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Developing Fake News Detection System Using Multinomial Naïve Bayes Supervised Learning Algorithm

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ABSTRACT

The tremendous harm caused by the spread of fake news is approaching unquantifiable proportions. Nations across the world are currently wrestling with the threat of false news spread by the internet and social media. The purpose of this research is to detect and report social media based fake news using machine learning. The study trained a machine learning model on a collection of false and real news using Python's Scikit-learn module. Additionally, the dataset was analyzed for the characteristics utilizing text representation models such as Bag-of-Words and Term Frequency-Inverse Document Frequency (TF-IDF). The research evaluated the Multinomial Naive Bayes classification technique on the title, author, and content, determining whether it is click-bait or not, or phony or real. The trials concluded that when compared to the Bag of words frequency, Multinomial Naive Bayes using the TF-IDF model provided the greatest accuracy for content categorization.

Keywords: fake news, false news, social media, Naïve Bayes ML, Bag-of-Words etc.

1. INTRODUCTION

Fake news paves the way for the dissemination of false information, misleading others and propagating false beliefs. These individuals earn significantly large sums of money as a result of the volume of interactions from their publications. Individuals disseminate misinformation for a variety of reasons, most likely to obtain political favour, to promote their businesses and products, or to exact revenge on another (revenge). It's difficult to distinguish false news from legitimate news since humans are readily affected, particularly via the sharing of friends and family. Due to relationships and trust, the majority of individuals are easily influenced (Osang, Inyang, & Afolorunso, 2020).

When fake news is used to spread rumours or false information to influence people's behaviour, it has swiftly developed into a societal issue. It has demonstrated that the propagation of false news has had a significant impact on governments worldwide, with Nigeria enacting legislation at various periods. Similarly, the spread of false news had a substantial effect on the 2016 US presidential election. Additionally, fake news was used to sway the United Kingdom's "Brexit" referendum.

In January 2018, the European Commission convened a high-level expert group to advise on policy proposals aimed at combating false news and misinformation distributed online. This committee produced a report in March 2018 titled "Reviewing Best Practices in the Light of Fundamental Principles and Appropriate Responses." Among the group's proposals was to "invest in research and innovation activities aimed at improving the technologies underlying online media services."

This paper reports the results of the experiment to detect fake news based only on textual information by applying machine learning techniques. The fake news detection system works a dataset of sites using machine learning techniques. The objectives of the study are as follows:

a. To design a model that would detect fake news using a given dataset to mitigate the spread of online fake news and its consequences.
b. To implement the designed system in objective (a) above.
c. To compare the outcomes of the experiment between multinomial naïve Bayes with a bag of words and multinomial naïve Bayes with TF-IDF vectorizer.

Curbing fake news would make society hold value in truth, logic would not be based on lies, organizations, individuals or political parties would no longer be affected through fake news.

2. RELATED LITERATURE

While fake news and other deceptive materials have existed from time immemorial, they have gained prominence in recent years. It has a detrimental effect on the individuals and organizations on the receiving end (Donepudi et al., 2020a). Many people believe in unverified news. This has rendered the majority of individuals incapable of memorizing the full tale. The issue of managing misleading news has been discussed. The answer is machine learning. Machine learning can assist in detecting fabricated news (Khan et al., 2019). These fabricated news stories may be easily and automatically detected using machine learning (Della Vedova et al., 2018).

Numerous scholars used machine learning classifiers to determine the validity of news stories. Researchers in (Abdullah-All-Tanvir et al., 2019) used machine learning classifiers to detect false news. In an experiment, the researchers discovered that the SVM and Nave Bayes classifiers are the most effective in detecting false news. These two were more accurate than other classifiers. Classifiers that are more accurate help in the detection of more fake news. According to experts (Kudarvalli & Fiaidhi, 2020), identifying false news is critical since many individuals spread misleading information on social media to mislead others. It is critical to recognize false news to safeguard individuals and organizations from having their reputations tarnished as a result (Rahman et al., 2020). They discovered that logistic regression is the best classifier due to its increased accuracy; they also used a variety of machine learning methods.

