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# Hoax Detection of Covid-19 News using Convolutional Neural Network and Support Vector Machine

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**Abstract**

It is undeniable that nowadays news spreads very quickly on social media. The ease of getting news on social media has resulted in some users using and spreading news without knowing the authenticity of the news. Twitter (X) users play an important role in spreading news on social media. In early 2020, cases of Covid-19 started to occur in Indonesia and some people spread news about Covid-19 without knowing the real information. The hoax news is increasingly spreading through Twitter media which is shared by irresponsible people. This research aims to investigate the efficiency of using deep learning, especially CNN, in detecting hoax news. This CNN model is then compared with SVM as the baseline of this research. The dataset used is news of Covid-19 in X Social media. The several stages conducted i.e. crawling data, data preprocessing, word embedding, data separation, modeling process, and model evaluation. The experiment show that the use of the N-Gram Unigram + Bigram + Trigram combination on CNN produces an accuracy value of 75.8%, meanwhile in the SVM modeling produces 77.9%. It can be concluded that SVM has better performance than CNN in detecting hoax news,

**Keywords:** hoax, detection, CNN, SVM, N-Gram

## I. INTRODUCTION

THE Twitter (now rebranded as X [1]) is one of the social media that users use to write reviews on the news that most users are talking about. In addition, users can also communicate and exchange information such as news, photos, and videos [2]. The ease with which people spread news on Twitter has resulted in a new habit in the community, namely accepting the news without knowing the truth of the new[3] Some irresponsible people often spread hoax news on purpose, which has a negative impact on society.

At a moment when Indonesia is experiencing an outbreak of Covid-19 cases in 2020, one of the news that is being discussed on Twitter is news about Covid-19. Some individuals or groups easily believe the news spread on social media, making social media a provocation tool to direct the public or readers to negative opinions of hoax news about the Covid-19 case. This hoax news has a very bad impact on the handling of the Covid-19 case. In fact, the community should help the government in preventing the increase in the number of Covid-19 cases by suppressing the spread of hoax news on social media. Therefore, a system is needed that can detect

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hoax news on social media such as X (Twitter), so that in the future the spread of hoax news can be controlled. The development of this hoax news detection system can be built using the Deep Learning text classifier method.

Deep learning is a method that is often used and combined with word embeddings in classifying hoax news [4]. [5] use the Inductive Representation Learning method in 2020, revealed that detecting the spread of hoax news can help suppress its rapid spread on social media. Yuliani[6] explained that even though hoax news is not a threat, the perception that arises from the spread of hoax news will affect the social and political conditions of a country. Meanwhile, Widaretna [7] uses the Word2Vec method to detect hoax news, stating that since the COVID-19 pandemic occurred, the spread of hoax news has continued to increase. Likewise, the statement by [8] stated that from 23 January 2020 to 15 June 2020 there were 850 COVID-19 hoax news related to circulating among the public through various social media. Even up to September 23 2020, hoax news in Indonesia related to Covid-19 has reached 1984 news.

Detection of hoax and non-hoax news using Long Short Term Memory (LSTM) and Convolutional Neural Network (CNN) methods in [9] shows that the CNN method provides the best accuracy results, namely 88% while the LSTM method is 84%, but the total the dataset used is not large enough. [10] uses the Naïve Bayes method, Recurrent Neural Network (RNN), and Support Vector Machine (SVM) with the expansion of the Global Vector (GloVe) feature, in 3 corpus namely Tweet, IndoNews, and Tweet+IndoNews for the similarity of the word Top 1, Top 5, and Top 10. The results of the study state that SVM has the highest accuracy value of 91.92%, but there are still inconsistencies in the RNN model. Research on the detection of hoax news was also carried out by [11] on social media Twitter with a dataset in the form of text and images of 5,800. The use of the CNN and RNN hybrid method showed an accuracy of 82.29% for LSTM, 73.78% for Decreasing LSTM and 80, 38% for LSTM-CNN. While research [12] Welly detects hoax news on Twitter using the CNN method with Term Frequency - Inverse Document Frequency (TF-IDF) and the combination of N-grams, produces a fairly good accuracy value of 89%. [13] identified hoaxes on social media Twitter using SVM by considering the effect of selecting the Information Gain feature. Dataset contains 25,329 is labeled with hoaxes and facts, resulting in an accuracy value of 95.56%. This study also shows that the accuracy value is influenced by the number of data features and the amount of data. Study by [14] uses CNN deep learning classifiers for fake news detection by using Reuter dataset to conduct experiments. The proposed model obtained the highest accuracy of 93.64%, which is higher compared to existing methods

