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Detection Of Online Fake News : A Survey

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***Abstract*—There has been a large surge of fake news in recent times due to the immense use of social media and online news media. It has become much easier to spread fake news then how it used to be earlier. This kind of fake news when spread may have a severe effect. Hence it is extremely essential that certain measures should be taken in order to reduce or distinguish between real and fake news. This paper presents a survey on fake news detection. In addition, this paper proposes a model that classifies unreliable news into real and fake news after computing a score and will be able to distinguish between real and fake news based on various parameters obtained from a Uniform Resource Locator (URL). The model proposed will use various MachineLearning and Natural Language Processing (NLP) techniques to achieve maximum accuracy.**

***Keywords—M*achine Learning, Natural Language Processing, and Fake News.**

I. INTRODUCTION

Traditionally people got news from various trusted sources that were required to keep up strict codes of practice. However, the presence of internet has encouraged an advanced method to distribute, share data and news with almost no guideline or article benchmarks.

Many people currently get news from online sources and social media which now has become a trend, and most of the time it becomes difficult to decide whether stories are authentic or ill-conceived. Information overload and a general absence of comprehension about how the web functions by individuals have additionally added to an expansion in fake news or hoax stories. Social media sites can have a major influence in expanding the span of this kind of story. Fake news is a news created to intentionally misguide or mislead readers. Fake news is spread mainly for gaining political or financial incentives. They submit this well-crafted news stories and also recruit social bots or paid scammers to spread the news more rapidly and different approaches using text-based analysis for detecting fake news [1]. Ever since the birth of social media and online news media, the spread of fake news has increased drastically. Social media sites such as Facebook, Google Plus etc are one of the biggest sources of spreading fake news.

This paper provides a survey on recent past research papers done on this particular domain and also proposes a model that can predict whether the news is real or fake using NLP techniques and Machine Learning. The model will be using the URL as an input that not only validates the headline but can also validate site behavior and other related parameters that can provide an improvement over past research.

The rest of the paper is organized as follows: Section II outlines the literature review where different research works on fake news detection and natural language processing are discussed briefly. Section III presents the proposed approach where the methodology used in the proposed model is discussed. Section IV concludes the paper.

II. LITERATURE REVIEW

Fake news detection is one of the hottest topics that has gained a lot of interest from researchers in recent years around the globe. This section focuses on already existing solutions that are used to predict or detect fake news. Many of the existing fake news detection methods heavily rely on feature extraction. The different classifiers used in the existing solution were identified and classified accordingly.

A. Naïve Bayes

Naive bayes is one of the least complex method utilized for building classifiers: models that designate class labels to problem instances, shown as vectors of feature values, where the class labels are assigned from some fixed set [2]. A dataset collected by BuzzFeed News containing Facebook news posts was tested by the model. It has a classification accuracy of approximately 74%. Naive bayes classifiers work by associating the use of tokens and then utilizes bayes theorem to ascertain a likelihood that an email is spam or not a spam message. One can characterize the likelihood of finding a word in the fake news article as a proportion of the fake news articles that contain this word to the total number of fake news articles. Labeled posts as "no factual", "mixture of true and false", "mostly true", and "mostly false" content. Any inconsistencies between the two evaluations were settled by a third individual. The dataset was partitioned into three subsets: training, validation and test dataset. The training dataset was utilized for training the naive bayes classifier. The validation dataset was utilized for adjusting global parameters of the classifier. Testing dataset was utilized to get the unbiased estimation of how well the classifier works on new data. Some words probably won't be available in the training dataset by any means. For these words, it was decided to define the probability of the

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news article being fake given that it contains this word as 0.5. Getting more data information fundamentally improves the performance of a learning algorithm.

Neural Network and Support Vector Machine (SVM) are also techniques for constructing classifiers for the detection of fake news. These techniques can also be used for testing along with Naïve Bayes [3]. The outcome demonstrates that Naïve Bayes to recognize fake news has a precision of 96.08%. Two additional techniques which were Neural Network and SVM accomplish the accuracy of 99.90%. There are four evaluation results which are F-measure, precision, recall, and accuracy. The purpose of this model was to comprehend the characteristics of fake news through the features analysis on twitter's news that was posted between Octobers 2017 to November 2017. It uses twenty-two attributes of raw data from Twitter API.