According to researchers (Aphiwongsophon & Chongstitvatana, 2018), social media is the primary source of posts. Anyone may create an account on these websites and publish whatever they choose. This post may include inaccuracies about a person or business. Detecting such fabricated news is a critical but challenging task. The researchers completed this task using three machine learning techniques. These include the Nave Bayes, neural network, and support vector machine. The Naive Bayes method had an accuracy of 96.08 per cent, whereas neural networks and SVM had an accuracy of 90.90 per cent. Albahr and Albahar (2020) examined four well-known machine learning algorithms, including the random forest, Nave Bayes, neural network, and decision trees, to demonstrate the classification performance's effectiveness in recognizing fake news. On this dataset, the Naive Bayes classifier beat the other approaches substantially. In this dataset, the Naive Bayes approach surpasses all other methods.

Vasuagarwala, Parveensultana, Srijanmalhotra, and Amitrajitsarkarb (2019) created a system or model that can anticipate if a news piece is true or fake based on data from prior news articles. The results indicate that SVM and logistic regression classifiers perform the best in this dataset's model, with SVM slightly beating the logistic regression classifier. Additionally, because the training data was mostly focused on US political and economic news, it was observed that news statements related to US politics were properly detected and fake news was recognized in their test instances. However, the test cases involving technical developments were projected erroneously.

Kula, Chora, Kozik, Ksieniewicz, and Woni (2020) trained and verified the model using the Flair library. All trained models attained a level of accuracy adequate for use in practical false news detection operations. The authors achieved a maximum accuracy of 92 per cent on the false news detection job when they used a dataset with comparable subjects to the ISOT dataset, which is concerned with political concerns. In all experiments, the greatest attainable accuracy exceeded this figure.

Krishna and Kumar's work (2021) focuses on creating a dataset containing both false and true news, and they employed a Naive Bayes classifier to construct a model that can classify an article as fake or real based on its words and phrases. Their study established that a fundamental artificial intelligence technique (such as a naïve Bayes classifier) may generate useful results when applied to a vital problem such as 'fake news classification.' As a result, the findings demonstrate that artificial intelligence technologies may be used successfully to this essential classification problem.

Arora et al. (2021) researched spotting bogus news by utilizing a variety of models, including LSTM, ANN, Naive Bayes, SVM, Logistic Regression, XGBoost, and Bert. All models were assessed on a Kaggle dataset. When the models' accuracies were examined, it was established that LSTM and BERT surpassed all Machine Learning models, with output percentages of 99.02 and 99.47 per cent, respectively, compared to Multinomial Nave Bayes' 97.94 per cent.

3. METHODOLOGY

This paper adopted the Structured System Analysis Design Methodology (SSADM) / SDLC). It is an acceptable methodology in software engineering. This consists of the following;

a. Preliminary investigation
b. Feasibility studies
c. System analysis
d. System design
e. Implementation and maintenance

3.1 System Design

This phase modelled a new system by eliminating or improving on the problems identified in the existing system and also meets the requirement of the objectives of the paper within cost-effective limits.
Figure 3.1: dataflow diagram

