

Indonesia Analysis Sentiment on Non Fungible Token (NFT)

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Abstract— NFT or Non-Fungible Token is a unique token attached to a digital asset that is connected to the blockchain system. Various assets, such as digital art, music cover, memes, sold as NFT. NFT has been widely discussed on various social media, Youtube is one of them. NFT has become a new trend for the Indonesian people, based on the fact that someone who sells a selfie photos at the Open Sea platform is going viral because it is an unusual event about why do they produce it. But people actually accept the trend as a mistake, they intentionally upload their identity on the platform. This happened because there was little information related to NFT and the public did not really understand that NFT could be a bridge for criminals. But in this case, many people as artists have been greatly helped in the marketing of their art. And even when the stock market is down, NFT remains one of the digital assets that attracts the attention of the world community. Therefore, this study was made to analyze the public's response with sentiment analysis. Data obtained from Youtube content comments and then classified into positive, negative, and neutral classes with Term Frequency-Inverse Document Frequency (TF-IDF) for the process of word weighting and classification using the Naïve Bayes Classifier algorithm. The test is carried out by calculating accuracy, precision, recall and F1-score, using a variety of data training and data testing. And the overall accuracy results are 64%, for positive prediction class precision is 63%, neutral class precision is 83%, while for negative prediction is 0% and recall obtained from positive is 99%, neutral recall is 0.7% while negative is 0%. These results are the data obtained on Youtube comment.

Keywords: Non Fungible Token, Naïve Bayes Classifier, Open Sea, Youtube;

I. INTRODUCTION

The transaction of Non Fungible Token (NFT) currently being widely in return, caused by the virality of a person named Ghozali who can sell his selfies for millions of rupiah on the Open Sea platform. Due to this

virality, many Indonesian people are starting to be curious and want to know what NFTs really are and how to get money through NFT.[1] NFT is a digital content that is connected to the blockchain system. what is meant by digital content is photos, art, video, audio and others. NFT converts digital content into a digital asset that is assigned a special token number and verified through blockchain. NFT also has its own uniqueness, an NFT will not be the same as other NFTs, both in terms of its work or value.[2]

The difference between Fungible and Non-Fungible Assets are: Fungibility or fungible that means the equivalent is exactly the same as an asset or whatever can be exchanged for the same value. For example the currency value. if someone have 10,000 rupiah then it can be bought for an item that worth 10,000 rupiah. While Non-Fungible is an asset that has different values. For example, someone's autographed t-shirt from a favorite artist's concert, a polaroid album of someone's cherished memories, or a seat ticket someone bought to attend a sporting event. None of those items are interchangeable in the same way as there is an aspect of uniqueness in those items.[3]

At this time social media has become a very popular communication tool among internet users in Indonesia. Social media is a place to express and argue about various topics. YouTube is one of those things.[4]

Youtube is a platform that allows users to upload, watch, and share videos. Youtube also allows users to express their opinion on a video that can be commented, especially based on the comment string provided by Youtube. It can be used to analyze whether public opinion is positive or negative [5]. This process can be manually determined whether an opinion is positive or negative. But with the large number of public opinions, it takes more time and effort to classify the opinion. Therefore, the application of machine learning

techniques has been proposed to classify the various data of opinion. This research is expected to classify YouTube user comments on an NFT video by performing the Text Mining function to process the data classifying documents, as well as the application of the Naive Bayes Classifier (NBC) algorithm using probability calculations.

II. LITERATURE REVIEW

A. Non Fungible Token (NFT)

NFT (Token Non-Fungible) is a digital asset owned by an individual or group in which the Ethereum blockchain is used to record everything that occurs in it. NFT is one of the valuable or unique items with an unchangeable exchange rate. Artwork, game assets, photos, videos, music, etc are NFT products that can be sold. People can also convert document assets into NFTs. In terms of selling price, NFT is determined by subjective factors such as quality, creativity, and the artist's reputation. [6]

B. Python

Programming in the Python programming language is one of the high-level stages because Python is an interpretive and multipurpose language. Unlike other programming languages, Python is extremely simple to understand and learn. Python language prioritizes user understanding of code and syntax to make it easier to understand. As a result, Python is very simple to learn for both beginners and those who have mastered other programming languages. Guidovan Rossum, the creator of this language, first introduced it in 1991.[7]

