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MYTHYA: Fake News Detector, Real Time News Extractor and Classifier

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***Abstract*—Fake news is a kind of exploitative journalism which is completely deprived of facts. It spreads disinformation, lies or hoaxes by means of traditional print media, televisions or radio media and nowadays through social media. The spreading of fake news on social media has changed the course of elections and thus impacted the future. Automating fake news detection is essential to maintain the integrity of news and journalism. In this Paper, a system that uses Gradient Boosted Decision Tree and Convolutional Neural network is provided to detect the stance of the news headlines and classify them as real or fake. By combining these two models systems gets the accuracy of 97.59%.**

***Index Terms*—exploitative, disinformation, gradient boosted decision tree, convolutional neural network**

I. INTRODUCTION

Now a day people believe what they hear rather than what they see hence leads to the belief of fake news. There is a thin line difference between the fact and the fake and drawing that thin line has become very difficult due to immense fake news spread across the internet.

Fake news is spreading of intentional disinformation or hoaxes. The spreading of fake news for social, political, organizational or personal gain has become a threat to society. To know about day to day happenings in the world more and more people are shifting from traditional printed news to broadcast news and from broadcast news to getting news from social media and online content. Hence this transition has created great opportunities like the information at just one click away. But it has also created great challenges of spreading hoaxes and misleading information. Hence classification of the news has become a difficult task.

But the fake news issue may be tackled with the help of various machine learning algorithms and artificial intelligence. The reason behind this is that the news articles contain a large number of words which are difficult to process but with the help of Natural Language Processing the important keywords are extracted and continue the processing on the extracted keywords. Even the simulation of human behavior like decision making can be achieved by machine learning and the decision between fake and fact is the basic objective of fake news detection problem.

II. RELATED WORK

In [1] The authors describe a system which uses naive Bayes classifier for fake news detection. Here as the properties of fake news articles and spam messages are same hence similar approaches are used.

In [2] It provides a general overview of techniques available for deception detection. The authors have provided approaches like Linguistic approach in which extraction of messages takes places which has deceptive content and analyzed to associate language patterns with deception. They also provided network approaches to harness deception in structured data.

Shlok Gilda [3] uses a dataset which is obtained from Signal Media and apply probabilistic context free grammar (PCFG) detection and term frequency inverse document frequency (TFIDF) of bi-grams on dataset. Using various machine learning algorithms for classification like Gradient Boosting, Support Vector Machines, Bounded Decision Trees, Stochastic Gradient Descent and Random Forest gave a comparative analysis on them and conducted an algorithmic survey.

Through experiments on a small data set on the proposed system, the authors found out that truthful and lying texts can be separated. An analysis showed patterns of words used in deceptive texts, including detachment from self and vocabulary [4].

In [5] A social argumentation framework for fact-checking has been described in this paper, the users submit their queries and the responders, who have some degree of expertise add evidence, sources to the queries. Their roles are dynamic and may change over time.

The performance of distinguishing fake news just from the content isn't satisfactory and it is recommended to consolidate users social commitment to improve the detection of fake news. It will develop a genuine world dataset estimating users trust level on fake news. There are two kinds of users, First Experienced who can perceive counterfeit news and second is Guileless who can accept fake news. A comparative investigation over implicit and explicit role features between these users which reveal their strength to differentiate counterfeit news [6].

Shashank Gupta et al. [7] describe a system in which they exploit the echo chamber communities i.e. the communities that share the same belief that exist in the social media. Because the spreading of fake news on echo chambers is easy for this they used tensor representation (3-mode representation) of the news: -News, User, Community. It is a novel state of art technique.

