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Investigation of Fake News Classification of Social Media content using CNN & LSTM: An empirical approach

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Abstract - Fake news is a tale formed with a target to mislead and misguide the reader or the consumer of the news. Fake news negatively affects the different factors of society such as economic, political, cultural, and many more. After the US presidential election of 2016, the automatic classification of social media content as fake news or real news has increased drastically. The current paper explains the process of fake news dissemination on social media, types of fake news categories, machine learning, and deep learning approaches applied in the past are discussed, and lastly talk about the limitation of fake news automatic classification is discussed. In this paper, two deep learning models are proposed for the identification of fake news. The first one is a combination of CNN and LSTM and the second one is the bidirectional LSTM. The first model achieves an accuracy of 89.67% and the second one achieves an accuracy of 88.54%.

Index Terms - Fake News, Categories of fake news, Cycle of Fake news, Dissemination, Convolution Neural Network, Deep learning.

INTRODUCTION

Social media platforms provide the following features to the digital message: the bare minimum amount for transfer, easy availability, easy propagation over the network, and 24*7 availability. With these features, social media, messages are within the reach of a wide range of people. On the other edge of the double-edged sword, social media text is an easy dissemination platform for fake news. A large volume of information is available on social media. The social media news spread like wildfire. The authenticity and veracity of social media news are a matter of concern nowadays. The risk involved in the dissemination of Fake news follows:

The Fake News is distributed to make a change in the behavior of people, once their faith, insight, or outlook are modified. Fake news can affect the political, social, cultural, and economic environment of human life. Hamper the product image in a negative sense. In the words of the columnist of Guardian Natalie Nougayrède: " The use of propaganda is ancient, but never before has there been the technology to so effectively disseminate it". After the US election campaign increased research area for the fake news this can be supported by Figure 1. After the breakout of covid-19 from 2020 until now, 75% of total research papers are published from overall publications on fake news. This shows a hike in the research work on fake news classification of social media.

The current research work has the following objectives:

- To determine the trajectory path of fake news dismission on the different social media platforms.
- To identify the state-of-art research work and their challenges
- To Classify the COVID-19 tweet dataset as fake news or real news using the CNN-LSTM and BILSTM models.
- To compare the proposed model results with the previous model's results.

The remaining paper is further organized as follows: the paper first explains the motivation for starting the research.

Secondly, the cycle of Fake news Dissemination on Social media platforms is explained to get deep inside the fake news propagation. In the third section, the Challenges in Fake News detection are also explained so that what is known prior.

Then Related work heading discusses the already-occurred research work on fake news. Under the heading Dataset and preprocessing, detail of the dataset is organized and what type of preprocessing is required. Then the proposed architecture is discussed under the heading proposed work which is followed by the result and the conclusion headings.

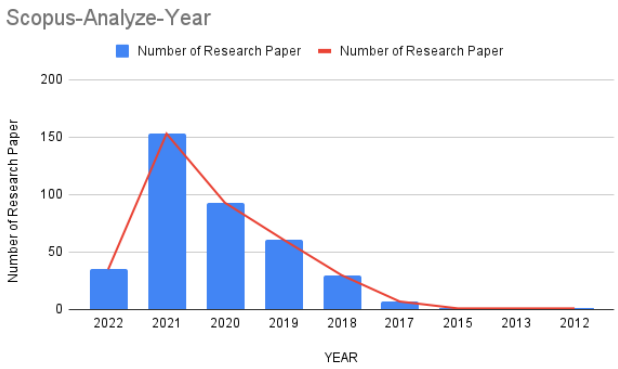

FIGURE 1

RESEARCH PAPER ANALYSIS OF THE SCOPUS WITH THE KEYWORD "FAKE NEWS CLASSIFICATION SOCIAL MEDIA"

MOTIVATION

In June 2014 a news post was distributed like wildfire on the social media platform Facebook with the heading "You Will Not Use Head & Shoulders Shampoo After Watching This Video,". Along with the heading, the post has a static image with some abnormal allergy on the neck, which claimed that by applying the Head & Shoulders Shampoo some peculiar sort of injury or infection occurred to the users [17]. The con image was created by merging the lotus seed pod image over the image of the breast rash caused by South American larvae [17]. This type of fake news smashes the brand's goodwill in the market.

Another hoax is created to defame the brand value of the McDonald's restaurant chain by presenting the proof that its patties have some sort of worm in the patties which leads to some outbreaks [24].