C. Sentiment Analysis

Sentiment analysis refers to techniques for assessing and identifying positive and negative emotions and opinions [8]. Opinion mining is another term for sentiment analysis. This section is also known as "exploring the emotions behind user's words." Users are currently express themselves through online platforms such as social media, e-commerce, and websites. As a result, sentiment analysis on a social media platform is an option. One benefit of sentiment analysis is that it can save a significant amount of time and effort. Automatic sentiment analysis is also possible. A wide range of tools are outfitted with specialized algorithms for analyzing large amounts of data.[9]

D. Youtube Scraping

In Indonesia, 88% of the total population uses the YouTube social media platform. Social media features like providing information in the form of short videos and captions are supplemented by a variety of creations and innovations that can pique user interest and display video comments. Written expressions of user attitudes

and emotions. Many researchers use social media to collect data in the form of user comments on specific topics and to investigate the opinions of social media users. To obtain data for these comments, a method known as "Scraping" is required. Python, a programming language, can be used to perform this scraping method. To perform scraping methods, this programming language makes use of the Selenium and BeautifulSoup libraries and scanning data in comment format based on ID/name in HTML syntax.[10]

E. Preprocessing Data

This phase includes data selection and comment data cleaning. The following are the stages of the preprocessing process :

- **Cleaning:** Unwanted characters such as punctuation, periods, commas, question marks, exclamation points, HTML and URLs, hashtags and mentions, emojis, and irrelevant characters were removed.
- **Tokenization:** Separation of sentences into word by word, so that the analysis process can be easier.
- **Case Folding:** Equalizing words to lowercase in each prepared sentence or opinion in the data.
- **Stopwords Removal:** Deleting or eliminating words that are not important or clear. As a result, because fewer processes are passed, this classification stage can be considered more efficient.
- **Stemming:** Changing affixes into initial or basic words.

F. Lexicon Based

Lexicon Based in this study serves to classify an opinion [11]. One of the benefits of applying the Lexicon method is the documents are converted into word dictionaries in sentences, which are then compared spontaneously with opinion dictionaries created using the lexicon method. If the sentence in the prepared data is an opinion, it will be assigned the same value.

G. TF IDF

TF-IDF (Term Frequency-Inverse Document Frequency) weighting is a step-by-step method of converting text data that transforms data from textual data into numeric data for weighting of each word or feature. TF-IDF is a statistical measurement whose function is used as an assessment of how important words are in a document. TF counts how often a word appears in each sentence in the given data and shows the importance of that word in each document. DF counts documents containing words showing how often they occur. However, IDF is the opposite of DF calculation. The calculation of word weighting using TF-IDF is the result of multiplying TF with IDF. The

weight or value of a word will be high if it always appears in the document.[12]

H. Naïve Bayes Classifier

Naïve Bayes classifier is one way of classification with Bayes' theorem. This classification uses a probabilistic and statistical method originally proposed by the British scientist Thomas Bayes. This method can also be called the Bayes theorem because it is a method of predicting future possibilities based on past experience. The basic function of Naïve Bayes Classifier is to assume a very strong independence from all conditions and events. Olson and Delen explain in their book that Naïve Bayes calculates the probabilities of each class of decisions. However, only if the decision class is true. This algorithm is based on the assumption that object attributes are independent. The probabilities included in the final estimate are calculated as the sum of the frequencies from the "master" decision table. The Naïve Bayes Classifier is more accurate than other classifier models. Journal of Naïve Bayes by Xhemali, Hinde, and Stone. "Decision Trees and Neural Networks in Training Web Page Classification" states that "the Naïve Bayes Classifier is more accurate than other classifier models".[13]

I. Confusion matrix

The classification procedure must, of course, provide an explanation as to whether or not a work process is efficient in the classification of this data. There are several methods of calculating the performance evaluation of the classification algorithm that can be used, one of which is the confusion matrix method. The results of the calculations contained in the application of the confusion matrix is the comparison of the classification results carried out by the prediction classification process with the actual classification results.

The confusion matrix which is the final result of this research calculation applies performance metrics which include Precision, Recall, F1-Score and Accuracy [14][15].