Fake news detection approaches can also be categorized, some of the categories include network analysis and linguistic approach [4]. The result found was that non-structured data like text are much harder to verify, unlike a structured dataset. In linguistic approaches, deception is detected by analyzing the language pattern of an extracted deceptive message. In data representation deception is identified by analyzing the individual and "n-grams" word frequencies. Probability Context-Free Grammars (PCFG) is used for deep syntax analysis. To describe the syntax structure, the sentences are modified into a set of rewrite rules. In Semantic analysis, by including profile compatibility features the n-grams and the syntax model. The rhetoric relation in linguistic elements can be identified by using the Rhetorical Structure Theory (RST) framework. Classifiers such as SVM and Naïve Bayesian models are used in linguistic approaches. In network approaches, to provide the aggregate deception measure, network information such as message metadata needs to be enhanced. The linked data method depends on querying existing publicly available structured data or knowledge networks. Authentication of identity on social media can be done by using social network behavior. To obtain maximum performance in Linguistic processing, it should have multiple layers like word analysis to discourse level analysis. Combining the identification of credible sources into network behavior can act as an alternative for strictly content-based approaches. Table 1 shows comparative summary of research work related to Naïve Bayes.

B. Logistic Regression

Logistic regression is a machine learning algorithm used for binary classification. In the accompanying model, the Dataset was acquired from Signal Media and a list of sources from OpenSources.co. Applying Term Frequency-Inverse Document Frequency (TF-IDF) of bi-grams and PCFG identification to a corpus of around 11,000 articles [5]. The model tests the dataset on numerous classification algorithms which are SVM, Stochastic Gradient Descent (SGD), gradient boosting, bounded decision trees, and random forests. Results found are TF-IDF of bi-grams fed into a SGD model identifies non-credible sources with an accuracy of 77.2%, with PCFGs having slight effects on recall.

The model uses two approaches for classification: classification via logistic regression and via harmonic boolean label crowdsourcing [6]. The two datasets were obtained by using a Facebook graph API which are complete dataset and intersection dataset. The Accuracy obtained by the dataset was exceeding 99% for logistic regression and 99.4% for the harmonic algorithm.

Systems dependent on basic, lemmatization, n-gram matching for the binary classification of "related" vs. "unrelated" headline/article pairs. The best outcomes were obtained utilizing a setup where the more fine-grained classification of the "related" pairs into "agree", "disagree", "discuss" is done utilizing a Logistic Regression classifier at first, then three binary classifiers with slightly different training procedures for the cases where the first classifier needed certainty i.e., the distinction between the best and second-best scoring class was below a threshold [7]. The model has achieved an accuracy score of 89.59. The used dataset was released by the organizers of the first Fake News Challenge (FNC1) on stance detection. The data comprises of a set of headlines and articles that are combined with each other (multiple times, in different combinations) and annotated for one of four classes: "unrelated", "agree", "disagree", and "discuss". Table 2 shows comparative summary of research work related to

TABLE I. NAIVE BAYES

Reference	Dataset	Input	Output	Methodology (Accuracy)
[2]	Facebook news posts	News articles	Mostly true, Mostly false	Naïve Bayes (74%)
[3]	948,373 messages by Twitter API	22 attributes Raw data from Twitter	Precision, Recall, F-measure	Naïve Bayes (96.08%) Neural network 99.90%) SVM (99.90%)
[4]	NA	Article	Fake or Genuine	Linguistic & network approaches

TABLE II. LOGISTIC REGRESSION

Reference	Dataset	Input	Output	Methodology (Accuracy)
[5]	11,051 articles	Raw article text	Source reliable or not	Stochastic Gradient Descent (77.2%)
[6]	Public post & likes–Fb API	Fb post	Hoax or Non Hoax	Logic regression (99%), Harmonic Boolean label crowd sourcing (99.4%)
[7]	Dataset by BibSonomy.org	Online site	The subset of the tags	Weighted score (98%)

logistic regression research work.

C. Support Vector Machine

SVM is a supervised machine learning algorithm that can be employed for both classification and regression purposes. A dataset consisting of 12600 truthful articles and 12600 fake articles [8]. First, the dataset is preprocessed using stop word removal and stemming features are extracted by using term frequency and TF-IDF and a feature matrix is formed from the documents. This is then passed through a classifier. The classifier consists of six different machine learning algorithms, SGD, SVM, Linear Support Vector Machine (LSVM), K-Nearest Neighbor (KNN) and Decision Trees (DT). Python was used to implement this model. The highest accuracy was obtained when using unigrams features and linear SVM giving an accuracy of 92%.

