**Understanding Non-Fungible Tokens Through Social Media Discussion**

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# Abstract

Non-fungible tokens (NFTs) are a peer-to-peer type of blockchain technology which is a unique digital asset transferred completely over the internet (Sarmah, 2018). NFT’s have become an integral component of many financial and art communities in recent years, boasting millions of consumers (Regner, 2019). Along with the non-fungible token technology, social media has become a crucial aspect of communication in society, with many consumers of the NFT industry communicating and expressing opinions of the industry on different social media platforms. Considering the rise in popularity of NFTs in recent years, this study aims to gain a deeper understanding of the non-fungible token community and industry through an in-depth analysis through social media discussion. Based on 6.64 million Tweets collected in this study, it can be concluded that there is a significant number of tweets that had a greater positive sentiment, compared to a negative sentiment, with the overall positive sentiment being about 40% greater than the negative sentiment. Along with identifying sentiment, we were also able to target three common emerging topics using topic modelling: Giveaways, Token Creation, and Community Interaction. Through all this analysis, it was discovered that the NFT community on twitter had an abundant number of bot accounts.

# Introduction

Non-fungible tokens (NFT’s) are an emerging element of blockchain and cryptocurrency technology that was founded in the latter part of the 21st century. Introduced to the market in 2009, Bitcoin initially was a pioneer in the blockchain industry, igniting a revolution of blockchain use via cryptocurrencies (Sarmah, 2018; Farell, 2015). Cryptocurrencies are an ever-changing popular digital asset today which are widely known throughout popular culture, discussed by both participants and non-participants within the cryptocurrency industry, and traded due to the large amount of monetary value which is exchanged in these blockchain transactions (Abraham et al, 2018).

As discussed by Draskovic et al. (2018), blockchain technology using cryptocurrency is creating a new way for people to make a living and is tremendously changing the way the world works, impacting not only the financial industry, but many other as well. According to Puneet (2017), large market cap companies such as Subway, Microsoft and Dell are early adapters of the technology, accepting cryptocurrencies such as Bitcoin as a form of payment. Everyday people who have access to the internet can download a trading platform and trade cryptocurrencies which can cost tens of thousands of dollars for a singular asset (such as 1 bitcoin). People today are leaving their day jobs and careers to try and profit from the cryptocurrency industry by buying and selling these digital assets such as a day trader of stocks would do (Draskovic, 2018; Knezevic, 2018; Puneet, 2017).

NFT’s are a new form of using cryptocurrencies in a unique way. Unlike cryptocurrency, which is just a digital asset in the form of one “coin”, NFT’s allow for a one-of-a-kind form of cryptocurrency which are a purely distinguishable form of a cryptocurrency. According to Wang (2021), although NFT’s most popular and known form are in pictures/gifs, they also come in more forms such as memes, music, video game items, trading cards’/collectibles. Compared to singular cryptocurrency coins, such as a Bitcoin, which sells for around $50,000, a singular NFT can be sold for anywhere up to a couple million dollars (Wang, 2021).

Due to the abundant amount of wealth surrounding NFTs, a deeper understanding of this industry is very important. Truly understanding this industry will allow for greater opportunities for individuals to gain financial security and increase the sources of income available to consumers. Along with financial gain, both cryptocurrencies and NFTs are disruptive technology, changing the way society and the world works. Limba et al. (2019) states that cryptocurrency and NFTs are becoming more and more involved in everyday actions today with millions of users, thousands of ATMs around the world and many companies’ transactions (Limba, 2019). Understanding them to their fullest will enable greater decision making and knowledge of how the world is changing and how the world will change in the future.

The widespread use of these technologies is very common, yet very confusing to many people, especially older generations, particularly because of the digital only format. It is difficult to understand the customers in the market and to see how the industry of NFTs truly works. Using previously completed studies, this study provides more extensive research into NFTs to gain a deeper understanding of the industry through ideas, opinions, and characteristics of users and their discussions relating to NFT’s via Twitter. To understand the research topic, we must first understand in depth: what blockchain is, how does blockchain work, the overview and popularity of Twitter, the cryptocurrency industry, and the overview of the NFT market.

# Literature Review

## Overview of Blockchain

Blockchain is the founding building block of both cryptocurrency and NFT’s (Ante, 2021). To gain deeper insight into the NFT market, an understanding of how the technology works is vital to fully comprehending the industry. As Sarmah et al. (2018) states, blockchain technology is not owned by any company, government, or organization. The architecture of blockchain is distributed, meaning that it does not have a central point over the internet. Instead, there are several nodes and connections which are the foundation of the cryptocurrencies which are all using blockchain technology. It is impossible for one user to gain full control over the database due to the distributed nature. Every user is connected to each other in some way through the extensive nodes and networks being used to record and perform the transactions taking place between peers (Sarmah, 2018).