III. METHODOLOGY

The research method has guidelines in the form of research procedures or steps to align the expected results with the original purpose. In general, the flow of this research starts from determining the research topic to be raised and conducting a literature study on related research. The topic of Sentiment Analysis of NFT for the Indonesian population was raised because this issue was considered still hot and worthy of discussion given the many irregularities committed by the community. After the data source for the need for analysis is

obtained, the next step is to preprocess the data to clean up incomplete data. After that the results obtained will be tested for correctness using the measurement confusion matrix. Figure 1 shows the flow of this research.

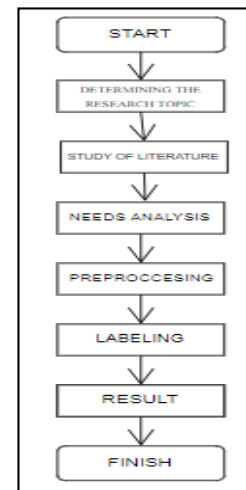


Figure 1. Research Flow

It can be seen that the design flow in the research uses a research methodology that has an appropriate and structured process design.

A. Data Collection

Data collection process uses the Scraping method where the data set comes from Youtube social media comments regarding "Non Fungible Tokens". Figure 2 shown description of the scraping process.

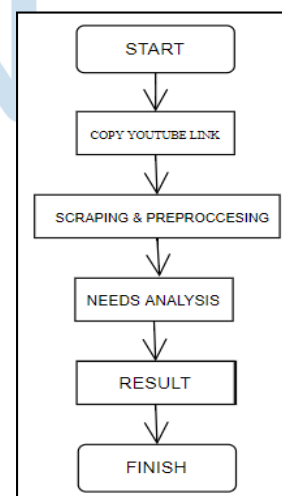


Figure 2. Data Collection Process

Data was scraped from Youtube website based on user comments using the selenium web driver library dictionary with the Non-Fungible Token (NFT)

keyword applied in Python and saved in.csv/xls format. The obtained data will continue the preprocessing phase.

B. Preprocessing

Figure 3 describes the pre-processing phase, which is a continuation of the data scraping phase. Data are cleansed, tokenized, case-folded, and stopwords are removed such that a new dataset containing only clean data is produced.

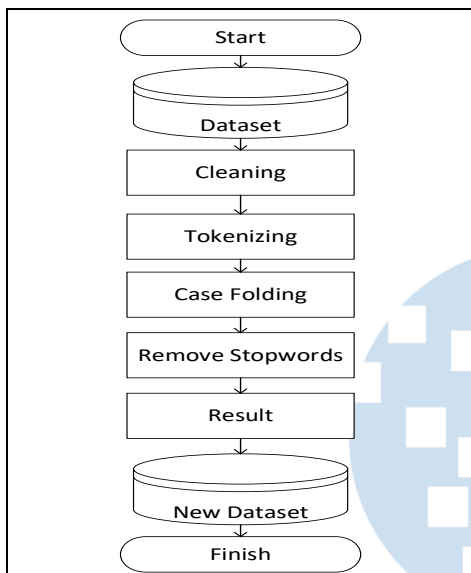


Figure 3. Scarping Process and Data Preprocessing

A new clean dataset is then obtained. This data will be used as the main data for sentiment analysis process. The data is obtained from YouTube video comments that contain NFT content and related variables. The data is then saved in .csv/.xlsx format so that it can be identified by Python.

C. Translate

Furthermore, the process of words translating on the clean data from Indonesian into English. This is done because in the python programming language there is only a vader sentiment library to bring up sentiment variables. This also called sentiment labeling. Example of Translated Youtube comment data results shown by table 1:

TABLE I. RESULTS TRANSLATE

Comment (before and after translating)
<i>Saya melihat Teknologi NFT ini untuk melindungi para pekerja seni yg sering mengalami</i>

pembajakan. Sehingga bisa menjaga originalitas sebuah karya di dunia digital.

I see this NFT technology to protect art workers who often experience piracy. So that it can maintain the originality of a work in the digital world.

D. Data labeling

The data is converted into English by carrying out the previous process, then the steps in labeling this data Youtube comment data must generate a polarity score from the results of this labeling calculation using a lexical dictionary. After calculating the polarity value, the sentiment variable analysis will appear positive, negative or neutral. The calculation raises the lexical sentiment.

$$\text{Sentence sentiment} \begin{cases} \text{positif if } S_{\text{positif}} > S_{\text{negatif}} \\ \text{netral if } S_{\text{positif}} = S_{\text{negatif}} \\ \text{negatif if } S_{\text{positif}} < S_{\text{negatif}} \end{cases} \quad (1)$$

E. Naïve Bayes Classifier

Naïve Bayes Classification is also included in an algorithm that is easy to use and simple and can predict an event based on the results of a good classification [16]. Naïve Bayes classification is also included in an algorithm that is easy to use and simple and can predict an event based on the results of a good classification.