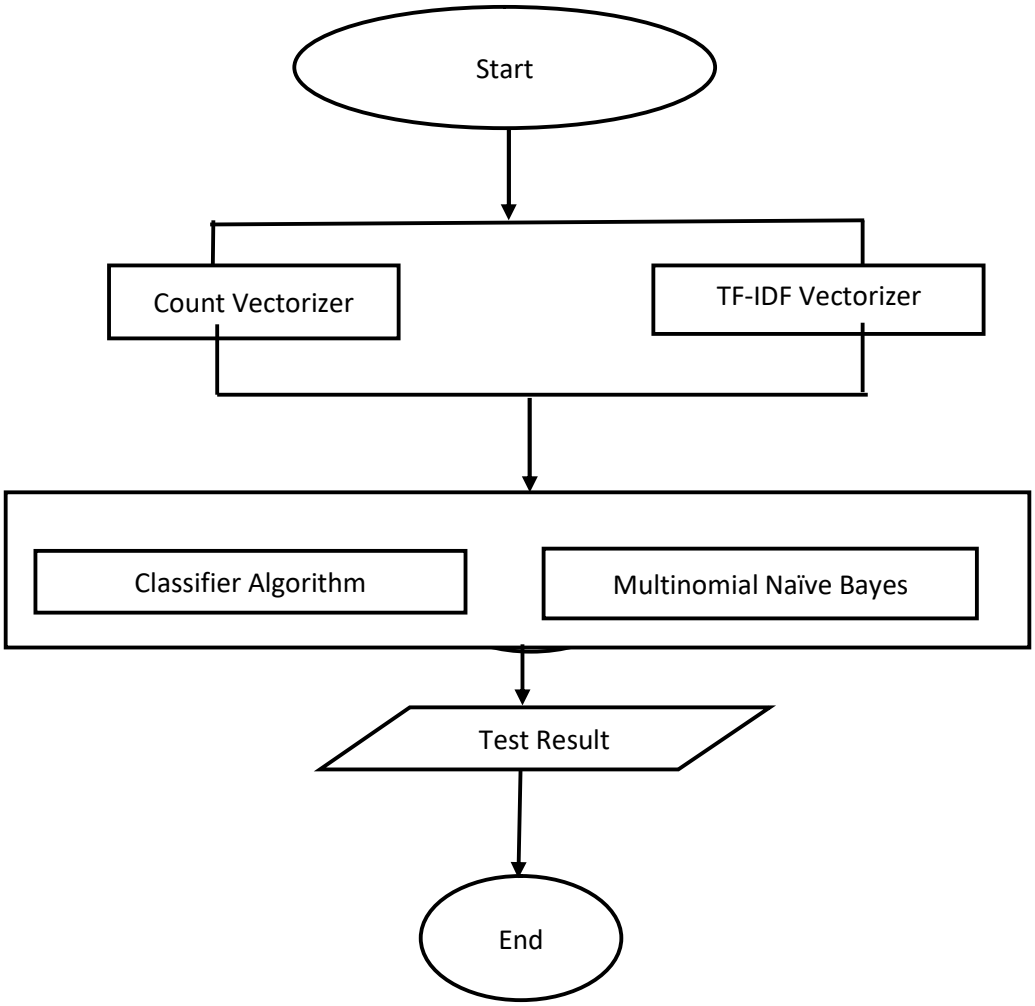

Figure 3.2: logical design

3.2 Program flowchart of the paper

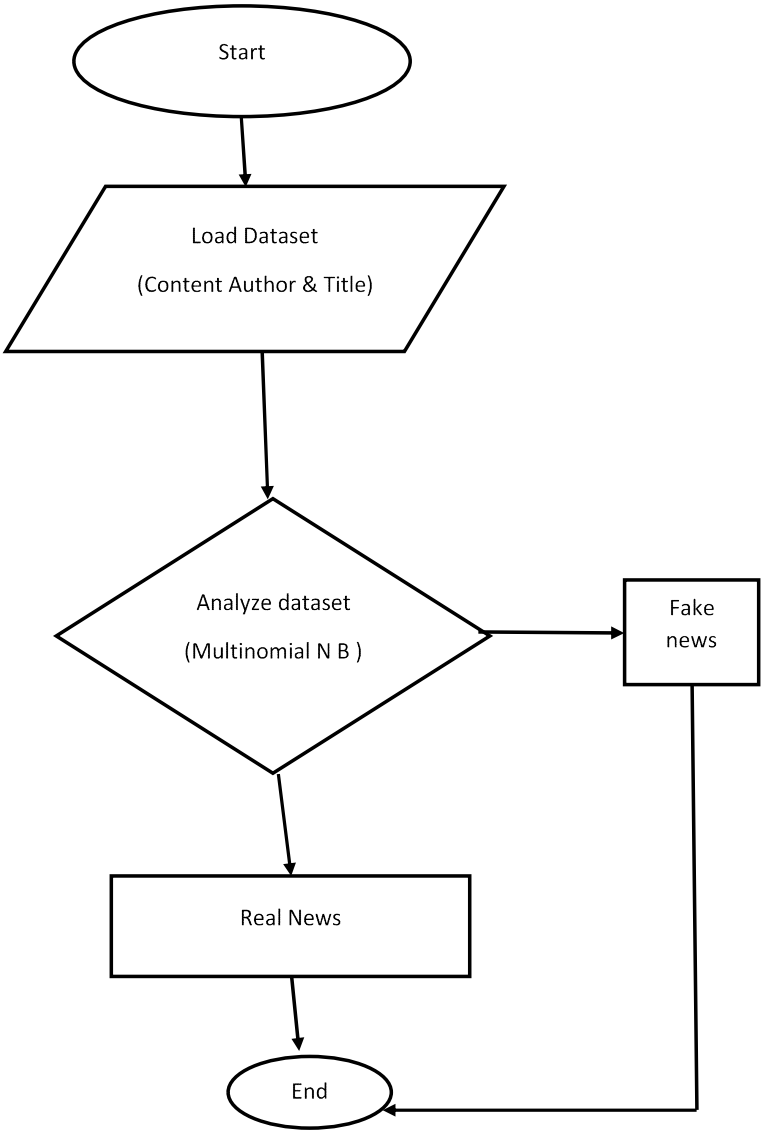

Figure 3.3 program flowchart

3.3 Implementation

In this paper, the algorithms used is Naïve Bayes ML, a comparison with the Tfidf-Vectorizer, and the Bag-of-words was carried out with it. The decision to choose these algorithms is based on their performance accuracies as reported in the related studies conducted by past researchers. The researchers trained the selected classifier on machine learning (ML) tools using datasets.