NLP methods along with machine learning can distinguish different parameters that include language patterns, sentiment, and word occurrences [9]. The Model has 82% accuracy. 12 news topics from 4 domains business, civics, "soft" news, and science were inspected with a dataset of 360 news articles. The dataset included 2 satirical news sites and 2 authentic news sources from 2015. The technique starts with performing a topic-based by sentiment-based classification. Text classification pipeline was programmed in Python 2.7 and utilize the scikit-learn open source machine learning package as the primary SVM model evaluation API. News article text, transforming the raw text to a pandas for use in python. Stop words were expelled, and unigrams and bigrams were tokenized. Scikit-learn library contains several tools designed for machine learning applications in Python7 and has been used in the supervised learning applications of real and fake news detection. The Sklearn.svm package is a set of supervised learning methods used for classification, regression and outlier detection, capable of performing multi-class classification.

There are various researches available that analyses linguistic techniques such as network- based, user-based and content-based methods. Content-based methods detect textual cues using lexical, semantic, syntactic and pragmatic levels of analysis. In user-based methods crowdsourcing was used to identify the fake news. Network-based detection method includes web traffic analysis, web metadata analysis, user network analysis. The hybrid method includes architecture recurrent neural networks, user behavior over time. A linguistic approach with different classifiers managed to detect clickbaits in online news with an accuracy of 93% [10]. Table 3 provides a comparative summary of SVM research work.

D. Multilayer Perceptron

A multilayer perceptron is a class of feed forward artificial neural network. It utilizes supervised learning technique called back propagation for training. Some models use input parameters like news article headlines and a news article body [11]. These are used to estimate the stance of the body towards the headline. The representation and feature are extracted from the article by using 2 bag of words representation: term frequency and TF-IDF. Scikit learn from python is used to tokenize the headline. The classifier used is an MLP with one hidden layer. A Rectified Linear Unit (ReLU) activation function is used for non-linearity in the hidden layer. The classifier divides the article into 'agree', 'disagree', 'discuss' and 'unrelated'. The classifier is implemented using tenserflow. The classifier was able to detect with an accuracy of 96.55%.

The inefficiency of stance detection using classification based algorithms was solved by framing the stance problem as a ranking problem [12]. The proposed model is a single, end to end ranking based algorithm with a multilayer perceptron. The input to this model is a pair of headlines and the article bodies. The evaluation is based on a weighted, two-layer scoring system.

There are researches available that investigate the performance of different classification models such as SVM, multinomial naïve bayes, softmax and multilayer perceptron. The MLP model yields the best score among all classification models. Cosine similarity and bag of words are used to improve the performance of the classifier [13]. Table 4 provides comparative summary of research work for multilayer perceptron.

E. Miscellaneous

The URL of the article is the input from which text is extracted [14]. The extracted text is then passed through a data preprocessing unit consisting of processes like tokenization and the generation of a word cloud. The data is analyzed by using 2 methods that are Stance detection and document similarity. Then it is passed through a classifier for

TABLE III. SUPPORT VECTOR MACHINE

Reference	Dataset	Input	Output	Methodology (Accuracy)
[8]	12,600 Fake news & truthful news	Article text, type label, title, date	Fake News or Real News	N-Gram Analysis, Tf-Idf, LSVM (92%)
[9]	360 news articles	News articles	Fake, Real	Support Vector Machine (82%)
[10]	Articles, Images, Network metadata	Articles, Images, Network metadata	NA	Content, User and Network-based Methods

TABLE IV. MULTILAYER PERCEPTRON

Reference	Dataset	Input	Output	Methodology (Accuracy)
[11]	5,000 most frequent words	Headline & body	Agree, Disagree, Discuss, & Unrelated	Multilayer perceptron (96.5%)
[12]	GitHub	Headline & article	Related or unrelated	Weighted score (89.59%)
[13]	provided by FNC	Headline and article	Agree, Disagree., Related and Unrelated	SVM, Multilayer Perceptron, Multinomial Naive Bayes (78.46%)

calculation of f-score. Here the fake news can be classified from a range of 1 to 10 where 1 is completely true and 10 is completely false.