F. Visualization

The next process is visualizing the data using the Matplotlib and Wordcloud libraries. The wordcloud visualization shows the words that often appear in the sentiment data. The output is a visualization in the form of a histogram that shows the results of the percentage accuracy of the polarity generated by each sentiment generated [17][18].

G. Confusion Matrix

In a data classification process, the use of methods must have an overview of the performance of each method. The confusion matrix method was chosen in this study. Because the Confusion Matrix method can calculate the accuracy and then compare it with the results of the classification of the actual procedure carried out with the classification results from the method. In this study, manual labeling is carried out so that the actual data classification can be seen from the polarity value. Visual or reference calculations from the confusion matrix method are Precision, Recall, F1-Score, and Accuracy.

- Precision model calculation results to determine the accuracy of estimates per value from the data compared to the model causation results. The formula for precision:

$$precision = \frac{TP}{TP + FP} \quad (2)$$

- Recall is the results of model calculations related to the visualization of the suitability of re-finding classification information. The recall formula is:

$$recall = \frac{TP}{TP + FN} \quad (3)$$

- Accuracy is the result of data calculation that show how much accuracy is generated from this classification model. The formula is:

$$accuracy = \frac{TP+TN}{TP+TN+FP+FN} \quad (4)$$

IV. RESULTS AND DISCUSSION

The explanation in this section is the results and discussion, starting with the Scraping, preprocessing, sentiment labeling, visual data, word weighting and the classification process using the Naive Bayes Classification algorithm, using the Python language.

A. Data Collection

Youtube Comments data collection with Selenium Web Driver is manually using the inspect element by taking the comments class on the youtube web browser. It can be seen in figure 4 :

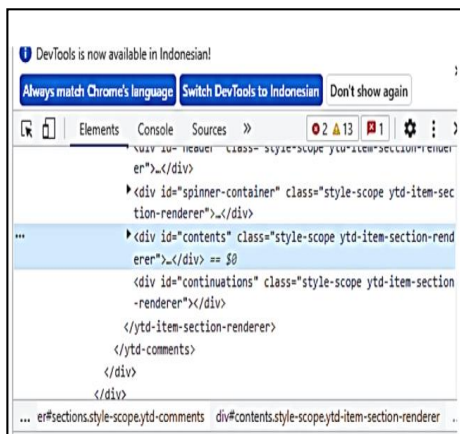


Figure 4. The process of taking youtube classes

Next, go through the youtube class properties to retrieve the data from the inspect element and paste it to the python coding section. The process of taking this youtube comment data must go through the stage of taking the comment class on the youtube website by using inspect element features on the web browser. This will make the comment data class (dataset) that just scraped is more relevant and just right.

The data retrieval uses several youtube links which produce 1188 data with the title of video content containing the word "Non Fungible Token NFT". After the scraping stage is executed, the data does not appear immediately because it has to go through the preprocessing stage. A visual representation of the scraping process, and preprocessing data retrieval with the selenium web driver as shown by figure 5:

```

C:\Windows\System32\cmd.exe - python yt_comments.py
Microsoft Windows [Version 10.0.19044.1766]
(c) Microsoft Corporation. All rights reserved.

D:\yt.comen\yt_comments_selenium>python yt_comments.py
[nltk_data] Downloading package punkt to C:\Users\Dinda Tasya
[nltk_data]   M\AppData\Roaming\nltk_data...
[nltk_data]   Package punkt is already up-to-date!

[WDMM] - ***** WebDriver manager *****
  
```

Figure 5. Run Scraping and Preprocessing



Figure 6. Scraping data in the web browser

The process in Figure 6 shows the process of taking comment data for further entry into the preprocessing stage. This data is unclean data that needs to be cleaned before entering the sentiment analysis stage. Data needs to be cleaned to get optimal results.

The data generated from scraping is text captured exactly as it appears in a YouTube comment. Hence, there is still noise or unnecessary information in the data. In this study, the generated data required preprocessing in order to be more organized.