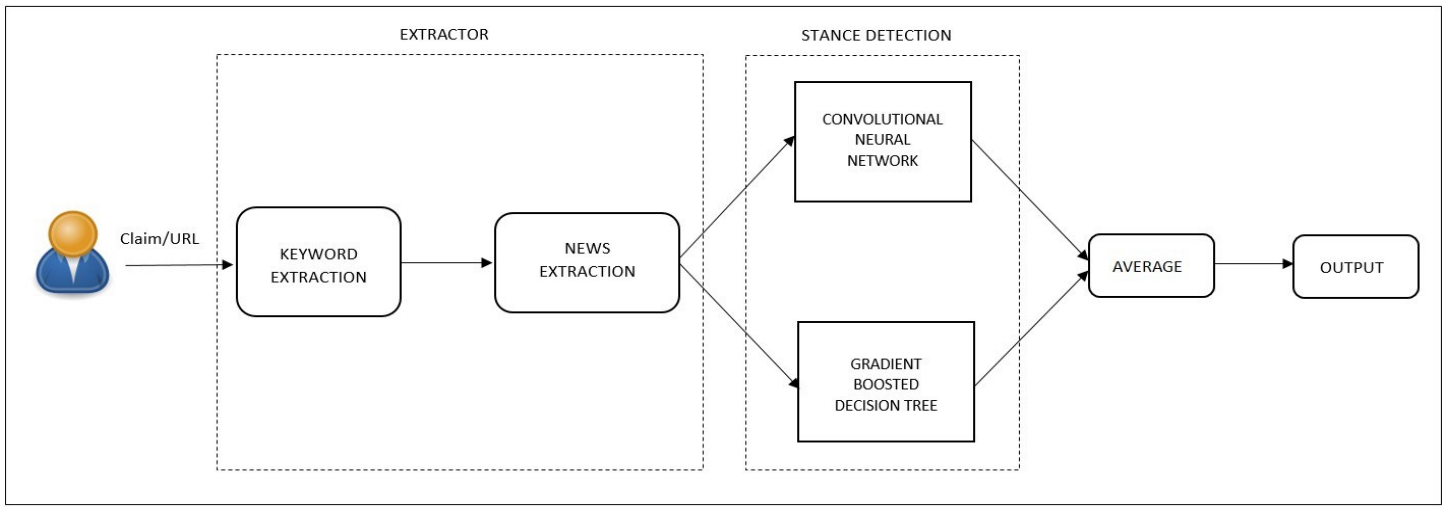

Fig. 1. Mythya Architecture

A system has been described which uses machine learning classification models integrated together with the proposed data pre-processing methods. It uses data imputation for the handling of categorical and missing values. To filter out irrelevant features TF-IDF vectorization is used. Multi-Layer Perceptron (MLP) classifier is used and the accuracy is increased by 15% [8].

In [9] The authors surveyed various state of the art techniques for fake news detection, surveyed various problems faced for fake news detection, stated various fake news types and survey various fake news detection techniques and approaches and gave a comparative analysis on them.

A system combining social context features and news content was implemented. To test it for real world scenario it is used within the chat bot of Facebook Messenger and it obtained the accuracy of 81.7% in detection of fake news [10].

III. PROPOSED SYSTEM

The problem statement that is to be tackled is, to identify the misleading information, hoaxes spread across the social media and various internet resources, and detect a stance and classify them as true or false from the given text or headline.

A. Architecture

Architecture as shown in Fig. 1, the proposed model consists of two main components: news extraction and stance detection. News extractor is responsible for extracting keywords from the given claim or from the URL provided by the user. Further, these keywords are used to extract relevant news articles or the body of the given headlines from the news database. Once the relevant news is available this news is headed for stance detection. Stance detection checks the stance of news sources on the given claim. If reputable sources agree with the claim them claim is considered as true, otherwise, it is considered as fake.

1) Extractor:

To understand what news sources think about the given claim, it is required to have news related to that claim. To get the related news, the Extractor has two components: Keyword Extractor and News Extractor.

- Keyword Extractor is used to extract the keywords from the given claim/headline. To extract the keywords from the given claim/headline, IBM Watson Natural Language Understanding API and Microsoft Azure Natural Language Processing API both are used. This API takes the claim and extracts all relevant keywords based upon words relevance to the claim.
- News Extractor is used to extract relevant news body from the database. This model uses EventRegistry news database. It has a vast collection of news and news can be searched on the basis of keywords. Further, these news articles are evaluated by stance detection module to get the reputed news sources stance on the claim.

2) Stance Detection:

This model uses Stance Detection to get the stance of reputable news sources on the given claim/headline. Here two methods are used to perform Stance Detection: Convolutional Neural Network and Gradient Boosted Decision Tree (implemented using XGBoost). Both of these methods take the given claim and the relative news body from the extraction component, process it. A further output from both of the algorithm is combined together to get the final output.

- Convolutional Neural Network is widely popular for its application in analyzing visual imagery. Recently convolutional neural network also gain popularity for its use in natural language processing. For natural language processing 1-Dimensional convolutional neural network is used. As shown in Fig. 2 convolutions will be applied to the claim as well as body matrix using feature sets and combine together to get one large vector, this vector is further passed to the hidden layers and classify using softmax.