Table 1: Experimental Procedure

Step 1	Extract features from the datasets
Step 2	Select data set for training and testing
Step 3	Compute the partial and conditional probability of instances of the data sets.
Step 4	Select the instances with maximum conditional probability, and then evaluate the output based on the accuracy
Step 5	Record results and other observations for each data set
Step 6	Repeat steps 1 to 5 for each vectorizer

4. MODELLING AND EXPERIMENT

Importing needed python Library

a. Loading the data

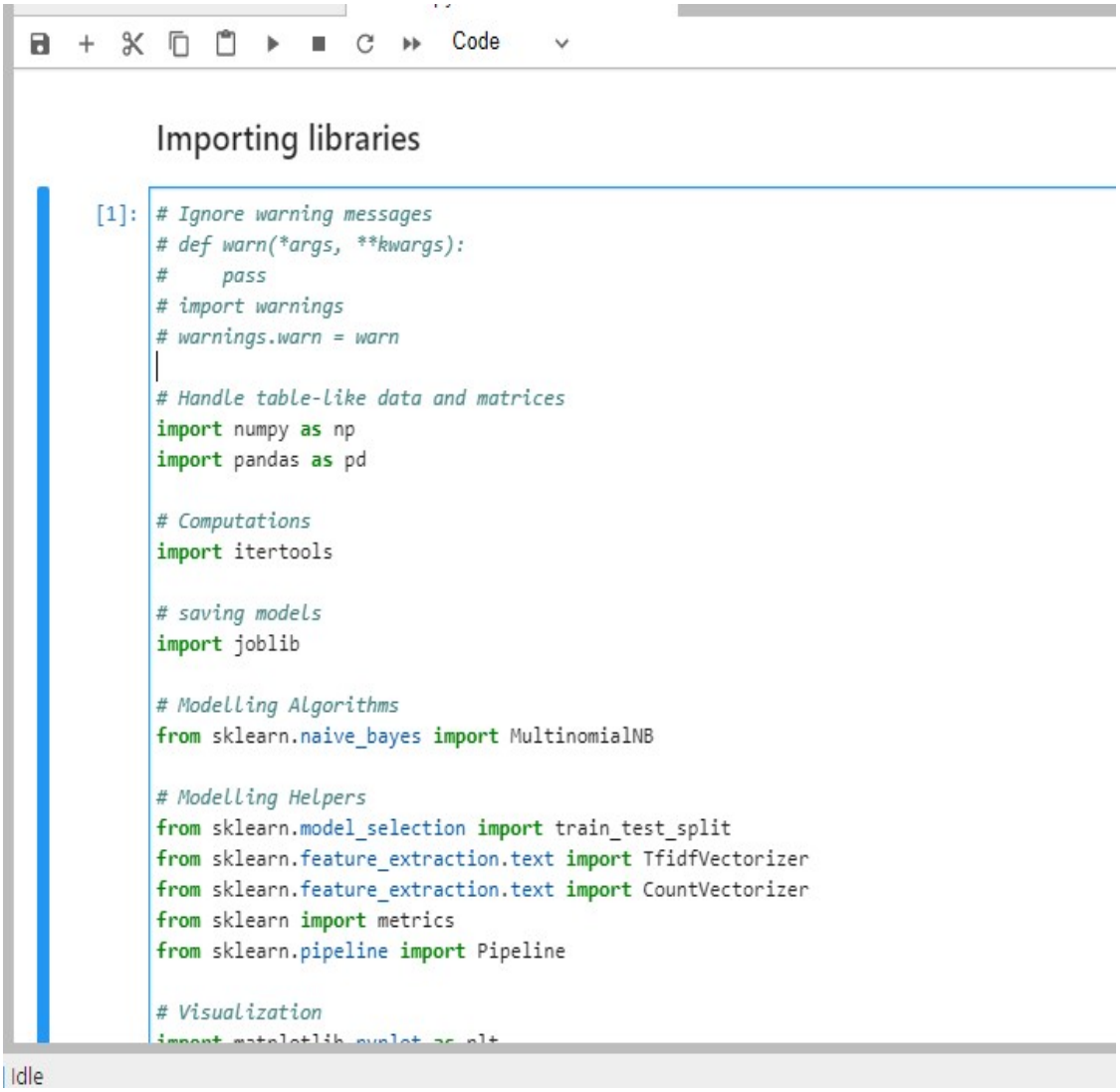

Figure 4.1 Python Libraries

```
[2]: train_data = pd.read_csv('data/train.csv.zip') # This is the data we will be using to train/bulid our models
     test_data = pd.read_csv('data/test.csv.zip') # This is the data we will use to evalute our model at the end.
     test_labels = pd.read_csv('data/submit.csv') # This is the actual/correct label(y) we will be using to do our com
```

```
[3]: train_data.head()
```

[3]:

	id	title	author	text	label
0	0	House Dem Aide: We Didn't Even See Comey's Let...	Darrell Lucus	House Dem Aide: We Didn't Even See Comey's Let...	1
1	1	FLYNN: Hillary Clinton, Big Woman on Campus - ...	Daniel J. Flynn	Ever get the feeling your life circles the rou...	0
2	2	Why the Truth Might Get You Fired	Consortiumnews.com	Why the Truth Might Get You Fired October 29, ...	1
3	3	15 Civilians Killed In Single US Airstrike Hav...	Jessica Purkiss	Videos 15 Civilians Killed In Single US Airstr...	1
4	4	Iranian woman jailed for fictional unpublished...	Howard Portnoy	Print \nAn Iranian woman has been sentenced to...	1

```
[4]: test_data.head()
```

[4]:

	id	title	author	text
0	20800	Specter of Trump Loosens Tongues, if Not Purse...	David Streitfeld	PALO ALTO, Calif. — After years of scorning...
1	20801	Russian warships ready to strike terrorists ne...	NaN	Russian warships ready to strike terrorists ne...
2	20802	#NoDAPL: Native American Leaders Vow to Stay A...	Common Dreams	Videos #NoDAPL: Native American Leaders Vow to...
3	20803	Tim Tebow Will Attempt Another Comeback, This ...	Daniel Victor	If at first you don't succeed, try a different...

Figure 4.2 loading data

b. Preprocessing dataset

```