Non-standard terms, such as slang, links, emoji, numerals, and punctuation marks, were the most commonly removed characters following the preprocessing phase. After removing these characters, the data are compiled into a new dataset with additional supporting attributes.

id	text_before	text_after	username	created_at
1	Pak Indrawan Nugraha mahaguru yang selalu kan	indrawan nugraha mahaguru tonton konten maju edukasi indonesia indra	unknown	2022-06-12 00:00:00
2	Nice discussion about NFT trending. Saya usul ba	nice discussion about nft trending usul bang deddy invite salah pakar cryp	Adif Laksa	2022-06-12 00:00:00
3	Saya melihat Tekhnologi NFT ini untuk melindun	tekhnologi nft lindung kerja seni alami baja jaga originalitas karya dunia d	Ahsin Arif	2022-06-12 00:00:00
4	Intinya nft ada untuk mendigitalisasi hak kekaya	inti nft digitalisasi hak kaya intelektual nft digital seni fisik hak karya mud	Panggil sa	2022-06-12 00:00:00
5	mas dedi sebenarnya tau jawaban dr pertanyaan	dedi sebenarnya tanya krna phd bidang pscology problem topik bicara d	Ibnus Shir	2022-06-12 00:00:00
6	Om Ded, mohon izin saya kasih masukan. Sebelu	om ded mohon izin kasih masuk video doktor indrawan metaverse keren	Nico	2022-06-12 00:00:00
7	Kalo meneurutku om Ded sama Pak Indra memar	meneurutku om ded indra awam nft karya seni digital unik digital contrac	Ninoy Gra	2022-06-12 00:00:00
8	Konsep saat ini banyak NFT yang dapat digunakar	konsep nft konsep game play to earn metaverse nft ubah character gerak	Hana Veri	2022-06-12 00:00:00
9	Ada satu quotes yang saya ingat bener di dunia n	quotes bener dunia marketing barang beli logika nilai rendah barang beli	Ihfal Ram	2022-06-12 00:00:00
10	Master Dedi & Maha Guru Indra duet yang top ba	master dedi maha guru indra duet top banget buka paradigma konten kua	Yutra 888	2022-06-12 00:00:00
11	Banyak mungkin yang belum tahu kalau terkadan	terkadang nft utility balik harga project kasih akses holdernya community	Pradana D	2022-06-12 00:00:00
12	Pak Indrawan Nugroho, selalu dari sudut pandan	indrawan nugroho sudut pandang cerdas bahas detail asai tarik angkat	Nuri Henc	2022-06-12 00:00:00
13	Pak Indrawan dan bro Deddy terima kasih buat si	indrawan deddy terima kasih sharingnya pikir sederhana bantu inovasi te	novianta	2022-06-12 00:00:00
14	Baru sedikit paham soal NFT, mendengarkan disk	paham nft dengar diskusi coba paham sudut pandang gambar gerak harga	Ilyazagus	2022-06-12 00:00:00
15	Semua sudah berubah mengikuti kemajuan jama	ubah ikut maju jaman bicara digital sisi kode pemrograman kreatifitas sisi	Agung Eka	2022-06-12 00:00:00
16	Setiap orang percaya apa yang mau dia percaya, r	orang percaya percaya nilai barang gantung perspektif nikmat alami harga	Anti Idiot	2022-06-12 00:00:00
17	Terimakasih sudah memberikan gambaran dan m	terimakasih gambar motivasi om dedy indra sehat serta keluarga amin ra	R waluya	2022-06-12 00:00:00
18	Saya rasa value dari NFT yang dibahas sekarang a	value nft bahas podcast bahas forum milik nft bangga kenal gila	Abdul Har	2022-06-12 00:00:00
19	I think the key is a Value . Like Pak Indrawan said	think the key is value like indrawan said at his content on rise above the c	Caesarzkr	2022-06-12 00:00:00
20	8:12 thank you mas indra karena menghemat 20 r	thank you indra hemat merit it takes humility to really admit own limitat	adrian ba	2022-06-12 00:00:00
21	penjelasan nilai NFT nya mungkin begini, untuk s	jelaz nilai nft karya nft susah logic compare karya fisik monalisa karya pica	Rochale	2022-06-12 00:00:00
22	Best conversation om ded:"Nasib kita dibatasi ol	best conversation om ded nasib batas pikir pikir plafon tinggi capai hidup	Irny Karer	2022-06-12 00:00:00
23	Sukses selalu untuk #CLOSETHEDOORuntuk Om D	sukses om dedi indra moga senantiasa sehat edukasi pribadi bangsa indor	Bang AW	2022-06-12 00:00:00
24	Mengenal NFT atau Karya seni digital. Memang si	kenal nft karya seni digital susah pikir nalar coba ambil sisi positif bantu k	FATTL Bor	2022-06-12 00:00:00