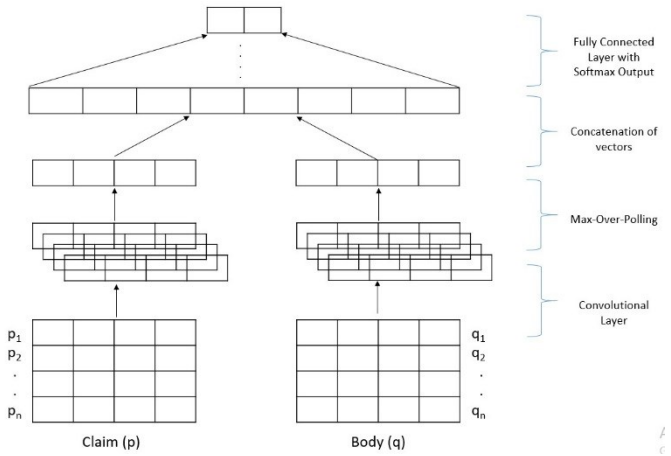

Fig. 2. Convolutional Neural Network

- Next algorithm which is used is Gradient Boosted Decision Tree. Different features like SVD, Count, Sentiment, TF-IDF and Word2V are extracted from claim as well as body as shown in Fig. 3. These features are passed to gradient boosted tree for classifying the claim depending upon the body. For better implementation of gradient boosted decision tree XGBOOST is used.

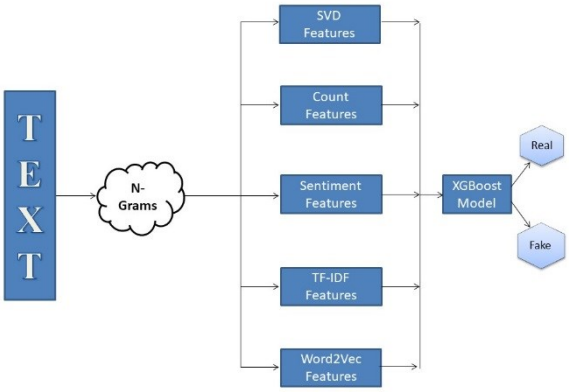

Fig. 3. Gradient Boosted Decision Tree (XGBoost Implementation)

After performing stance detection output from both the classifiers are taken and given to a function which will take the average of both of the outputs and gives the class as a final output which will have higher average value.

B. Mathematical Model

1) Convolutional Neural Network:

As shown in Fig. 2 let,

$p_i \in R^k$ be the word vector of k dimensions representing i-th word in the claim. $q_i \in R^k$ be the word vector of k-dimensions representing i-th word in the body. Both claim and body represented as

$$p_{1:x} = p_1 \oplus p_2 \oplus \dots \oplus p_n \quad (1)$$

$$q_{1:x} = q_1 \oplus q_2 \oplus \dots \oplus q_n \quad (2)$$

where $\oplus$ represent concatenation operator. $p_{i:i+j}$ refers to the concatenation of words $p_i, p_i + 1, \dots, p_i + j$. Filters is involves in convolutional neural network say $z \in R^{wk}$, applied to window of w words to produce new feature. For instance let's take m_i, generated from a window of words $p_{i:i+w-1}$ by

$$m_i = f(z \cdot p_i : i + w - 1 + b) \quad (3)$$

Similarly, for body text,

$$g_i = f(z \cdot q_i : i + w - 1 + b) \quad (4)$$

Here $b \in$ f refers to function (non-linear) and b refers to bias term. For every probable window of words in the claim and body text, this filter is applied to produce feature maps.

$$m = [m_1, m_2, \dots, m_n - w + 1] \ (5) \ g = [g_1, g_2, \dots, g_n - w + 1] \quad (6)$$

Then max-over-pooling operation will applied on each feature map to get the maximum value $\hat{m} = max m, \hat{g} = max g$ as the feature corresponding to this particular filter. This pooling takes the most important feature which is having highest value in feature map.

After applying max-over-pooling both vectors having highest values of filters for claim and body is combine together and sent to fully connected layer as input. Softmax is applied to the values coming from output layer to get the relevant classified values [11].

2) Gradient Boosted Decision Tree:

Consider training data with $x_i \in W$, where W is set of features of claim and body and label with $y_i\{0,1\}$, where 0 represent 'Fake' and 1 represent 'Real'. The aim is to select a classification function $F(x)$ to reduce the aggregation of loss function $L(y_i, F(x_i))$

$$F* = \underset{i=1}{\overset{N}{\text{X}}} argmin L(y_i, F(x_i)) \quad (1)$$

The estimation function F which is considered by the gradient boosting is in an additive form:

$$F(x) = \underset{m=1}{\overset{t}{\text{X}}} f_m(x) \quad (2)$$

where T is representing total iterations. The $\{f_m(x)\}$ are structured in a gradual style; at the m-th stage, the new function, f_m is chosen to optimize the totaled loss while keeping constant. [12]