Based on the results of previous research, it can be concluded that the use of CNN provides accurate results on hoax datasets sourced from websites. Therefore, in this study, CNN will be used to detect hoaxes on Twitter social media datasets. The performance of this CNN model will also be compared with the SVM classifier as baeline of this study, which is one of the classifiers commonly used in machine learning tasks with generally good results [10]. Convolutional Neural Network (CNN) is a neural network architecture that was originally developed for processing image data, but has been used successfully in various text processing tasks, including text classification. There are some of the advantages of CNNs in text classification: Hierarchical Pattern Recognition and Modeling, Automatic Feature Extraction, Ability to Handle Big Data, Transfer Learning etc. Whereas SVM is a method that uses a hypothetical space that has a linear function in high-dimensional features and is trained using learning algorithms based on computational theory [8]. Support Vector Machine (SVM) is one of the most frequently used machine learning algorithms in text classification, and has several advantages that make it a good choice in some contexts. Some of the advantages of SVM include: Ability to Handle Highly Characterized Data, Ability to Handle Both Unbalanced Classes, Ability to Overcome Overfitting, Kernelization for nonlinear data patterns etc. The news used in this research is hoax news related to the Covid-19 case. Crawling was carried out on Twitter social media datasets with Covid-19 data in 2020, where at that time a lot of hoax news appeared and caused people to panic. The widespread of hoax news on social media such as Twitter requires a system to quickly detect the validity of news.

## II. LITERATURE REVIEW

In social media, the ease of uploading news through social media has a positive impact as well as a negative impact on society. On the one hand, this convenience provides very easy access at an affordable cost and the rapid spread of news makes many people tend to use social media to find and consume news through social media. However, on the other hand, the fast and easy spread of news causes the risk that the news spread contains hoax news. News that is easily spread has low quality news that is deliberately disseminated [15]. There are several types of hoax news that are often found, such as using headlines that are interesting and do not match the content of the news to attract readers' attention, there are typical hoaxes that are often made more dramatic or exaggerated to spread misleading rumors [16]. Hoax news also leads to social, religious, and political issues and sometimes leads to phenomena that are rising in society, for example regarding the Covid-19 case [17]. The more tweets about Covid-19, especially about the Covid-19 hoax news, will have a very bad impact on readers. For example, there are people who are affected by Covid-19 disease and these sufferers accidentally read hoax news, it can attack the psychological and health of sufferers [18].

There are several previous studies that have been conducted regarding hoax news analysis with several different methods and cases. Social media users play a significant role in the spread of hoax news on online social media [3]. Many users consume sharing articles with inaccurate information either intentionally or unintentionally. The hoax news is written to confuse readers and therefore the need for a desire to understand which articles contain hoax news or not. Because there are users who tend to share hoax news, who are categorized as hoax news spreaders.

Detecting hoax news is a complicated challenge, due to its ever-changing nature in study by [19]. The fake news datasets and real news datasets are used and then implemented into the RNN, CNN, LSTM, and Bi-LSTM methods to obtain good results. The use of this method produces the highest accuracy of 94.6% when using the Bi-LSTM model. In a similar study, Bagas [13] analyzed hoax news using Deep Learning with several models namely LSTM, Bi-LSTM, GRU, Bi-GRU, Naïve Bayes, SVM and 1D-CNN resulting in excellent accuracy. The highest accuracy result is 97.90% using the 1D-CNN model, results obtained by experiments without using dropout values, recurrent dropout, and not using SpatialDropout1D.

Hoax news detection research using the Convolutional Neural Network (CNN) and Long Short Term Memory (LSTM) methods was also conducted by Kurniawan [9]. The experimental results show that the CNN method provides better accuracy results, namely 88% compared to LSTM with an accuracy of 84%. the shortcomings in this study are that the number of datasets used is not large enough. The research on hoaxes was also conducted by [10] by using the Naïve Bayes, Recurrent Neural Network (RNN), and Support Vector Machine (SVM) methods and combined by Global Vector (GloVe). In this study, researchers used 3 GloVe corpus namely Tweet, IndoNews, and Tweet+IndoNews on the similarity of Top 1, Top 5, and Top 10 words. The results of the study show that SVM has the highest accuracy value of 91.92%. There are shortcomings in this study, namely the inconsistency of the RNN model built.