Figure 7. Scraping and preprocessing results

In Figure 7 shows the data results that have gone through the scraping and preproccking stages. So that a data that collected will be made a data table in order to facilitate the next stage of the process. The data frame contains five attributes, that is:

- *Id*: the id attribute contains the serial number of the data starting from 1-finish so that the data is easier to know how many there are
- *Text_before*: This attribute contains text or YouTube comments from scraping before preprocessing
- *Text_after*: this attribute contains text or youtube comments after preprocessing
- *Username*: username is the name created by the user on the comment maker's account on the youtube.
- *Created_at* : this attribute contains the time of scraping data

B. Labeling

This labeling stage uses a dictionary to reference the core or main language. Determining the origin of this study, to classify opinions and polarity scores using the Vader Sentiment dictionary. The way to calculate sentiment is by calculating the formula for polarity score < 0 for negative classification, polarity score $= 0$ for neutral classification, and polarity score > 0 for positive classification. Table II shows the example of the result in sentiment classification using the lexicon based method.

TABLE II. VADER SENTIMENT LABELING

Comment (before and after translating)	Score Polarity	Sentiment
<i>saya lihat tekhnologi nft ini untuk lindungi para pekerja seni yg sering mengalami bajakan hingga bisa jaga originalitas buah karya di dunia digital.</i>	0,8176	Positive
nft technology protect steel natural artworks keep the originality of digital world works	0,8176	Positive

The results of the data after being given a level with the library vader sentiment. The results of the data table appear containing youtube comments, Score polarity, and Sentiment. After all the data are labeled, then we will issue the positive and negative label data results with a bar plot as shown in the Figure 8:

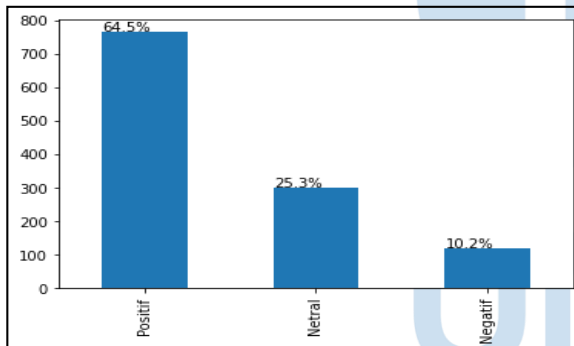


Figure 8. Sentiment classification percentage

From the total dataset that has been labeled, it can be seen in Figure 8, from 100% of the data that has been labeled the results are 64.5% positive, 25.3% Neutral, and 10.2 Negative

C. Word Cloud Visualization

The results of the data above are then searched for what words that often appear using the word cloud. Figure 9 shows uses the python programming language and the matplotlib library.

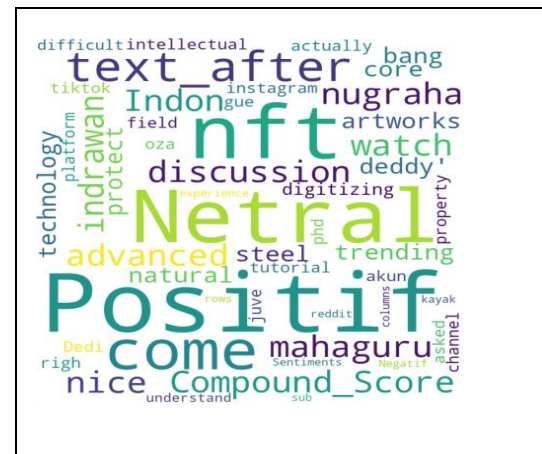


Figure 9. Word Cloud Results

D. TF IDF

After the data has gone through the preprocessing stage, then there are 2 stages of this process, namely TF (Term Frequency) and IDF (Inverse Document Frequency). The number of words that exist in a document, and the more words that appear in each document, the higher the TF value. While the IDF is inversely proportional where if the words that appear not often or few in the document then the IDF value will be more than the words that often appear.[17] Figure 10 is an example of a TF-IDF script:

```

1 # proses TF-IDF dan
2 from sklearn.feature_extraction.text import CountVectorizer
3 from sklearn.feature_extraction.text import TfidfVectorizer
4
5 tf = TfidfVectorizer()
6 text_tf = tf.fit_transform(data['comment'].astype('U'))
7 text_tf

