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Fake News Detection: A Survey of Techniques

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Abstract*: The extensive spread of fake news (low quality news with intentionally false information) has the potential for extremely negative impacts on individuals, society and particular in the political world. Therefore, fake news detection on social media has recently become an emerging research which is attracting tremendous attention. Detection of false information is technically challenging for several reasons. Use of various social media tools, content is easily generated and quickly spread, which lead to a large volume of content to analyze. Online information is very wide spread, which cover a large number of subjects, which contributes complexity to this task. The application of machine learning techniques are explored for the detection of 'fake news' that come from non-reputable sources which mislead real news stories. The purpose of the work is to come up with a solution that can be utilized by users to detect and filter out sites containing false and misleading information. This paper performs survey of Machine learning techniques which is mainly used for false detection and provides easier way to generate results.

***Keywords*: Content modeling, Fake news detector, Fake news categorization, Stance detection, Machine learning, Social media, online fake news, twitter.**

I. INTRODUCTION

Fake news identification has attracted growing public and researcher attention as the dissemination of misinformation online increases, especially on social media such as media feeds, news forums, and online news articles. Fake news can be any content that is not true and generated to convince its readers to believe in something that is untrue.

Fake news intentionally misleads people into believing false information and shifting people's response to real. Based on their content, produced fake news is difficult to detect because the language used in fake news is very close to the language used in actual news, as fake news is created with the purpose to be trusted. Hence detecting fake news on social media possesses several challenging research problems.

Fake news identification from online social media is extremely challenging due to various factors. First, the collection of fake news data is difficult, and it is also difficult to manually label fake news. Second, people write fake news. Many liars have a tendency to deliberately use their words to avoid being caught.

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Because of the booming trends of online social networks, fake news has emerged in large numbers and in the online world for various commercial and political purposes. Online social network users can quickly get infected with this digital fake news with misleading words, which has already had enormous effects on the offline community.

A. Need and Motivation

The viral spread of misinformation may result in affecting the reliability of the news ecosystem, damaging the reputation of any personal or organization and cause the fear among general public which will weaken the social stability . Generated fake news are very hard to detect based on their content of the news because the language used in fake news is similar to the language used in true news, as the fake news are created with the intention to be trust the public. Hence there is need of fake news detection.

B. Challenges

The main challenge of fake news detection is to identify the part of information is a fact or not. Fact is a simple conception which is composed of something that has happened at some time, somewhere, eventually with/to someone. It seems clear to recognize the value of information should not be easy to perform by machines in the case they are given total control to decide which information is displayed to whom, when and in through which channel. To capture the essence of the journalistic criteria to find out the information to report on and it makes a difference because so many posts on social media follow general idea of reporting on something

II. FAKE NEWS DETECTION

A. Definition

Fake news is the false information which is intentionally written to mislead people. There are main two key features of this definition that is authenticity and intent. The very first, fake news contain false information that can be verified as such and second, fake news is created with dishonest intention to mislead readers. The viral spread of misinformation can result in serious problem such as affecting the reliability of the news ecosystem, damaging the reputation of any personal or organization, or causing fear among the public that can weaken the social stability. Given a set of 'm' news article which contain 'text' and 'headline', so that the data can be represent as set of headline and text tuples $A= \{(A^H, A^T)\}$. In the fake news detection problem, it predicts whether the given piece of information is fake or not.

B. Types

The following three type of fake news detection which are mention as follows:

a) **Fabrication:** Fabrication news is an intentional lie that does not usually go beyond one source. The source is probably aware that the story is false. Fabrication news heavily depends on clickbait.
b) **Hoax:** This type of news use more sophisticated methods of fooling audience. Hoax news are spread by multiple sources. Some of which may believe that the story is true. This type of news seen on various sources, for example the false news of Donald trump during election was spread through various social media like twitter, facebook, blogs etc., so public can easily trust on such type of news
c) **Satire:** A False news story that the source presents as true as a joke. When satire is shared with people that aren't familiar with the source. There is always a chance someone will think it is real.

C. Approaches

The study of fake news detection performed by various researched by using different approaches which are discussed as follows:

a) **Knowledge-based:** Knowledge based approaches based on fact-checking by using external sources which proposed claims in news content. The main goal of fact-checking is to assign a true value to a claim in a particular context of the news article. Fact checking approaches can be categorized as expert-oriented, crowdsourcing-oriented, and computational-oriented.
b) **Style-based:** Style-based approaches detect fake news by capturing the manipulators in the writing style of news content. There are mainly two categories of style-based methods first is Deception-oriented and second is Objectivity-oriented. In Deception-oriented , it capture the deceptive statements or claims from news content. Objectivity-oriented approaches capture style signals that indicate a decreased objectivity of news content.
c) **Stance-based:** Stance-based approaches utilize users' viewpoints from relevant post contents to check the veracity of original news articles. Stance of users can be represented as explicitly or implicitly. Stance based approaches used on social context.
d) **Propagation-based:**Propagation-based approaches focused on how fake news spread and interrelations of social media posts to predict news credibility. Propagation-based approaches used on social context.