[12]: train_data.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20800 entries, 0 to 20799
Data columns (total 5 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   id      20800 non-null  int64
 1   title   20242 non-null  object
 2   author  18843 non-null  object
 3   text    20761 non-null  object
 4   label   20800 non-null  int64
dtypes: int64(2), object(3)
memory usage: 812.6+ KB

[13]: train_data.isnull().sum()

[13]: id          0
      title     558
      author   1957
      text       39
      label       0
      dtype: int64

[14]: test_data.isnull().sum()

[14]: id          0
      title     122
      author    503
      text        7
      dtype: int64
```

Figure 4.3 Preprocessing Dataset

c. Test output and comparable results

Using Naive Bayes ML model with Count Vectorizer

```
[24]: count_vectorizer = CountVectorizer(ngram_range=(1, 2), stop_words='english')
      # Fit and transform the training data.
      count_train = count_vectorizer.fit_transform(X_train)
      # Transform the test set
      count_test = count_vectorizer.transform(X_test)
```

```
[25]: # using MultinomialNB with the count vectorized data
      nb_classifier = MultinomialNB(alpha = 0.15)
      nb_classifier.fit(count_train, y_train)
```

```
[25]: MultinomialNB(alpha=0.15)
```

```
[26]: # checking the accurracy with the model
      pred_count = nb_classifier.predict(count_test)
      acc_count = metrics.accuracy_score(y_test, pred_count)
      print(acc_count)
```

```
0.9415865384615385
```

Figure 4.4a

Using Naive Bayes ML model with TF-IDF Vectorizer

```
[27]: tfidf_vectorizer = TfidfVectorizer(stop_words='english', ngram_range=(1, 2))
      #Fit and transform the training data
      tfidf_train = tfidf_vectorizer.fit_transform(X_train)
      #Transform the test set
      tfidf_test = tfidf_vectorizer.transform(X_test)

[28]: # using MultinomialNB with the count vectorized data
      nb_classifier = MultinomialNB(alpha = 0.01)
      nb_classifier.fit(tfidf_train, y_train)

[28]: MultinomialNB(alpha=0.01)

[29]: pred_tfidf = nb_classifier.predict(tfidf_test)
      acc_tfidf = metrics.accuracy_score(y_test, pred_tfidf)
      print(acc_tfidf)

      0.9432692307692307
```