At stage m, approximate loss function will be:

$$L(y_i, F_{m-1}(x_i) \_ f_m(x_i)) \approx L(y_i, F_{m-1}(x_i)) + g_i f_m(x_i) + 1/2 f_n \quad (3)$$

Where $F_{m-1}(x_i) = \sum_{j=1}^{m-1} f_i(x_i)$ and

$$g_i = \partial L(y_i, F(x_i)) \div \partial F(x_i) | F(x_i) = F_{m-1}(x_i)$$

C. Proposed Algorithm

input: claim or URL of a news
output: claim or news in URL is real or fake

1) extract keywords from claim or URL body
2) extract the news related to keywords
3) run gradient boosted decision tree and convolutional neural network model
4) get the output of both and calculate average value
5) if P(REAL) > P(FAKE) then
6) output:= "News is real";
7) else
8) output:= "News is Fake";
9) end if;
10) end if;
11) show output;

IV. DATASET

Kaggle Fake News Detection Dataset: This dataset contains 4009 entries. Each entry has URL, headline, body and label. Label represent its status whether the article is real or fake. Article with label 1 is considered real and articles with label 0 are considered fake.

URLs	Headline	Body	Label
http://www.bbc.com/news/world-us-	Four ways Bob Corker skewered Donald	Image copyright	1
https://www.reuters.com/article/us-	Linklater's war veteran comedy speaks to	LONDON (Reuters) -	1
https://www.nytimes.com/2017/10/09/	Trump's Fight With Corker Jeopardizes Hi	The feud broke into	1
https://www.reuters.com/article/us-	Egypt's Cheiron wins tie-up with Pemex f	MEXICO CITY	1
http://www.cnn.com/videos/cnnmoney	Jason Aldean opens 'SNL' with Vegas trib	Country singer Jason	1
http://beforeitsnews.com/sports/2017/	JetNation FanDuel League; Week 4	JetNation FanDuel	0
https://www.nytimes.com/2017/10/10/	Kansas Tried a Tax Plan Similar to Trump'	In 2012, Kansas	1
https://www.reuters.com/article/us-	India RBI chief: growth important, but no	The Reserve Bank of	1
https://www.reuters.com/article/us-	EPA chief to sign rule on Clean Power Pla	Scott Pruitt,	1
https://www.reuters.com/article/us-air-	Talks on sale of Air Berlin planes to easyJ	FILE PHOTO - An Air	1
https://www.activistpost.com/2017/09/	U.S. President Donald Trump Quietly Sign	By Aaron Kesel	0
http://beforeitsnews.com/sports/2017/	2017 Fantasy Football Team Defense Ran	2017 Fantasy	0
http://beforeitsnews.com/sports/2017/	Just Shut Up & Play Some Damn Baseball	Just Shut Up & Play	0

Fig. 4. Fake News Detection Dataset

V. RESULT

The following Result tables were the product of running validation dataset on the system. The accuracy that was encountered by running Gradient Boosted Decision Tree model on the system was 97.39%. The accuracy of the system on Convolutional Neural Network was 92.17%. And by combining output of both these models the accuracy was 97.59% which was greater than both the prior two.

CNN model loss is shown in Fig. 5. Model loss for training drop down to 0.16 while the loss for validation set is 0.17.

