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Identifying Fake News with Various Machine Learning Model

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Abstract- **News is basically information, information regarding recent or current events. There are various platforms or sources of news like: print media, TV channels, digital media, social media and films. It is obvious that news floating in these platforms are not always correct. Sometimes these platforms contain false or incorrect information, which is termed as fake news. Fake news can be in the form of images, videos, audios and texts. Generally fake news is generated due to a machine or human intervention. In order to identify fake news in various platforms this paper reviewed several techniques based on a machine learning and artificial intelligence. This paper is going to review various machine learning based approaches and some of the models are Naïve Bayes Classifier that has been tested in a software system with a data set of Facebook news posts and had achieved an accuracy of 74%, Convolutional Neural Network (CNN) for image visualization scored a mean accuracy of 92.85%, Recurrent Neural Network (RNN) for audio and text visualization had achieved an accuracy of 93% on the datasets collected from Brussels terrorist attack in 2016. Some of the hybrid models are like for the early detection of false news on twitter using propagation path classification using combined CNN and RNN model had achieved an accuracy of 85%, Meta Optimization Semantic Evolutionary Search model (MOSES) scored a mean accuracy of 63%, Capsule Neural Network (CapsNet) model for an image, audio, video, text mining scored overall accuracy of 99.8%. Total twelve machine learning models have been represented with proper data visualization of their accuracy percentage and found that Artificial Neural Network based Capsule Neural Network (CapsNet) model is the best with a highest accuracy of 99.8% over LIAR and ISOT set of datasets.**

Keywords- Fake news, deep learning, Convolutional Neural Network (CNN), Recurrent Neural Network (RNN), Capsule Neural Network (CapsNet)

I. INTRODUCTION

Misinformation floats in the form of text, image, video, audio, text & photo, text & video, photo & video, and text & photo & video [6][7]. This type of information may affect community. One of the best example to show an effect of fake news is that in 2013 US lost 136.5 billion dollar in the stock market after the rumor of explosion at white house, but this loss has been recovered in 6 minutes [1].

In India, there are four main platforms for circulating news. These four platforms are the main epicenter for conveying news to the 1389.7 million population of India. These four platforms are: print media, digital media, TV, and film. In the 21st century, most common source of misinformation and false news is social media [7]. To follow the code of ethics, enforcing accountability, and eliminating fake news in print media, TV, and film have the system of grievance mechanism. Print media has to follow the Code of Ethics by Press Council of India, TV has to follow Program Code, and film has to follow guidelines of the Censor Board. There are too much baseless information, fake news, and noxious content on social media [13][14][15]. In the recent five years, twitter has recorded an increase of 200% misinformation regarding Asian people and an increase of 50% in the non-English fake news in India [15]. On 25 February 2021, the government of India has announced new IT regulations for social media and OTT platforms.

Several papers had proposed techniques which classifies news into fake news and legitimate news [1]. In the last 50 years there has been so much advancement in deep learning and machine learning. So as to enhance the performance, system and models are pre-trained with proper fact finding and fact detection using above techniques [2]. Section 2 presents detailed knowledge about fake news and list of companies combating spreading of misinformation in real life. Section 3 presents all the ML models helpful in classification and detection of false news. Section 4 concludes the paper and summarizes with the help of accuracy of all models.

II. FAKE NEWS AND MISINFORMATION

Fake news can be basically understood in four forms: characterization, creation, circulation and countering [8]. Characterization is a first step to the detection of fake news that to know first that what category of fake news is to be detected. The second form is creation, it basically concerns the fake news production. The third form is circulation. Circulation and spreading of false information is mostly done with the internet and social media. Handling and countering fake news floating in various platforms is important so as to save people from getting hunted by it. The fourth form, described in the above paragraph is countering, handling, detection is a task of people who want to save society from the adverse effect it. This type of people create and provide some services for the fake news detection called Fact-checking services. In Table 1 five startup companies has listed. These companies and services have been

founded by Indian people. They are helping the world in combating over spreading of fake news.