Data analysis includes the article credibility analysis with textual content, creator-article publishing historical records, subject and creator credibility analysis. A deep diffusive Network model based on the relation between the article, content and author has been proposed that includes network structure information [15]. An effective relationship is established between the articles, author and contents by using the Gated Diffusive Unit (GDU). The Dataset includes tweets by politifact from the official twitter account and fact-checked articles on the politifact website. The political statements from various sources such as speech, article report etc are collected by politifact. The Output for this model can be mostly false, mostly true, true, false, half true and half false.

The diverse Website Registration Behavior of the publisher can characterize a news into fake or real [16]. The paper characterizes the websites and reputations of the publishers of fake and real news. It uses 3 Datasets, it also identifies that applying TF-IDF and Latent Dirichlet allocation (LDA) is not efficient in detection of fake news.

Social spam such as ads is often used by spammers to make a profit by attracting users to a site. The system uses a dataset provided by BibSonomy.org. It contains 25000 as spammers and the remaining 2,000 as legitimate users. The weka software library is used for the classification model [17]. The dataset contains 431 users in which 203 are spammers. The additive logistic regression (LogitBoost) can reach an accuracy of 98% even without any tuning required along with a false positive rate of below 2%. For sake of comparison, it also considers LSVM. By extending the number of iterations to 1000, the accuracy of AdaBoost was increased to 98.4% with a 2% false positive rate while even after tuning the accuracy of SVM did not change.

Sarcasm often uses positive words to convey a negative meaning. It is very difficult to detect sarcasm in Indian languages. The main reason for this is an insufficient amount of resources required for training and testing [18]. The proposed model uses SVM for which the input is a hindi tweet and from which keywords are extracted. It takes a tweet as input and extracts the important keywords. Comparison of 2 sets of keywords is done where one is extracted from the input tweet while the other is taken from a related news story. If both sets contain similar keywords means the orientation of news and tweet are the same. If not similar, then it calculates a number of positive and negative keywords in both tweets and news. If news contains more positive or more negative keywords, then it means the user is trying to negate temporal fact intentionally that is input tweet is sarcastic. The first Limitation is that it does not give full assurance that news and tweets belong to the same time-stamp. Secondly in the absence of a sufficient annotated dataset for training and testing, one cannot apply traditional methods for sarcasm detection in Hindi tweets.

3-Level Hierarchy Attention Network (3HAN) architecture has three levels: one each for words, sentences, and the headline [19]. It constructs a news vector: an effective representation of an input news article, by processing an article in a hierarchical bottom-up manner. The paper also compares different methods for obtaining high accuracy for distinguishing fake and real news like word count base models and neural models of which 3HAN has a high accuracy of 96.77%. 3HAN provides an understandable output through the attention weights given to different parts of an article, which can be visualized through a heat map to enable further manual fact checking.

A Java application is used to detect fake news for which the input given is news and website [20]. There are four algorithms used in the research. Algorithm 1 verifies the IP address and labels it accordingly. Algorithm 2 detects the source of fake news by checking the author's name in a database. Algorithm 3 determines the status of the news based on algorithms 1 and 2 and Algorithm 4 filters the news on the basis of precedence followed by claims and later by fake news.

Writing style analysis of hyperpartisan (extremely one-sided) news is also one of the ways to detect fake news [21]. The dataset contains 1627 manually fact-checked articles from BuzzFeed which contains 299 fake news in which 97% was originated from hyperpartisan. It uses Unmasking (a Meta-learning approach) to obtain authorship verification,

TABLE V. MISCELLANEOUS

Reference	Dataset	Input	Output	Methodology (Accuracy)
[14]	NA	URL of the article	True, Mostly true, Fake, Mostly fake	Data Preprocessing, Stance Detection
[15]	Tweets and articles from PolitiFact	Tweets, articles	True, Mostly True, Mostly False, False	Deep Diffusive Network, Gated Diffusive Unit
[16]	3 datasets (3-month time span)	The title, URL, publisher, no of shares, likes	Fake news or Real news	TF-IDF & LDA
[17]	75,385 news articles	Headline and article	True or false stance	Ranking Based Method (86.66%)
[18]	Hindi tweets	Tweets and its related news	Sarcastic, Not Sarcastic	Support Vector Machine (79.4%)
[19]	20,372 fake and 20,932 real articles	Article text	Fake or Genuine	3HAN, HAN, GRU, GloVe (96.24%)
[20]	Legit website, content & author	Ip address of website, Article, Content & Author	Fake or Real	Algorithms using Java
[21]	1627 articles by BuzzFeed	Left-wing & Right wing articles	Constructs an error curve	Unmasking (Authorship verification)
[22]	NA	Social media site	Real or Fake	Crowd signal

