

# Fake News Detection using Machine Learning

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## ABSTRACT

Recently, fake news has been incurring many problems to our society. As a result, many researchers have been working on identifying fake news. Most of the fake news detection systems utilize the linguistic feature of the news. However, they have difficulty in sensing highly ambiguous fake news which can be detected only after identifying meaning and latest related information. In this paper, to resolve this problem, we shall present a new Korean fake news detection system using fact DB which is built and updated by human's direct judgement after collecting obvious facts. Our system receives a proposition, and search the semantically related articles from Fact DB in order to verify whether the given proposition is true or not by comparing the proposition with the related articles in fact DB. To achieve this, we utilize a deep learning model, Bidirectional Multi-Perspective Matching for Natural Language Sentence (BiMPPM), which has demonstrated a good performance for the sentence matching task. However, BiMPPM has some limitations in that the longer the length of the input sentence is, the lower its performance is, and it has difficulty in making an accurate judgement when an unlearned word or relation between words appear. In order to overcome the limitations, we shall propose a new matching technique which exploits article abstraction as well as entity matching set in addition to BiMPPM. In our experiment, we shall show that our system improves the whole performance for fake news detection.

**KEYWORDS:** Fake news detection, Sentence matching, Natural Language Processing, Deep learning, BiLSTM model, Machine Learning

## INTRODUCTION

Fake news has been incurring many problems to our society. Fake news is the ones that the writer intends to mislead in order to achieve his/her interests politically or economically on purpose [1]. With the generation of a huge volume of internet news and social media. It becomes much more difficult to identify fake news personally. Recently, many researchers have worked on fake news detection system which automatically determines if any opinion claimed in the article contains fake content [2]. In a large context, the forms of their research are carried out with the method that connects the linguistic pattern of news to deception, and that verifies deception by utilizing external knowledge [3]. The first approach can quickly verify fake news at a low cost. However, in order to detect clever fake news, it is necessary to grasp the semantic content of the article rather than partial patterns and verify it through external facts updated by human. Therefore, we search the in put proposition and related articles from the Fact DB, and develop the fake news detection system to verify if the found articles and proposition are semantically related.

## Related Works:

Recently, as the deep learning in the NLP field has been developed, various types of the sentence matching techniques have been introduced. We introduce the related research of the sentence matching techniques as we divide the works into the unsupervised learning, and supervised learning based works.

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## A. Unsupervised Learning:

One of the most important elements in the sentence matching is the way of expressing a word into a data structure. The existing method of expressing words is one-hot encoding vector. However, this method requires lots of dimension to express a single word, and cannot express the relation between words. Overcoming these shortcomings, the word-to-vector (word2vec) [5] method was proposed which maps significant information into the vector of fixed dimensions. The word2vec is enabled to learn the weight to increase the probability that the nearby words will appear for the main word, and uses the corresponding weight as a vector. As an extended research of word2vec, sentence-to-vector (sent2vec).

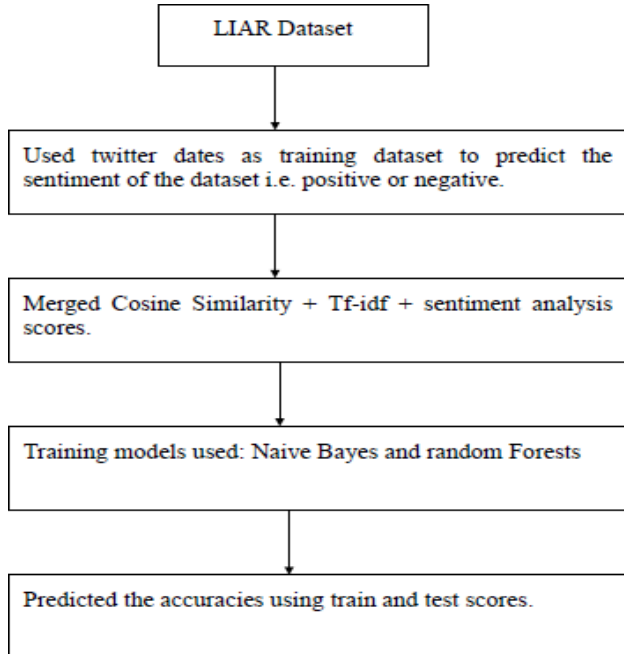
## B. Supervised Learning:

Recently, the research of the machine comprehension is developed with attention mechanism and BiLSTM. LSTM resolved the vanishing gradient problem of Recursive Neural Network (RNN) by adding the layer that forgets the past information, and remembers the current one to the cell. Since LSTM handles sequential inputs, it is often used for encoding and decoding of sentences. However, as the length of LSTM becomes longer, the model loses the information, and it shows a tendency to remember the latter information. Therefore, scholars worked on improving the performance of the existing LSTM through attention mechanism which reminds important information selectively. They also showed using BiLSTM together can improve performance. The Bi-Directional Attention Flow (BiDAF) [7] minimizes the