With the outbreak of the covid-19 fake news also affect the health of the common people. The news is proven to be fake by WHO example: "The new coronavirus can be transmitted by mosquito bites" [7].

THE CYCLE OF FAKE NEWS DISSEMINATION ON SOCIAL MEDIA PLATFORMS

Before understanding anything in more detail let's first all discuss the cycle of how fake news is disseminated. Fake news can be dissemination through the above cycle the key component of this cycle is

A malicious user(publishers):

- **Cyborg/ News Bots:** The cyborg is a special type of account, in which the machine works as the camouflage of humans registered on social media. Cyborg offers the feature to switch between humans and bots.
- **Social bots:** when the fake social media accounts are handled by the algorithms.
- **Trolls:** are generally handled by humans for misinformation.[6]

Social Media Platforms: Twitter, Facebook, and Whatsapp are some of the accepted social media platforms used nowadays. These social media platforms are seen as mutually exclusive but they are interconnected with common end-user trails.

Trail of the different users: Different types of user trails can be created on the social web given as follows:

- **stance network:** These types of trails node indicate all the tweets relevant to the news and the edges indicate the weight of the similarity of the instance.
- **co-occurrence network:** This trail of the web is formed by the customers indulged in a similar type of post on the social media web**.**
- **Friendship network:** friendship network specifies the following/followee structure of users who published the synonym social media micro text.
- **Diffusion network:** The diffusion network, maintain a complete route of all the channels from which the fake news is scattered over the network.

End-User(consumers): Are the people affected by that news? The end-user is also the node in the fake news distribution network.

CHALLENGES IN FAKE NEWS DETECTION

- In everyday changing technology nowadays the features and the characteristics of the social media network content impose the challenge for identification [10].
- Finally, as aforementioned, the identification of false news is in its initial stages of development.
- The techniques for the creation of the fake news dataset are very expensive in terms of time and unpleasant work for humans. As the annotation of the fake News data required more extension of the evidence other than the text of the news, also needs the situational facts to claim news as fake news [1,19]. A tool for automatically collecting quality news should be developed [13].

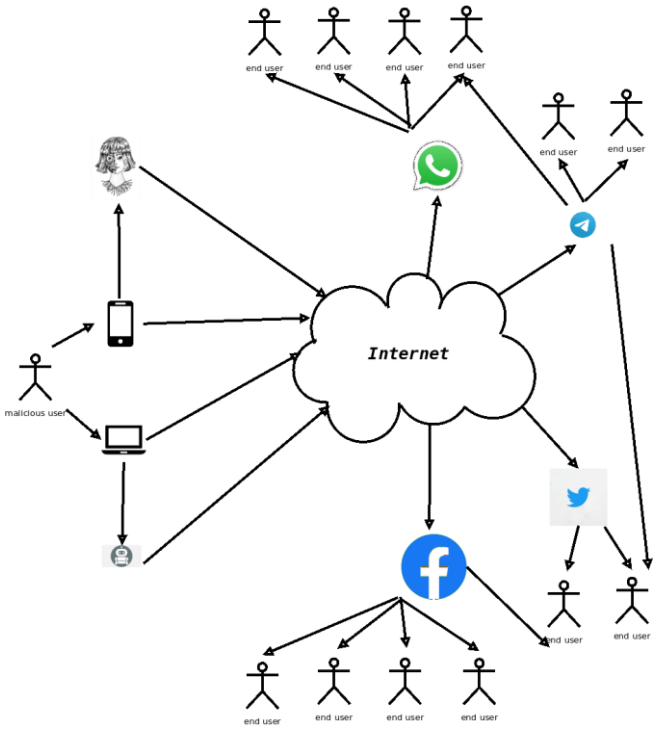

FIGURE 2

THE CYCLE OF FAKE NEWS DISTRIBUTION, ON SOCIAL MEDIA PLATFORMS

- Limited work was done on semi-supervised or unsupervised models [1].
- Most of the previous work was done for binary classification; it is much more reliable to forecast the likelihood of fake news in place of predicting the class of the label.
- Machine learning models / deep learning models are created and should be implemented in social networks, mobile apps, and browser extensions [13].
- Maximum research work on fake news detection is done in the English language and the least work is done in the low resource available language [19].
- Identification of fake news by humans is a very subjective task. [22]

RELATED WORK

The Algorithms as under are put under the umbrella of machine learning supervised categories so they use them as classifiers of fake news generated by social media platforms idea is to identify the best among them [1, 10].