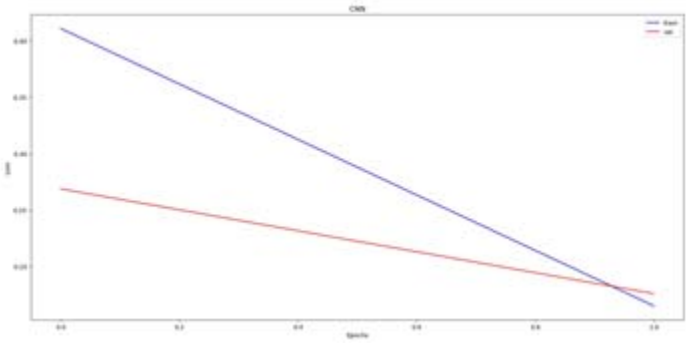

Fig. 5. CNN Loss Vs Epoch

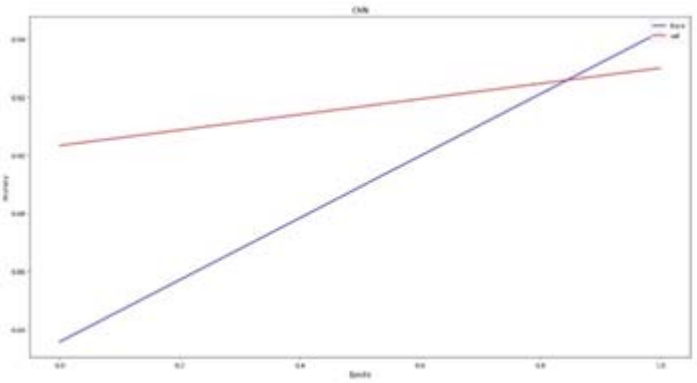

Fig. 6. CNN Accuracy vs Epoch

The accuracy V/s epoch graph is shown in Fig. 6. System achieved accuracy for training dataset is 94.24% while the accuracy for validation set is 93%.
CNN model gives the accuracy of 92.17%. Following table shows the result of CNN model.

TABLE I
CNN MODEL

	Fake	Real
Fake	487	53
Real	25	432

Fig. 7 shows the structure of single tree in GDBT.

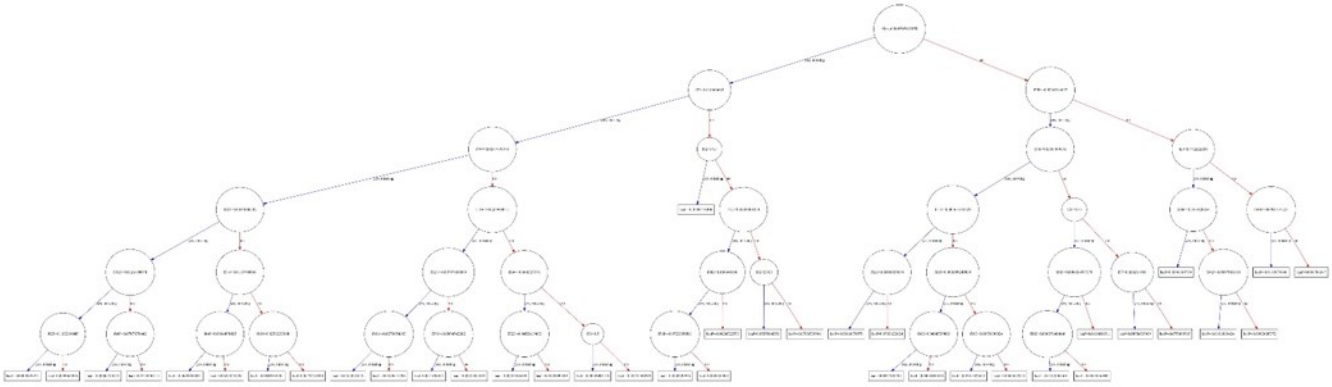

Figure 7. Structure of tree model

GDBT (implemented using XGBoost) gives the accuracy of 97.39%. Table II shows the confusion matrix.

TABLE II
GDBT MODEL

	Fake	Real
Fake	522	18
Real	8	449

Following table shows the combined result got by considering output of both models and by taking their average. The final accuracy which is got by combining result is 97.59%.

TABLE III
COMBINED RESULT

	Fake	Real
Fake	521	19
Real	5	452

By combining result of both models the accuracy of the system increased by 0.2%.

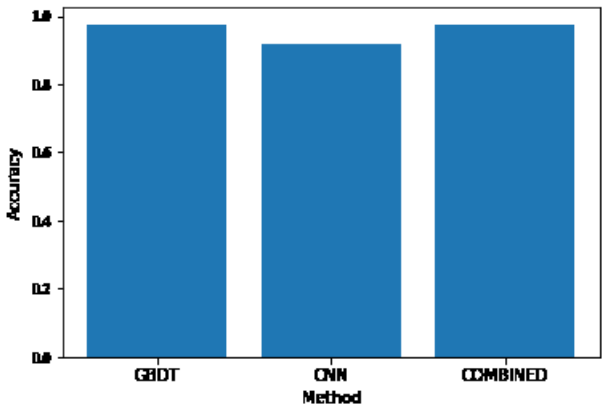

Fig. 8. Result Analysis

VI. Conclusion & Future Scope

This system is another approach for tackling the fake news problem on social media by automating the detection process. The system uses two different machine learning algorithms i.e, Gradient Boosted Decision Tree (GBDT) and Convolutional Neural Network(CNN) to find alternate facts and classify it into true or false. The system gives an accuracy of 97.59% when combined both these models.

This system can be integrated with different social media websites and applications as a filter for fake news. Hence resulting only true content reaching to the users and thus have a good impact on our society. Parallel processing also might improve the efficiency of the system.

Acknowledgment

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