III. FEATURES FOR FAKE NEWS DETECTION

Many of the experiment performed on feature based classification which helps to detect fake news. Textual fetaures consist of information which makes easy to detect false information. Some of the features are describe bellow.

a) **Semantic Features:** Semantic feature capture semantic (meaning) aspect of the text. These features derive the meaningful pattern from the data.
b) **Lexical Features:** lexical fetures mainly used in tf-idf vectorization for summarizing the total number of unique word and the frequency of the word. Lexical features include pronouns, verb, hashtag, punctuation etc.
c) **Sentence-level Features:** These features include bag-of-word approach, part -of -speech and n-gram approach. Sentence level features is the language feature which is mostly used in text classification.
d) **Psycholinguistic Features:** These features and word count is based on dictionary based text mining software.

IV. TECHNIQUES FOR FAKE NEWS DETECTION

This section summarize some existing research works in the field of Machine learning/deep learning and also use of natural language processing to analyses about fake news detection and propose a model according to the existings applicants.

A] Naïve Bayes:

- Naïve Bayes is a probabilistic classifier based on independent classification of features.

$$P(A|B) = \frac{P(B|A)\ P(A)}{P(B)}$$

Using Bayesian probability terminology, the above equation can be written as:

$$\text{Posterior} = \frac{\text{prior x likelihood}}{\text{evidence}}$$

- Paper [6][12] used naïve bayes approach for classification of fake news.

Mykhailo Granik and Volodymyr Mesyura [6] used simple approach for fake news detection using Naïve Bayes classifier. The main idea used in this paper is to treat each word of the news article independently.
Supanya Aphiwongsophon and Prabhas Chongstitvatana [12] used the machine learning algorithm for accurately classification of fake news. The three main algorithm used-Naïve bayes, Support vector machine, Neural network. SVM and Neural network works well which give highest accuracy that is 99.90%.

Dataset	Method	Accuracy
Facebook News post	Naïve bayes	74%
Twitter's News	Naïve bayes SVM Neural Network	96.08% 99.90

Table1. Performance of Naïve Bayes algorithm

B] Support Vector Machine:

- Support vector machine is a discriminative classifier which uses hyperplane to split two classes data point with maximum margin.
- To separate the two classes of data points, there are number of possible hyperplanes that could be chosen. The main objective of SVM classifyis to find a plane that has the maximum margin, i.e the maximum distance between data points of both classes.
  - Paper[1][7][9][11][12] used SVM classifier.

Bilal Ghanem and Paolo Rosso [1] presented an approach that combines lexical, word embedding and n-gram features to detect the stance in fake news.

This paper used SVM classifier to extract most important category to each classification class and NN for extracting important feature. Paper investigated the importance of different lexicons in the detection of the classification labels.
Rachana Kunapareddy and SriRohithaMadala [7] proposed the model which utilizes the machine learning and deep learningto recognize fake news problem by testing against an informational index of newsposts. Proposed result showed that phony news identification can be tended by using SVM, Random forest and CNN.
Shlok Gilda [9] explored the various natural language processing techniques. The dataset used in this work is signal media and it tested on various classification algorithms-SVM, Bounded decision tree, Random Forest, Stochastic Gradient descent. Gradient Descent give highest accuracy that is 77.2% compare to others used algorithm. The limitation of this work is not reliable for models when the probability score is not calibrated.
Stefan Helmstetter and Heiko Paulheim [11] showed the practical approach to identify the fake news on twitter as binary machine learning problem. This wok used weakly supervised approach and classification algorithms-SVM, Decision tree, Neural network, Random forest. The proposed works got best F1 score value by considering tweet features and user features.

Dataset	Method	Accuracy
FNC-challenge dataset	SVM, NN	58% (macro F1)
Liar dataset(Phony News)	SVM, Random forest and C NN	SVM-57.27% RM-61.47%
Twitter's News	SVM	99.90%
Signal Media	SVM SGD BDT Random Forest	73.6% 77.2% 67.6% 64.8%
Twitter's News	SVM, DT, NN, RF	94%

Table 2. Performance of SVM algorithm

C] Decision Tree:

- Decision tree is used to making decision and it works for both classification and regression. It perform computation with less computation.
- Decision tree handle both categorical and continuous variables.The objective of Decision Tree is to create a training model that can use to predict the class or value of the target variable by learning simple decision rules inferred from training data.
- The paper [9][11] used decision classifier. The comparison of accuracy of decision tree shows in table 2.