Hoax news detection research on Twitter social media was also conducted using data in the form of text and images and the method used was the CNN-RNN hybrid [11]. The dataset used amounted to 5,800 tweets. The results showed an accuracy of 82.29% for LSTM, then an accuracy of 73.78% for LSTM Drop, and 80.38 for LSTM-CNN. The use of CNN in hoax identification was also carried out by [12] Welly with a focus on the use of Term Frequency - Inverse Document Frequency (TF-IDF) for various combinations of N-grams and the use of Information Gain as a feature selection tool. This research produces a good accuracy value of 89.49%.

This research specifically compares deep learning models, namely CNN and SVM machine learning in Covid-19 hoax news detection, where in previous research this has never been done. The selection of CNN is based on the results of several previous studies that show this model provides better results than other deep learning models. Meanwhile, the selection of SVM is also based on the consideration that the method often provides better results than other machine learning models.

## III. RESEARCH METHOD

### A. *Data Crawling*

The data used is taken from social media Twitter, regarding the news of Covid-19. The dataset is a collection of Indonesian-language tweets taken based on the keywords "Covid-19", "Corona", "virus", and "hoax", in the period from February to March 2020 as many as 3897 data. Data is retrieved using the help of the open-source snscrape library. TABLE 1 displays the sample results of data crawling that has been done.

TABLE I
THE SAMPLE RESULTS OF DATA CRAWLING

| Username | Text | Language | Retweet | Followers | Following |
|---|---|---|---|---|---|
| pikiran_rakyat | Sempat sebut virus corona hoaks ke lawan politiknya, Trump kini menghadapi kematian pertama akibat covid-19 di as https://t.co/OUo7UwPhnZ | Indo | 0 | 20 | 132 |
| hambauanlang | @redditindonesia …..belum ada penelitian yang spesifik meneliti ketahanan virus corona Covid-19 untuk bisa bertahan hidup ketika menempel di suatu benda dan berpotensi menginfeksi manusia. ……. | Indo | 0 | 169 | 49 |
| bacautas | Halo kak @DjanChoek, utas yang kakak minta sudah siap: "Foto2 SUNYINYA BANDAR UDARA DUNIA karena CORONA Virus (Covid-19). Masa suram untuk bisnis perjalanan dan penerbangan ... #CoronaVirusUpdates | Indo | 0 | 0 | 8 |

### B. *Labeling*

The dataset was then manually labeled in 2 class labels, namely label "0" to state factual news and label "1" to state hoax news. Table 1 contains examples of hoax news and non-hoax news datasets. The determination of a tweet to be included as a hoax or fact label uses references or references from the government and official mass media. The collection of news that is used as a reference, was released by the Ministry of Communication and Information (Kominfo), PPID Diskominfo Prov. Central Java, TvOne, and CNN Indonesia. News that has a major impact on public opinion, hoax news with the aim of creating misunderstanding among the public, news with the intention of seeking certain benefits, news with the aim of influencing people's views, distributing propaganda will be classified as hoax news. The news is compared with factual news obtained from official government news and official mass media. To avoid subjectivity, labeling is done by 3 people, and then what is used as a reference is the most labels.

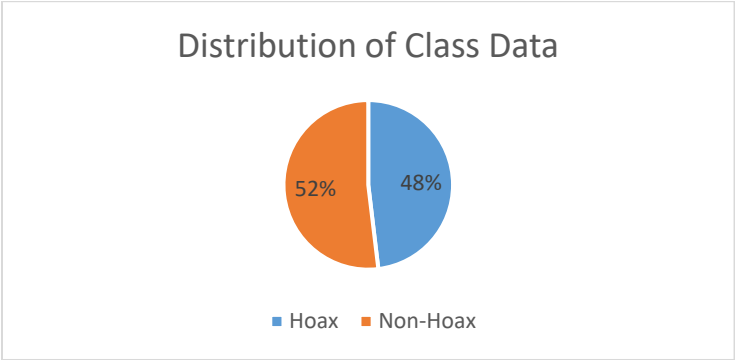


Fig. 1. Distribution of hoax and non-hoax class labels

The proportion of hoax and non-hoax labels is presented in Figure 1, with 48.1% hoax labels and 51.9% non-hoax labels. Based on this value, the distribution of data labels can be considered balanced.

