is necessary to be conducted by professionals, journalists, political analysts or other associated experts who are quite familiar with societal, political and other related areas in the environment concerned.

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