i.e. it provides an unmasking curve

The focus on leveraging crowd signals for the detection of fake news. Users flags in social media are also used for conducting research on user flagging accuracy but this alone is inefficient [22]. For this purpose, a "detective" algorithm that performs bayesian inference was developed. Table 5 provides a comparative summary of papers using different techniques which are discussed in this sub-section.

III. P ROPOSED APPROACH

The paper proposes a system that classifies unreliable news into real and fake news after computing a score. This model will use various NLP and machine learning techniques to help achieve maximum accuracy as shown in Fig. 1. The input to the model is a URL. From the URL various parameters are extracted. This parameter includes source, author, headline and article. First, the source of an article must consist of the site name. The site name allows us to check the site age. Site age is the time that the site has been online. If the site age is high, then there is a likely chance that the site is real. If the site age is less, then there is a higher chance the site may be fake. A score is assigned to the output of the site age based on the time the site is online. The site name is then compared with a data set which consists of a list of legit websites that are manually obtained. This comparison is used to assign a score. After this, the website registration behavior of the author is checked and one more score is generated. The headline and article are passed through a data preprocessing unit where the features are extracted. Then the extracted features are passed through a process to detect the stance of the author towards the article and a score is generated. Then the articles are passed through a classifier which is made of various machine learning algorithms and various scores are generated for each. The algorithms used are naïve bayes, KNN, SVM, LSVM, linear regression, and logistic regression. All the scores which are obtained are then added and averaged to generate a final score which decides whether the news is real or fake.

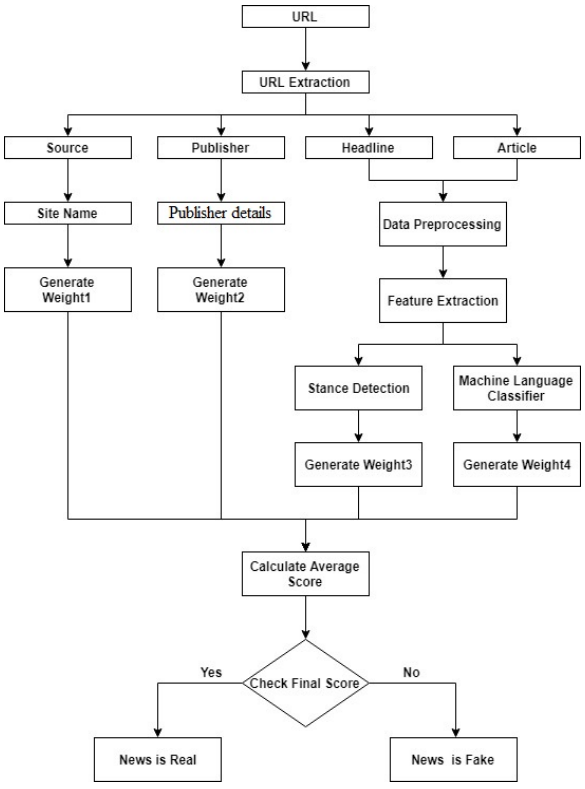

Figure. 1: Proposed Approach

IV. CONCLUSION

Machine Learning uses a statistical technique to give the computer the ability to learn with data hence it is widely used in the detection of fake news. Methods used for taking parameters and for categorizing the type of news are also discussed. It was observed that the dataset is first preprocessed using preprocessing techniques such as stop word removal, tokenization and stemming. The techniques TF-IDF and probabilistic context-free grammar that are used to extract features are also identified. From the literature review it has been observed that the accuracy for predicting fake news in social media is much higher than any other online news media hence we have targeted online news media fake news detection along with website verification. In future work, our proposed model will be tested for fake news detection by using URL as an input which will not only validates headline but will also validate site behavior and other related parameters.

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