- logistic regression
- naive Bayes
- k-nearest neighbor
- support vector machine
- decision tree

The decision tree is a machine learning supervised learning approach used to construct the tree-like structure with an internal node as a condition using the attributes and leaf node as the class labels.

Conroy, N. J. Et al combine the machine learning approaches with linguistic Cue and use the bag of a word, Rhetorical structure, and discourse analysis using SVM Classifiers [12].

Eugenio Tacchin Et al.[14] , Nguyen Vo and Kyumin Lee[15] use the characteristics such as likes, followers, shares, etc. using the classification tree and SVM and achieve an accuracy of 93%[13].

Madani Et al.[7] combine apache-spark side by side with different machine learning in one model and for another model use the one deep learning approach with the help of the news tweets features. The result of the model shows that the random forest approach achieved an accuracy of 79% best result of the others approaches claimed by the paper.

Manzoor, S. I., & Singla, J. [10] write a systematic review with the concept: the easy availability of social media makes the dissemination of information smooth with the limitation of censorship on fake and real news. To implement the censorship machine learning algorithms are used.

Jain, A.,[18], proposed an approach, first of all, the author tried to aggregate the news and then classify the fake or real news using a Support Vector Machine.

Khanam, Z. Et al. [16] LIAR-PLUS benchmark dataset is used for the political data set. The technology used a different machine learning algorithm of linear regression, random forest, SVM, XGBoost, KNN, Decision tree Naïve Bayes, majority voting, and other classifiers. Among all the models the XGBOOST's performance is the best with an accuracy of more than 75%.

DATASET AND PREPROCESSING

The research work uses the tweet text for fake news classification on the covid-19 dataset. The data set consists of the tweets that are labeled as fake and real tweets concerning covid-19 tweets. A total of 2140 tweet data is available for classification, out of 1120 are labeled as real and the rest 1020 are labeled as fake [23] as shown in Table 1.

TABLE I

DATASET COUNT

Sno	Label	Count
1	Real	1120
2	Fake	2020
	Total	2140

The original dataset contains four columns index, id, tweet(text), and label. The label associated with each tweet text is fake and real. Table 2 listed some of the fake news and real news sample from the original data set. After observing the tweet text, the requirement of the preprocessing need. For performing the preprocessing # tag, emojis, stop words, and hyperlinks are eliminated from the original tweet text. The stop words are eliminated to reduce the execution time of the text.

TABLE 2

COVID-19 NEWS EXAMPLE FROM TWITTER

Sn0	id	Tweet	label
2	3	#donaltrump, #Covid-19 #virus According to the U.S. President Donald Trump what would they do if he grab the Covid-19 virus https://t.co/3MEWhusRZI [23]	“fake”
3	4	“Death troll in the state is 630. There still see a large national recession in death. As per their CDC model lacking back in symptoms time in treatment and the death reporting that is not shown in the report.” [23]	“real”

PROPOSED WORK

The proposed architecture for the classification takes labeled Twitter text as input after the preprocessing. Then convert the text to a vector with the pre-trained word2vec of the google model. Once the data is converted to a vector it's time to create a model The architecture proposed is LSTM and CNN. LSTM gives the commendable, especially with the time series, data so work well with text data. The power of LSTM is in its special gate which is the forget gate of unnecessary value and remember the important value for a longer time.

CNN is known for performing the classification, of images but is also performing good in-text classification.

The proposed model is sequential of a combination

of LSTM and CNN. With the first layer as embedding, the second layer being LSTM, the parameter fixed for this layer are as follows unit 64, input shape 32 by 1000, and set return sequence is true.

Then dropout layer is used for avoiding overfitting with a dropout rate of 0.2. Thereafter CNN layer with filter size 32, kernel size 3, and activation function relu eq(1) is used.

$$f(x) = max(0,x) \qquad (1)$$

The global max-pooling lastly the dense layered sigmoid eq(2) as activation for the classification of the tweets under the two labels fake and real tweets.

$$f(x) = 1/(1+exp(-x)) \qquad (2)$$

The optimizer used is nadam for fitting the model. The completed model is shown in Figure 4.