Figure 4.4b

User Interface

This is the point where human-computer interaction and communication in a device take place. This includes display screens, keyboards, a mouse and the appearance of a desktop. It is also the way through which a user interacts with an application or a website. In this work, users interacts with the system through the following interface below:

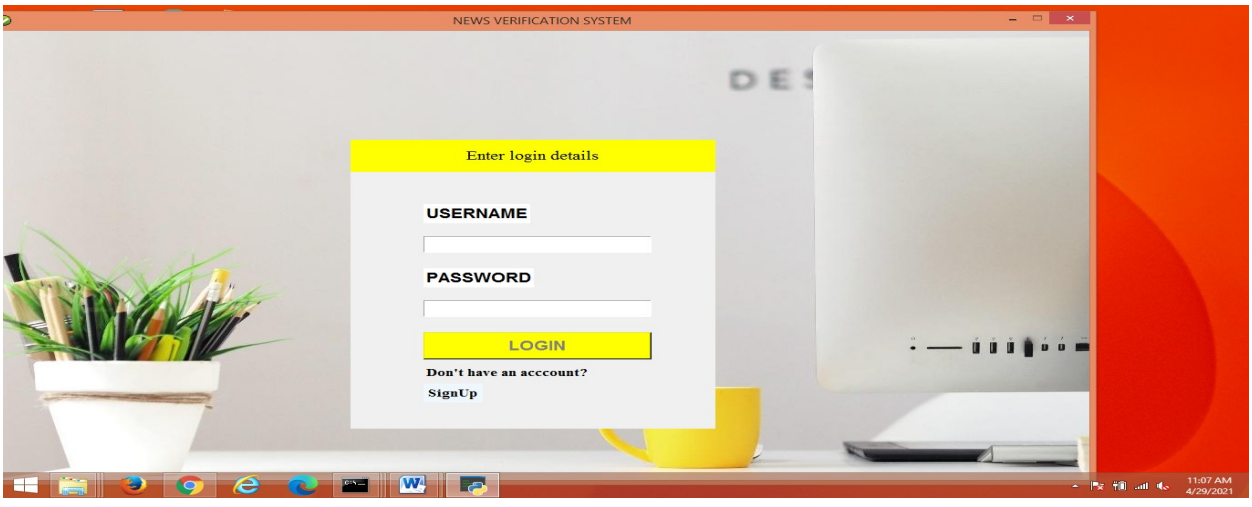

Figure 4.5a The Login form

This is an entry page that provides access to the verification system, identification and authentication is carried out by inputting the username and password combination if registration has been carried out already.