D] Neural Network

- Neural networks are based on computational models for the threshold logic. Threshold logic is the combination of mathematics and algorithm.
- Neural networks networks are based either on the study of the brain or the application ofneural networks to artificial intelligence.

Ali K. Chaudhry and Darren Baker [2] developed several deep neural network-based models to tackle the stance detection problem, ranging from relatively simple feed-forward networks to elaborate recurrent models featuring attention and multiple vocabularies. Proposed model used to identify whether a particular news headline "agrees" with, "disagrees" with, "discusses," or is unrelated to a particular news article.
Yang Yang and Lei Zheng [3] proposed a model named as TI-CNN (Text and Image information based Convolutional Neural Network) which combine the text and image information with the corresponding explicit and latent features. The proposed model has strong expandability which can easily absorb other features of news. TI-CNN is trained with both the text and image information simultaneously.

Dataset	Methods	Accuracy
Fake news challenge dataset	Deep neural network	79%
News dataset	Convolution neural network	80%

Table 3. Performance of Neural Network

Gayathri Rajendran and Bhadrachalam chitturi [4] employed deep neural networks for feature extraction and stance classification. RNN models and its extensions showed significant variations in the classification of detailed class. Bidirectional LSTM model achieved the best accuracy for broad as well as detailed classification. The research work extended on stance classification with extra features like user or topic or sentiment based features. Sherry Girgis and Eslam Amer [5] used deep learning with the large dataset which increase the learning and get best result using word embedding for extracting features or cues that distinguish relations between words in syntactic and semantics. Oluwaseun Ajao and Deepayan Bhowmik [8] Proposed framework that consider inference of tweet geo-location and origin of fake news and author which quickly identifies the fake news stories.

E] Gradient Boosting

- Boosting is an ensemble modeling technique which is used to build a strong classifier from the number of weak classifiers.
- Its build a model by using weak models in series. In this techniques, the first model is built from the training data and the second model is built which tries to correct the errors present in the first model.
- This procedure is continued and models are added until either the complete training data set is predicted accurately or the maximum number of models are added Rohit Kumar Kaliyar and Pratik Narang [15] used multiclass dataset and experiment demonstrate the effectiveness of the ensemble framework compared to existing benchmark results. Gradient Boosting algorithm give 86% of accuracy using four classes.

Eugenio Tacchini and Stefano Moret [10] proposed novel Ml fake news detection method.

This work used the content and social context feature to increase the accuracy. The accuracy obtained for this work is 81.7%. The proposed work method implement within facebook messenger chatbot and validate for the real application.

Pedro Faustini and Thiago Covoes [13] proposed the work for detection of fake news by training the model with only fake news sample through one class classification. The work used DCDistanceOCC algorithm which give similar result like other machine learning algorithm or even better result. Support Vector Machine give best result for one class classification.

Young kyung Seo and Chang-Sung Jeong [14] present fast and efficient model by exploiting grammatical transformation based on deep learning. Proposed model consist of four layers-word embedding layer, context generation layer, matching layer and inference layer. Proposed model tested on CNN news dataset to check the performance of the model.

V. OBSERVATION AND DISCUSSION

The features based detection mainly focused on manually generating or automatically learning a set of latent and observed features for detecting fake news.The main goal is to frame these features to detect, eliminate or block fake news and site from which the news is created within machine learning framework. The qualitative and quantitative analysis of fake news based on wrting style of different creators, propogation patterns and its credibility. The techniques that are used for fake news detection is useful for correctly classifying the true and fake news. There are various techniques are used for fake news detection. Some techniques are works well for small data samples and some techniques worksw well for large data samples. The neural network give higheset accuracy of 99% in most of the research work. Gradient Boosting Algorithm with different features extraction has improved the accuracy for detection system. The result when performing on the twitters datset as shown in table[1] has highest accuarcy as compare to the other dataset.

VI. CONCLUSION

The Goal of this survey has been review, summarize, compare and evalute the current research on fake news. There is an increased research trend towards detection of false information due to extensively use of social media platforms for dissemination of information and news. This paper gives an overview of fake news detection, datasets, machine learning techniques, type and performs comparative analysis of the state-of-the-art rumor detection approaches.

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