```

<1186x3324 sparse matrix of type '<class 'numpy.float64''>
with 15060 stored elements in Compressed Sparse Row format>

Figure 10. TF IDF process script

E. Data Splitting

In this data split stage, it means that the distribution of varied data according to the needs in the classification results later because this data split is very influential on the classification results in this study. The data is divided into 2 parts in the form of test data as well as training. sample data splitting script with 20% test data shown by figure 11.

```
# splitting data
from sklearn.model_selection import train_test_split

x_train, x_test, y_train, y_test = train_test_split(
    (text_tf, data['Value']), test_size=0.2, random_state=0)
```

Figure 11. Script for data split process

F. Naïve Bayes Classifier

After going through all the pre-processing and data splitting stages, the next stage of classification will be carried out using the Naive Bayes algorithm. Figure 12 shown the stage of classification using Naive Bayes Classifier.

```
# naïve bayes
from sklearn.naive_bayes import MultinomialNB
from sklearn.metrics import accuracy_score,
precision_score, recall_score, f1_score
from sklearn.metrics import classification_report
from sklearn.metrics import confusion_matrix

clf = MultinomialNB().fit(x_train, y_train)
predicted = clf.predict(x_test)
```

Figure 12. Naive Bayes Classifier Script

G. Classification results

At this stage the YouTube comment data has been calculated for its classification by the Naïve Bayes Classification algorithm using python programming. The results of the classification report is :

	precision	recall	f1-score	support
Negatif	0.00	0.00	0.00	18
Netral	0.83	0.07	0.13	72
Positif	0.63	0.99	0.77	148
accuracy			0.64	238
macro avg	0.49	0.35	0.30	238
weighted avg	0.65	0.64	0.52	238

Figure 13. Result of classification report

Figure 13 shows the results of sentiment analysis testing with Nave Bayes on YouTube social media concerning Non-Fungible Tokens with an accuracy value of 64%. Precision of positive prediction class 63%, precision of neutral prediction class 83%, and negative predictions class of 0%. Positive recall was acquired by 99%, neutral recall by 0.7%, and negative recall by 0%. These are the results derived from YouTube comments. The confusion matrix produced the following results:

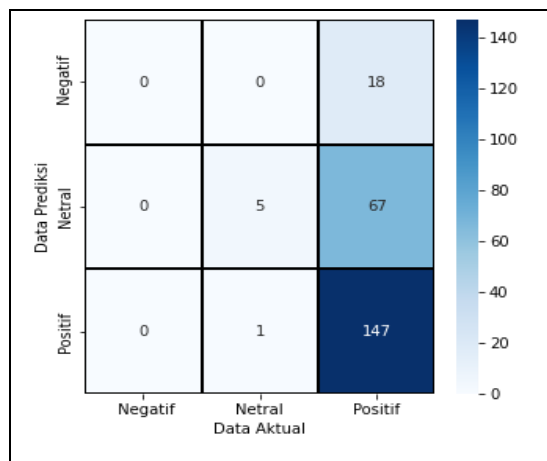


Figure 14. Confusion Matrix Results

V. CONCLUSION

Due to the success of a young man named Ghazali selling his selfie photo for billions of rupiah, the results indicate that a large number of Indonesians responded positively to the viral NFT event in Indonesia. This study analyzes public sentiment about Non-Fungible Tokens from YouTube comment using the Naive Bayes Classifier algorithm which achieves an accuracy of 64%. Precision of positive prediction class 63%, precision of neutral prediction class 83%, and negative predictions class of 0%. Positive recall was acquired by 99%, neutral recall by 0.7%, and negative recall by 0%. The results of sentiment analysis data with the Naïve Bayes algorithm are also assisted by TF-IDF in processing word weighting in text analysis

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