TABLE I. FIVE INDIAN STARTUPS COMPANIES COMBATING FAKE NEWS IN REAL LIFE

Startup Name	Founding Year	Headquarter Location	Founder Name
Check4Spam	2015	Bangalore	Bal Krishn Birla, Shammas Oliyath
Logically	2016	London	Lyric Jain is born in India
MetaFact	2017	Delhi	Sagar Kaul, Minho Ryu, Praveen Anasuya
Citispotter	2019	United Kingdom	Pallav Sethiya, Dushyant Sethiya
13TABS	2019	Jharkhand	Sagar Mishra and team

- Check4Spam– in 2020, Karnataka state police collaborated with it for countering rumors amid the coronavirus outbreak.
- Logically– it uses ML and NLP for information clustering. In 2020, it won the Aatmanirbhar Bharat App Innovation Challenge in the news category.
- MetaFact- it uses NLP for better understanding of posts on digital media and performs cognitive operations like bucketing, indexing etc.
- Citispotter– it develops AI based end-to-end content solutions for companies to decrease harmful and damaging content.
- 13TABS- it is a web search engine of Trylika Technologies Pvt Ltd. It uses fact-checking to get result.

III. TECHNIQUES AND MODELS FOR FAKE NEWS DETECTION

There are various traditional models, models which are pre trained, deep learning models. In this section we are going to describe all those models.

A. Traditional Machine Learning Models

In proposed models of traditional machine learning, feature extraction is performed by an expert and group of experts.

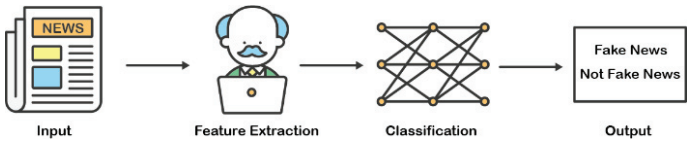

Fig. 1. Traditional Machine Learning Model

This type of model learns from the data and also get trained using the data. Data which helps the model to get trained is provided by the subject matter experts. In Fig. 1, where human expert is responsible for inserting all features and data in the model.

1) Naïve Bayes Classifier based model:

Naïve Bayes classifier is one of the earliest and popular method that has been introduced in mid 90s to handle spam filtering problem [9]. It is based on the Bayes theorem of probability, this is why it is also termed as simple probabilistic classifier [6].

Priori probability of class c1 fake news is denoted by P(c1) and a-priori probability of class c2 not fake news is denoted by P(c2) [5].

Various steps involved in the algorithm of Naïve Bayes Classifier are:

- First step is Input Data Pre-processing.
- Applying Naive Bayes to the Training data set.
- Foreseeing the test result.
- Using Confusion matrix testing the accuracy of the result.
- Envision of the test set result.

Decision rules associated with Naïve Bayes classifier is: IF P(c1) > P(c2) then select class c1 and IF P(c2) > P(c1) then select class c2. Let features are denoted by f, probability by P, class one by c1, class two by c2. Then using Bayes theorem.

$$P(c1|f) = [P(f|c1) * P(c1)] / P(f)$$

$$P(c2|f) = [P(f|c2) * P(c2)] / P(f)$$

P(c1|f) is conditional probability of fake news class c1 given that features are f [10].

P(c2|f) is conditional probability of not fake news class c2 given that features are f [10].

P(c1) and P(c2) are priori and a-priori probability and P(f) is evidence [10]. Naïve Bayes classifier has been tested in a software system with a data set of Facebook news posts and had achieved an accuracy of 74% [9][11]. This algorithm has been used in face recognition, spam filtering, text classification and sentiment analysis as a real world application.

B. Deep Learning Models

Deep learning models falls under representational machine learning. Unlike traditional machine learning where feature extraction from data is work of an expert

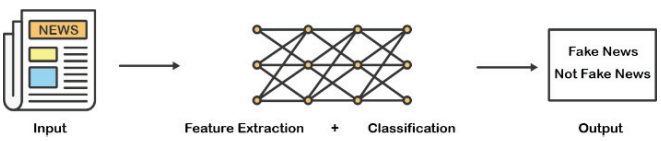

Fig. 2. Deep Learning Model

As stated in Fig. 2 below, the unstructured data is given as input to this model then extracting features and classification is an automated process.