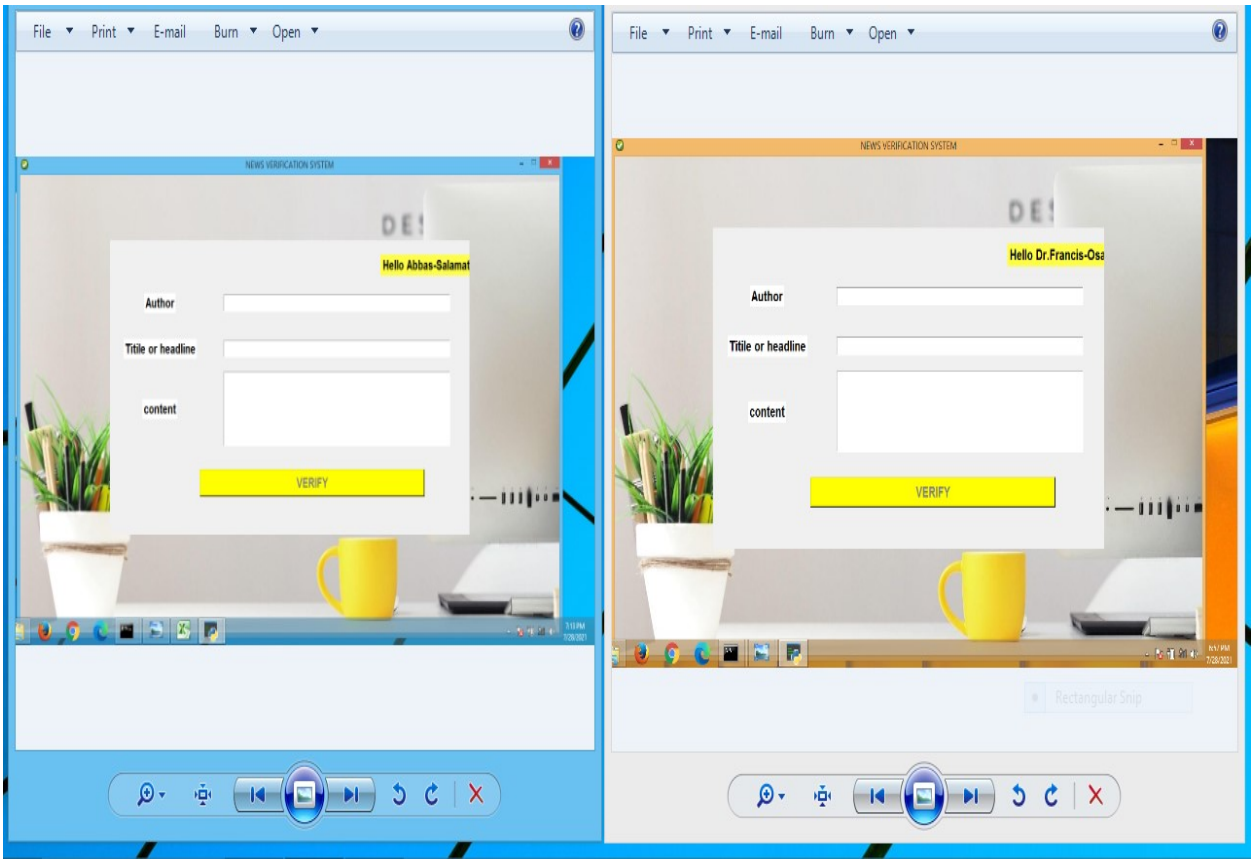

Figure 4.5b the news verification forms

The blank verification form; This form show details of the verification system, here, you can input the name of the author, title of the news you wish to verify and then the content, once all these have been inputed and verified , it displays the result as unreliable (fake) or reliable (real) news.