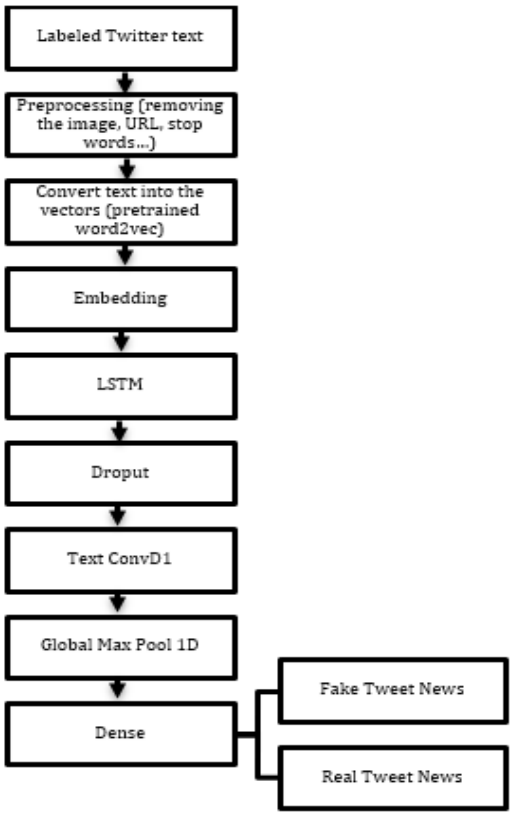

FIGURE 4

PROPOSED MODEL CNN WITH LSTM

For the classification of the tweet covid-19 data the next model proposed is also sequential architecture. The first layer is the embedded layer with the pre-trained model. The LSTM layer is used in forwarding and backward directions that are bidirectional LSTM with a unit size of 64. The Dropout layer with the rate of 0.5 is used. The dense layer with the unit size 1 and activation function sigmoid is used for the classification. To fit the model the ADAM optimizer is used. The complete model is visualized in Figure 5

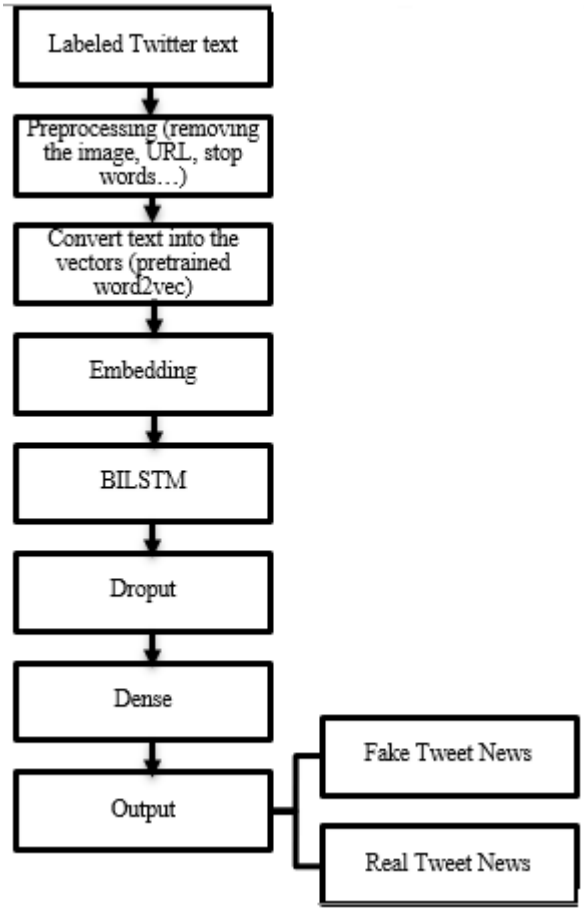

FIGURE 5

PROPOSED MODEL BILSTM

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RESULTS

The two proposed model performances are measured on the four numerical measurements as follows:

Accuracy is a measuring parameter for the deep learning model efficiency, which depicts the value of proximity between the predicted value and the actual values eq(3).

$$Accuracy = \frac{(TN+TP)}{(TP+TN+FN+FP)} \quad (3)$$

Precision is another measurement of the deep learning model efficiency, which depicts the ratio of correctly predicted by the model to the model identified as the positive result whether it is a false prediction or the true prediction (TP+FP) by the model eq(4).

$$Precision = \frac{TP}{(TP+FP)} \quad (4)$$

Recall is one of the measurements of deep learning evaluated by the confusion matrix. It is the ratio of correctly modeled predicting the true positive to the true positive and false negative value eq(5).

$$Recall = \frac{(TN+TP)}{(TP+TN+FN+FP)} \quad (5)$$

F1 -Score is the numerical average in the form of reciprocal of precision and recalls eq(6).

$$F1 - socre = 2 * \frac{(precession*recall)}{(precession+recall)} \quad (6)$$

Using accuracy, recall, precession, and F-1 score mentioned in the eq (3), eq (4), eq(5), and lastly the eq(6) validation data is evaluated on the LSTM and CNN combination model and achieved the following results as shown in Table2.