1) Convolution Neural Network based model:

In mathematics, the word convolution is an operation on two function and produces a third function. In context to ML, convolution is method of multiplying matrices to produce outputs for training [1]. These CNN models is mostly suitable for analyzing text data, image data and video data [2][4]. CNN is an automated process, extracting the features and classification of data is automated so no need to mention the features explicitly [3][15].

This model captures the arrangement of pixels and generate the relationship between pixels. If the image will be of human then this model will automatically detect the features like nose, eyes, mouth, hair, ears and will compare the interrelated position of every part from pre trained dataset and CNN will generate output as a human image.

Various steps involved in the algorithm of CNN based Model are:

- Step 1 –First step is we start off with input Data.
- Step 2 –Then apply filters and feature extraction to the image, which gives us a convolutional layer.
- Step 3 –Then with the help of rectifier function, we break up the linearity of that image.
- Step 4 –Then that image given as input to the pooling step, the main purpose of it is to provide spatial invariance to the convolutional neural network.
- Step 5 –After pooling, we make a map of pooled feature.
- Step 6 –Then we flatten that mapped pooled feature before inserting into an ANN.

The two week of tweets of datasets has been collected from 2016 Brussels terrorist attack and CNN model has achieved an accuracy of 93%, another group of researchers used four layer graph CNN and got an accuracy of 92.7% [3]. On considering the above two accuracies 93% and 92.7% comes from different datasets, the mean accuracy of CNN comes to be as 92.85%.

2) Recurrent Neural Network based model:

This model has a word in its name called recurrent. The basic understandable meaning of recurrent is occurring often. Recurrent means looping constraint means output at each step is captured as input in next step in neural network [1]. As it is shown in the Fig. 3 that looping constraint is applied on the hidden layer of ANN. For learning, RNN uses sequential processing of information [1]. RNN is used to visualize and detect news in the form of text data and audio data.

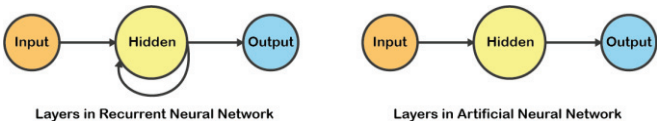

Fig. 3. Layers in Recurrent Neural Network and Artificial Neural Network

Various steps involved in the training algorithm of RNN based Model are:

- Step 1 –First we have to calculate the current state. This is calculated by the previous state and current input.
- Step 2 –For the step of next time, the current state (ht) becomes (ht-1).
- Step 3 –Based on the problem, we can go as many time steps. Then from all the previous states, we can join the information.
- Step 4 –After all the time steps are completed. To calculate the output, the final current state is used.
- Step 5 –Then the output is compared to the target output, based on it the error is generated.
- Step 6 –Weights are updated as the error is back-propagated to the network. This is how the (RNN) network is trained.

This RNN model has achieved an accuracy of 93% on the datasets that has been collected from Brussels terrorist attack in 2016.

3) Hybrid CNN-RNN deep learning based model:

This hybrid deep learning model is made combining the convolutional neural network and recurrent neural network for the classification of fake information [1]. CNN is method of multiplying matrices to produce outputs for training and RNN processes information sequential. The hybrid model combining CNN and RNN has been rigorously tested on two types of datasets FA-KES, ISOT [1]. FA-KES is a dataset collected from the Syrian war time, this dataset contains news regarding date, location, article and they had used labels with values as 0, 1 for fake news and real news respectively [1]. ISOT dataset contains real and fake articles from two websites Kaggle.com and Reuters.com [12]. ISOT is a dataset regarding politics, world news, government news and it contains total 44898 articles with 21417, 23481 real and fake news respectively [1][12].