### *C. Data Preprocessing*

By performing proper data preprocessing, the quality of text data can be improved, ensuring that the classification model will be able to understand and interpret the text better, and produce more accurate classification results. Effective preprocessing is a critical step in the development of a successful text classification system. The steps taken in this stage are as follows.

1) Data cleaning, removing unnecessary symbols such as; URLs; numbers; hashtags; Reserved Word (RT, FAV), punctuation marks; emoji; and removing usernames.
2) Stopword removal, removing of words in tweets that are considered meaningless such as the words 'which', 'there', 'or', 'at' and others.
3) Case folding, a process carried out to replace capital letters into lowercase letters.
4) Stemming, and the process of reducing words that are derived into basic forms.
5) Tokenizing data, the process of separating words in one sentence with the aim of the text analysis process.

### *D. Data Splitting*

The dataset is divided into two, namely train data and test data. Train data is used for the model training process and test data is used to test models that have passed the previous model training process. In this study, the data division carried out is 90:10 (90% train data and 10% test data). The results of splitting data are 3507 records as train data and 390 records as test data.

### *E. TF-IDF Feature Extraction*

TF-IDF (Term Frequency-Inverse Document Frequency) is the feature extraction method that converts text data into numerical features based on the frequency of occurrence of a given word and the occurrence of the word in the whole document. TF expresses the number of words that are present in a document, where the more frequently the word appears, the higher the TF value. Meanwhile, IDF indicates the measure of how often the word is present in the whole document. The more often the word appears, the higher the IDF value. The formula of TF-IDF can be seen in the following equation :

$$TF_{t,d} = \sum_{x \in d} f_t(X) \tag{1}$$

$TF_{t,d}$ : Term Frequency of term t in all documents d
$f_t(x)$: Term Frequency of term t in document X

$$IDF_t = \log\left(\frac{|D|}{df_t}\right) \tag{2}$$

$|D|$ : total document
$df_t$ : number of occurrences of word t in document d

### *F. Model Learning of Convolutional Neural Network (CNN)*

The CNN structure consists of an input layer, a convolution layer with dropouts, a flattened layer, a fully connected layer, and an output layer [20]. CNN is categorized in the NLP (Natural Language Processing)

domain, followed by words that have been converted to vectors and then used in neural networks. The vectors are then inputted into a system network using a one-dimensional convolution layer and the pooling layer is used as feature extraction from the text input.

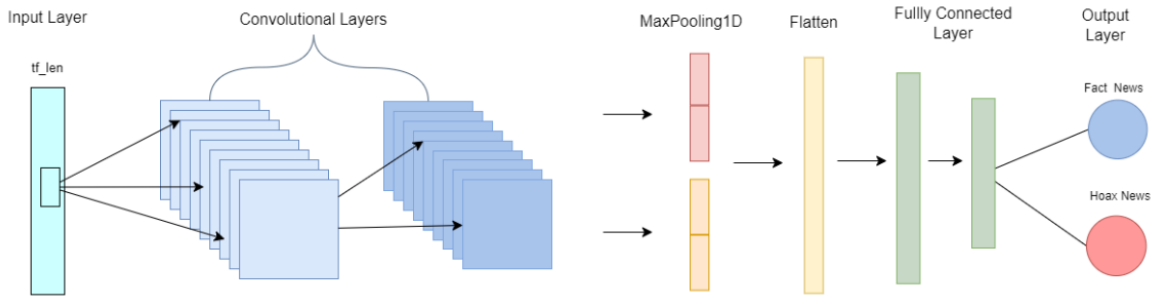


Figure 2. Architecture of CNN Model

The CNN learning step in this research starts from the input layer with the parameter 'tf_len' which is the length of the time series data used as input with a length of 1 (number of channels). From the input layer, then enter the Convolutional Layers which amount to two layers. The first layer uses a filter of size 50, a kernel of size 3, and uses RelU activation while the second layer uses a filter of size 20, a kernel of size 5, and uses RelU activation, with a layer dropout rate of 0.5. The use of the activation function 'RelU' is expected to transfer the non-linearity of the data into the model, while the use of dropout here is used to prevent overfitting. In the MaxPooling1D layer, a pool_size of 2 is used. This layer is used to reduce the data dimension by taking the maximum value from a certain range. At this stage, there is also a Flatten Layer, in this layer converting data from matrix format into vectors to be prepared for the fully connected layer. In the fully connected layer, a dense layer with 32 units is used and uses the RelU activation function and a dropout layer of 0.5. The last layer, the output layer, uses a Dense layer with 1 unit and uses a sigmoid activation function.