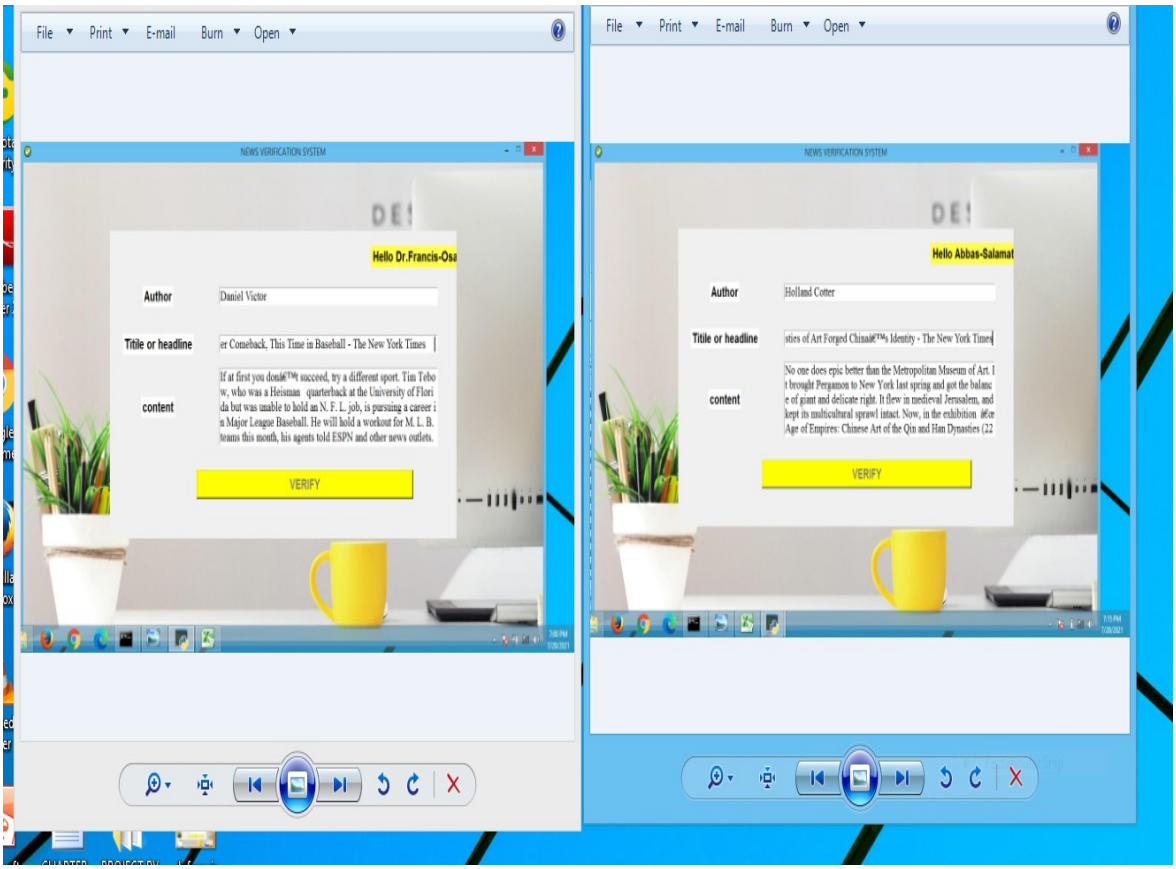

Fig 4.5c: New verification forms

This form shows detail of the verification system, with the name of the author, title of the news you wish to verify and then the content already inputed and waiting to be verified either as unreliable (fake) or reliable (real) news.

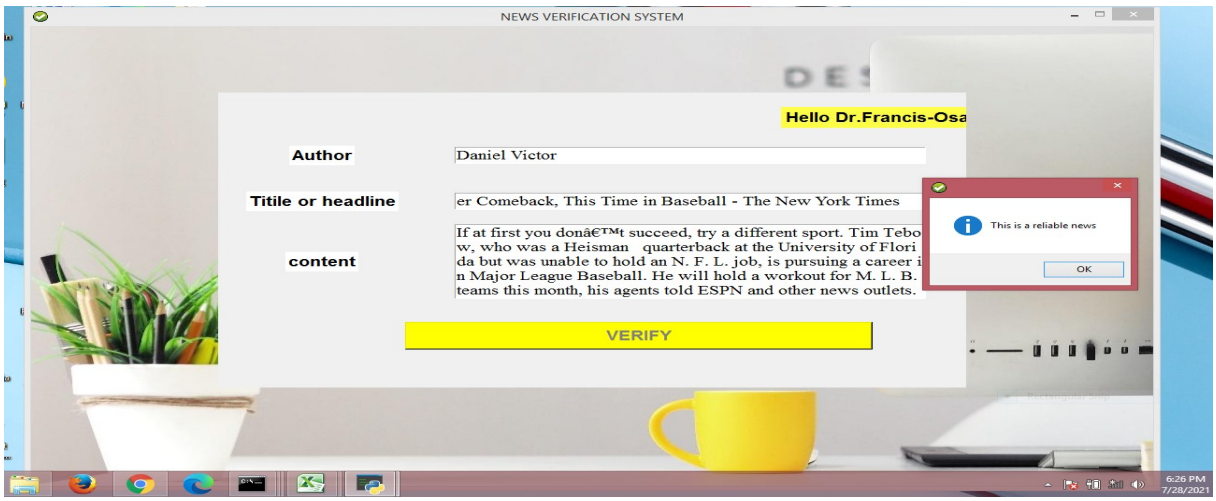

Fig 4.7 News verification form

This form shows detail of the verification system, with the name of the author, title of the news you wish to verify and then the content already inputted and verified as unreliable (fake) news.

5. CONCLUSION

In the paper, the news dataset was used to implement a Tfidf-Vectorizer and count vectorizer. Experimental results on real-world datasets demonstrate that the combination of multinomial naïve Bayes with the Tfidf-Vectorizer can detect fake news with greater than 94.33% accuracy, which is significantly faster when compared with the count vectorizer. Most importantly, the approach requires only 10% labelled fake news samples to achieve this effectiveness under NL Learning settings.

6. LIMITATIONS

Although online news datasets can be gathered from diverse sources, manually determining the authenticity of this news is a herculean task, as it often requires annotators with domain expertise who performs a careful analysis of claims and additional evidence, context, and reports from authoritative sources. Existing public datasets of fake news are rather limited due to these challenges. To facilitate the research for fake news detection, this survey provides a usable dataset, named FakeNewsNet**,** which includes news content and social context features with reliable ground truth fake news labels.

7. RECOMMENDATION

Further works should consider designing a system that detects fake news directly from any source/site on the internet rather than a fixed data set.

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