1	title
2	Donald Trump Sends Out Embarrassing New Yearâ€™s Eve Message; This is Disturbing
3	Drunk Bragging Trump Staffer Started Russian Collusion Investigation
4	Sheriff David Clarke Becomes An Internet Joke For Threatening To Poke People â€˜In The Eyeâ€™
5	Trump Is So Obsessed He Even Has Obamaâ€™s Name Coded Into His Website (IMAGES)
6	Pope Francis Just Called Out Donald Trump During His Christmas Speech

Fig. 4. Fake News collection of ISOT datasets

1	title
2	As U.S. budget fight looms, Republicans flip their fiscal script
3	U.S. military to accept transgender recruits on Monday: Pentagon
4	Senior U.S. Republican senator: 'Let Mr. Mueller do his job'
5	FBI Russia probe helped by Australian diplomat tip-off: NYT
6	Trump wants Postal Service to charge 'much more' for Amazon shipments

Fig. 5. Real News collection of ISOT datasets

TABLE II. HYBRID CNN-RNN MODEL ON TAKEN DATASETS

Data sets	Type of News	Total News	Real News	Fake News	Accuracy
FA-KES	Syrian War News	802	426	376	60%
ISOT	Political News	44898	21417	23481	100%

Various steps involved in the algorithm of Hybrid CNN RNN based Model are:

- The first layer in hybrid CNN RNN model is the input layer. Using this the pre-trained word, this model is then trained by feeding in that training datasets[1].
- Next layer is the 1D CNN layer also called as Conv1D. This is used for the local features extraction using 128 filters of size 5 [1].
- The CNN model is pooled by so as to generate large feature vectors [1]. Without affecting the network's efficiency, reduce the count of parameters to down-sample the feature vectors [1].

For the early detection of false news on twitter using propagation path classification using combined CNN RNN model had achieved an accuracy of 85% [3].

4) Meta Optimization Semantic Evolutionary Search model:

MOSES or Meta Optimization Semantic Evolutionary Search technique follows supervised learning. As supervised learning works on the training data means pre trained set of data, so MOSES is going to need pre trained data [16]. This model can be used with a single CNN, RNN model. Algorithm of this approach consist of four main steps.

- Step 1 –Select from population, choose one exemplar from population news set.
- Step 2 –Building a field set, this mapped set will act to map between linear bit strings.
- Step 3 –This is called Meta because it has two loop of optimization. Inner optimization loop consist of three steps scoring the first instance, new instance generation, search terminates.
- Step 4 –Close process, this accept the best instance news found in previous step and add it into population news.

MOSES approach has been rigorously tested two times and got a good accuracy of 65% on first attempt and 61% accuracy at second test [16]. Mean accuracy that comes out is 63%.

5) Capsule neural network based model:

A Capsule neural network (CapsNet) a type of artificial neural network (ANN) and subcategory of machine learning. The word capsule in capsule neural network represents nested layers within a layer. Suppose we have a human image to identify using CapsNet model then it compares all the features associated with human image with each other. As input image containing a nose, ears, eye, mouth, teeth cannot be always human image. It can be any Homo sapiens. CapsNet compares the relativity between are the features and point it out as a human image.

Researchers had introduced ISOT and LIAR datasets in 2017 [12]. LIAR is a dataset that contains all the 128000 statements from POLITIFACT.COM [12]. ISOT dataset contains politics, world news, government news and it contains total 44898 articles with 21417, 23481 real and fake news respectively [1][12].

TABLE III. CAPSULE NEURAL NETWORK ON TAKEN DATSETS

Sr. No.	Data set	Type of News	Total News	Real News	Fake News	Accuracy
1	LIAR	Politifact.com	10296	7105	3191	69%
2	ISOT	Political News	44898	21417	23481	100%

This model is combination of Support Vector Machine (SVM) with accuracy 86%, Linear Support Vector Machine (LSVM) with accuracy 92%, K-Nearest Neighbor (KNN) with accuracy 83%, Decision Tree with accuracy of 89%, Stochastic Gradient Descent (SGD) with accuracy 89%, linear regression with accuracy 89% [12]. The overall accuracy comes for capsule neural network is 99.8% [12].