### *G. Model Learning of Support Vector Machine (SVM)*

SVM is a machine learning algorithm for classification problems by finding a hyperplane that separates two classes of data with a maximum margin. This hyperplane is the decision boundary that maximizes the distance between the data classes, called the "margin" [21]. The SVM model learning process in this study starts from initializing the SVM model object by using the parameter C = 1.0. The value of C is useful to control the trade-off between maximum margin and penalty for misclassification. A higher C value will try to provide the maximum margin but may allow misclassification, while a lower C value will be stricter in minimizing misclassification. The kernel used in this study is a "linear" kernel which means it will use a linear hyperplane to separate the hoax class and the fact class. The degree is 1, and the gamma parameter is set to auto, but since we are using a linear kernel, this parameter is not used. Next, train data ('train_x') and training data labels ('train_y') are used to optimize the SVM model by adjusting the hyperplane that separates data from two different classes by finding the hyperplane with the maximum margin. This process will produce a class prediction value from the test data.

### *H. Measurement of System Performance*

In this research, the accuracy value is used to measure the performance of the system. The accuracy describes how correctly the model can classify correctly in total for both positive and negative classes. The accuracy formula used is as follows.

$$\text{Accuracy} = \frac{TP+TN}{TP+TN+FP+FN}\ x\ 100\% \quad (1)$$

In this context, True Positive (TP) is the amount of observations that are actually hoaxes and also predicted as hoaxes by the classification model. False Positive (FP) is the amount of observations that are actually facts, but wrongly predicted as hoaxes by the classification model. False Negative (FN) is the number of observations that are actually hoaxes but wrongly predicted as fact by the classification model.

## IV. Results And Discussion

This study uses data as many as 3896 records taken from Twitter social media. The data taken is data with the Indonesian language. This research was conducted by comparing three different feature combinations built with CNN and SVM classification models. The expected goal is to get modeling results with the best accuracy in certain feature groups and classifiers. Performance measurement is conducted by using the accuracy obtained through the average results of program execution five times from each scenario. For the process of testing and measuring system performance, the data is divided into train and test with a ratio of 9:1. There are several N-gram feature comparison scenarios carried out, namely testing using unigram (1,1), unigram and bigram (1,2), and unigram-bigram-trigram (1,3) features for both CNN and SVM classification methods. The feature weighting method used in this research is TF-IDF. The results of this experiment can be seen in Table III.

TABLE III
Example of Data Pre-processing Results

| **Combination of N-Gram** | **Accuracy (%)** | |
|---|---|---|
| | **CNN** | **SVM** |
| Unigram | 72.8 | 74.6 [10] |
| Unigram + Bigram | 75.3 (+2.5) | 77.9 (+3.3) |
| Unigram +Bigram + Trigram | 75.8 (+3.0) | **77.9 (+3.3)** |

Experimental results in Table III show that SVM performance outperforms CNN for the same feature (unigram) as well as for other features. When tested with more complex feature variations, namely unigram - bigram and unigram - bigram - trigram combinations, both classifiers show an increase in accuracy. The best result is by using the most complex feature which is unigram - bigram - trigram combination. The final result obtained is that the best system performance is obtained when using the SVM method and using the most complete features, namely the combination of unigram - bigram - trigram. The use of SVM models with this full feature outperforms the use of SVM models with unigram features only as used by [10]. The results also show that the use of multiple words as a single feature has a significant effect on the increase in system accuracy.

## V. Conclusion

This research aims to test the performance of CNN compared to SVM (baseline) in detecting hoax news, especially in the case of covid-19 and also to determine the effect of using N-Gram features on the classification performance obtained. The data used is data taken from social media Twitter (X), related to Indonesian-language covid-19 news. The experiment results show that the SVM method has better accuracy performance than the CNN method in various features tested. It can also be concluded that the use of SVM as used in the baseline proved to be good for hoax news detection, especially the covid-19 hoax case. The use of complete N-Gram features, namely the combination of unigram-bigram-trigram, can improve the accuracy of CNN and SVM classifiers significantly.. The best performance is obtained by combining SVM and full N-Gram features, namely the combined unigram-bigram-trigram feature. This combination of features and SVM can improve the accuracy of SVM by more than 3%, compared to only using SVM and unigram features (baseline). The results also show that there are some important word phrases that are quite accurate in detecting hoaxes, which are not found in single-word features.

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