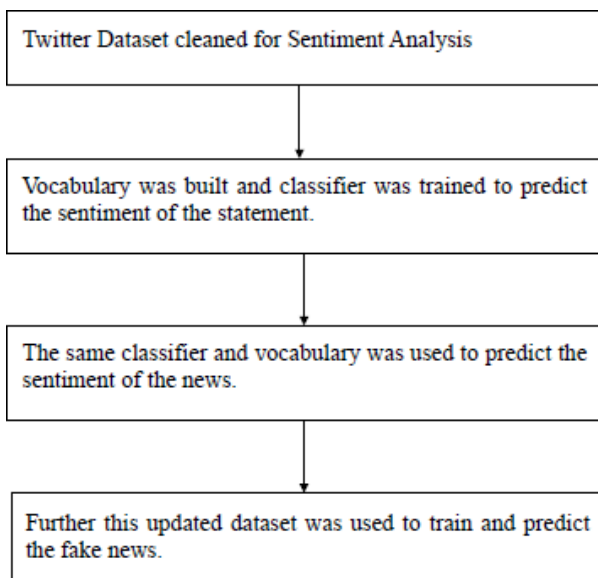
loss of information by applying the attention mechanism at each time stamp of LSTM. In particular, BiMPM [8] applied BiLSTM and attention mechanism to sentence matching.

**Proposed System:**

This section discusses the proposed solution for fake news detection by combining Fake News with Sentiment Analysis. Proposed solution is shown in Fig. 1. It consists of various steps as below:



- Step 1 :** Merged data set was prepared using from different data sets namely Politifact, Kaggle and Emergent datasets.
- Step 2 :** The different text preprocessing techniques like bigrams (series of two words taken from a given text) ,trigrams (continuous series of three words taken from example text), CountVectorizer (count of terms in vector/ text , term frequency-inverse document frequency (tf-idf) vectorizer.
- Step 3 :** We have used tf-idf vectorizer on twitter dataset along with cosine similarity to build our vocabulary. Then Naive Bayes classifier was used to predict the sentiment of news statement of test data set (Merged data set) as shown in Fig. 2.



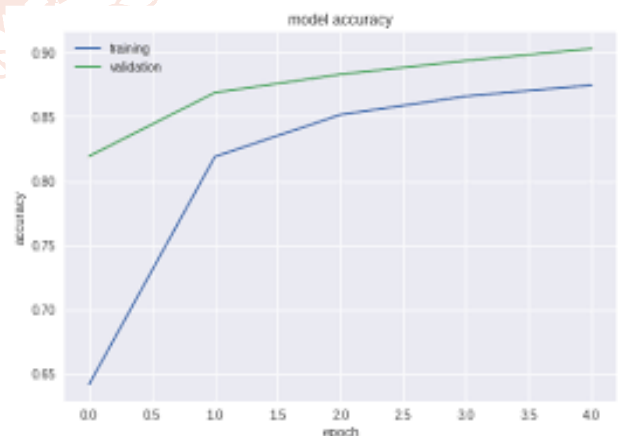
- Step 4 :** We added additional columns: tf-idf scores, sentiments and Cosine similarity scores in Merged data set.
- Step 5 :** Training model was built using Naive Bayes and Random Forest (train-test ratio: 3:1)
- Step 6 :** Performance is evaluated and compared using accuracy.

Proposed solution consists of important steps 2 to 4 as preprocessing. It uses tf-idf Vectorizer with cosine similarities method for tokenizing a collection of text documents along with building a vocabulary of pre-existing words. Further we encoded the novel documents using that vocabulary. The encoded vector is returned with length of the entire vocabulary (bag of words) and an integer count for the number of times each word appeared had in the document.

**System Evaluation:**

We evaluate the performance of proposed system in this section. Given the relevant article on the input proposition, the evaluation verifies the ability to determine whether the semantic content of the input proposition can be found in the relevant article. We train the BiMPM which is the foundation of our system, and the experiments identify how much the performance improves by adding modules proposed previously. We first build the data set directly to train the BiMPM to output true or false when given a short article consisting of three or four sentences and propositions. In the datasets construction, the following policy is set up to proceed with the learning.

1. Extract one sentence from a short article, and use it into an input proposition.
2. Generate the data, which is true through variations of thesaurus, a change of word orders, and omission of some contents.
3. Distort some information such as numbers, nouns, and verbs or omit words to generate false data.



**Fig.2. Training accuracy of test set for each epoch.**

Proved the sentences used in the new test set are longer, and consist of new words that are not in the previous dataset. In terms of the using True Positive Rate (TPR) as the y-axis and False Positive Rate (FPR) as the x-axis.

**Conclusion:**

In this paper, we have proposed the fake news detection system using Machine learning which is built and updated by human’s direct judgement. Our system receives a

proposition as an input to verify, and search the related articles so that it verifies if the article found by the entered proposition can be semantically concurred with the proposition. To achieve this, we utilized model which is a deep learning model for sentences matching and machine learning. However, even though has shown good performance in various datasets, it has some limitations such that the longer the length of the input sentence is, the lower its performance is, and it has difficulty in making an accurate judgement when an unlearned word or relation between words appear. In order to overcome the limitations, we have presented the new matching technique which makes use of article abstraction as well as entity matching set besides BiMPM. In our experiment, we have shown that our system improved the whole performance for fake news detection.

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