C. Comparing all Machine Learning models-

All the supervised and unsupervised based ML models listed in below Table 4, has rigorously been tested on various ISOT, FA-KES and LIAR type of dataset and a graph for easier data visualization of accuracy associated with all these models has been drawn in Fig.7 below.

TABLE IV. COMPARISON TABLE FOR ALL MACHINE LEARNING MODELS

SR. No.	Model/Technique Name	Model/Technique is used for News	Accuracy %
1	Naïve Bayes Classifier	Face Recognition, Spam and Text Filtering	74.0%
2	Convolutional Neural Network	Text, Image, Video data type visualization	92.8%
3	Recurrent Neural Network	Text, Audio data type visualization	93.0%
4	Hybrid CNN-RNN model	Text, Image, Video, Audio visualization	85.0%
5	MOSES model	Meta optimized evolutionary Search	63.0%
6	Capsule Neural Network model	Tabular, Text, Image data Visualization	99.8%
7	Support Vector Machine model	Supervised Machine Learning Model	86.0%
8	Linear Support Vector Machine	Supervised Machine Learning Model	92.0%
9	K-Nearest Neighbor	Supervised Machine Learning Model	83.0%
10	Decision Tree based model	Uses Learned and Trained Datasets	89.0%
11	Stochastic Gradient Descent	Batch Gradient Descent for optimization	89.0%
12	Linear Regression model	Finance and Investing type of news	89.0%

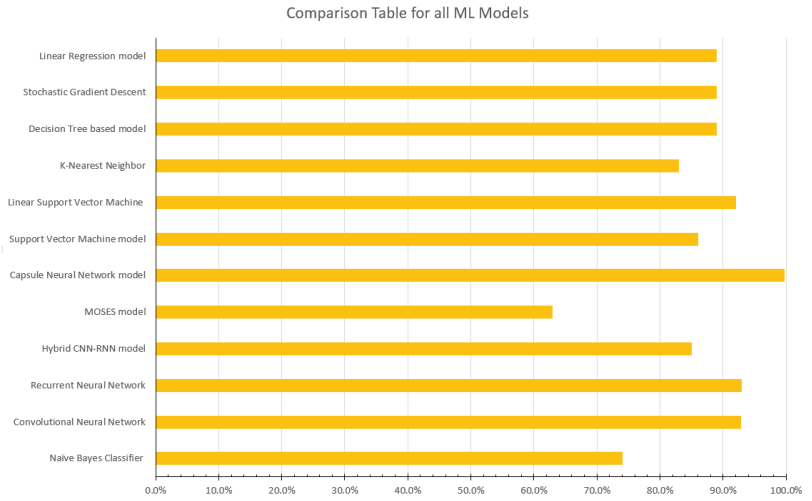

Fig. 6. Accuracy Comparison Table for all listed Machine Learning Models

IV. CONCLUSION

Advancement in Machine Learning technology had help in combating fake news that have been floating over print media, digital media, social media, TV channels and films. All the proposed models have been tested with certain set of datasets like FA-KES, ISOT and LIAR collected specially for misinformation basis. The traditional ML model Naïve Bayes Classifier get an accuracy of 74.0%. The single machine learning models CNN gets accuracy of 92.8%, RNN gets an accuracy of 93%, SVM gets an accuracy of 86%, LSVM gets an accuracy of 92.0%, K-Nearest neighbor gets an accuracy of 83.0%, Decision Tree model gets an accuracy of 89.0%, Stochastic Gradient Descent model gets an accuracy of 89.0%, Linear Regression Model gets an accuracy of 89.0%.The hybrid ML models hybrid CNN-RNN model gets an accuracy of 85.0%, The MOSES approach model gets an accuracy of 63.0% and Capsule Neural Network model get an highest accuracy of 99.8%.

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