The result can be seen in table 2 that LSTM & CNN achieved an accuracy of 89.67%. From the formula of eq (4) the precision for the real label is0.89 and the fake label is 0.90. Using the formula of the eq (5) the recall with the label real is 0.92 and for the label, the fake is 0.88. The harmonic means of the precision and recall as stated in the eq (6) for the label real is 0.90 and for the label, the fake is 0.89.

TABLE 2

RESULT OF COMPARISON OF TWO PROPOSED MODE LSTM & CNN AND BILSTM MODELS

s	Model	Accuracy	Label	Precision	Recall	F1-score
1	LSTM with CNN	89.67%	Real	0.89	0.92	0.90
			Fake	0.90	0.88	0.89
2	BiLSTM	88.54%	Real	0.86	0.91	0.88
			Fake	0.92	0.86	0.89

On the other hand, the BiLSTM achieved 88.54% accuracy.

Form Figure 7 shows the confusion matrix of the BiLSTM model. The true positive value is 321, so the precision achieved of the label real is 0.86. With the same model, the Precision for the label fake is 0.92. The Ture negative value obtained is 305. The recall with the BiLTSM model and fake label is 0.86 and for the label real is 0.92. The F1 score with the label fake news is0.89 and for the real news label is 0.88.

In Figure 6. It is observed that training model accuracy is good and is implemented in the real world for the classification of fake news.

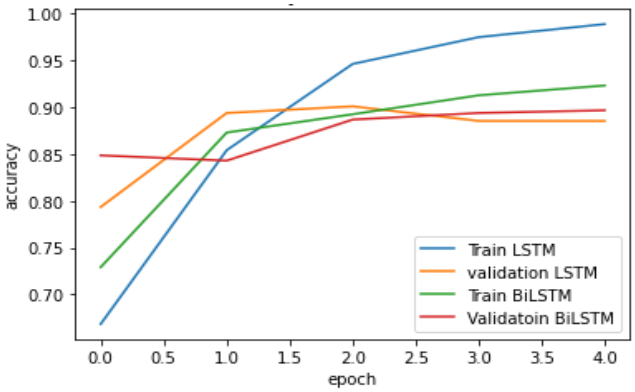

FIGURE 6

ACCURACY OF THE PROPOSED MODEL

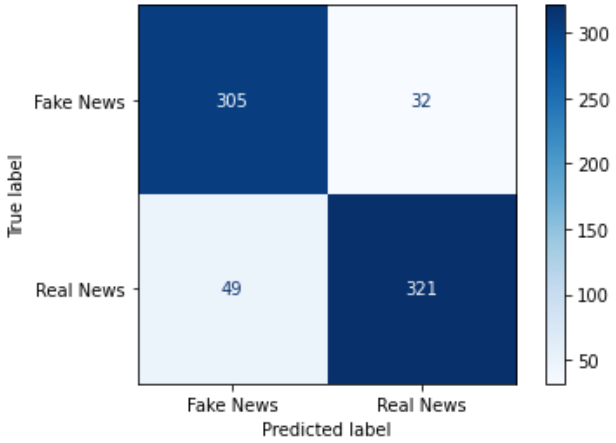

FIGURE 7

CONFUSION MATRIX OF BILSTM MODEL

CONCLUSION

From the support of the results seen in table 2 that LSTM & CNN achieved a higher accuracy of 89.67% as compared to the BiLSTM. From the Table 2 column of precision, it is also observed that BiLSTM for the label fake achieves the 0.92 highest among all the observations. In the recall column, the model LSTM & CNN with the label fake achieved the 0.92 value. In the observation of table 2 column, F1-score is LSTM & CNN with the label real achieved 0.90 It has been concluded from Table 2 results that the LSTM & CNN perform well over the BiLSTM model.

To achieve future work implementation of a real-time dataset should be performed.

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