Just like the internet, blockchain is maintained by a network of computers and users (Sarmah, 2018; Dattani & Seth, n.d.; Limba, 2019; Farell, 2015). In the process which creates a “blockchain”, a user will perform a transaction within the network, complex computer algorithms then validate the authenticity of the transaction. A chain is then created by linking this transaction with former transactions. The chain of transactions created is then called a blockchain (Sarmah, 2018). A block is a list of transactions which is the data being sent from peer-to-peer through the chain. Blockchain is ultimately a chain of transactions which performed, authenticated, and linked through peers on the network with each transaction being linked with the previous transaction. As discussed by Sarmah et al. (2018), Bitcoin is a leader and pioneer in the cryptocurrency community by implementing blockchain technology to create its bitcoins. Blockchain simply is the platform that allows the mining, storage, and trading via the distributed network (Sarmah, 2018; Devries, 2016; Tapscott, 2017).

## Functionality of Blockchain

Blockchain works in a very secure and quick way between two users connected through the distributed network (Dattani & Seth, n.d.). As mentioned by Sarmah (2018), the best way to describe how it works is with an example. When utilizing blockchain for trading cryptocurrencies, such as bitcoins, one person wants to send 1 bitcoin to another person. The transaction, 1 bitcoin, is then sent online as a block. Every part of the distributed network then is broadcasted the block. Then by using algorithms and programming to authenticate whether the transaction is real, those in the network approve or deny the transaction of the 1 bitcoin. After approved, the block is then added to the chain of previous transaction record, therefore moving the singular bitcoin from the first person to the second (Sarmah, 2018; Dattani & Seth, n.d.).

## Overview and Impact of Twitter

Social media and the ever-expanding telecommunication between people have resulted in tremendous financial growth across various industries (Vilas, 2020). According to Abraham et al. (2018), since launching in 2006, Twitter is one of the largest social media platforms used today with 1.3 billion accounts by 2018. Twitter also experienced an average of 330 million monthly active accounts, and an average of 500 million tweets sent out each day. That means that 1 out of 15 people on Earth sent a tweet on a given day. Along with everyday people, companies, brokers, financial agents, investors, television stars and professional athletes, approximately 83% of the world’s leaders have Twitter accounts (Abraham, 2018; Vilas, 2020). This means that influential people, such as CEO’s or presidents, are exposed to tweets from all over the world. The influence that anybody, especially celebrities, has on decision making has greatly increased due to this increase in communication of information through social media.

As discussed by Knezevic (2018), the pattern of people staying home and using the internet to make a living also influences how people communicate with each other to spread their word-of-mouth ideas. This effect results in the increase of users on social media websites such as Discord, Twitter, Instagram, Facebook, and so on since the beginning of blockchain. Twitter is one of the biggest social media applications used today (Tandon, 2021), with certain celebrities and users having tens of millions of followers. As discussed by Wu (2015), the words and attitudes of these popular accounts are then heard throughout the globe of many Twitter users by the retweets and likes used between the connections of followers from user to user, all linking back to the singular tweet (Wu, 2015). Tweets of celebrities such as Kanye West, Elon Musk and LeBron James can be seen being presented on numerous new stations and media channels.

As discussed by Ante (2022), CEO and billionaire, Elon Musk, uses his 132 million Twitter following to communicate many different opinions on specific technology topics such as cryptocurrency. In 2021, Musk changed his Twitter account bio to “#bitcoin”, which resulted in a $6,000 increase of a bitcoin, from $32,000 to $38,000. This single change in his bio ultimately increased the market capitalization of Bitcoin by about $111 billion (Ante, 2022). Many people around the world saw this change and it greatly affected their decision-making process, and their own opinions on cryptocurrency, ultimately resulting in the price increase. There was not any intrinsic value change or change in Bitcoin itself which caused this change in price.

As previously discussed by Sarmah (2018), Bitcoin using blockchain technology was first introduced in 2009, but had been studied and conceptualized in 2008 (Sarmah, 2018). With the launch of Twitter in 2006, it is interesting to consider how the creation of Twitter influenced the launch of Bitcoin. Twitter could have both positively or negatively influenced the spread of information about Bitcoin to affect the consumer decision-making process or could have as well affected how timely Bitcoin concepts and ideas spread and grew cryptocurrency. This relation between the two disruptive technologies resulted in an economic change.

## Functionality of Cryptocurrency

Cryptocurrencies are essentially electronic cash that uses blockchain technology to perform transactions (Farell, 2015; Abraham, 2018). As discussed by Farell (2015), the founder of Bitcoin, Nakamoto wanted to put the trust into cryptographic proof in the form of algorithms with the network of users having the main control. Therefore, there is no true intrinsic value of cryptocurrencies, with both the market and individual coins being a valuation of supply and demand. Along with the network of users having more control, due to the nature of validating transactions through the network, each user has the ability to know where each coin currently resides. This essentially means that each peer on the network has access to view the cryptocurrencies which every other peer on the network owns (Farell, 2015; Limba 2019).

According to Farrell (2015), the process that the network goes through to verify and authenticate each transaction of coins is the process of mining the specific cryptocurrency. The user who solves the complex computer algorithms to perform this process is called the “miner”. Due to the large amount of time and electricity it takes for the miner to verify the transactions, various protocols, such as that of Bitcoin protocol, offer rewards to the miners in the form of transaction fees and newly minted coins. This is how new coins are introduced to the market. However, there is a maximum number of bitcoins which can be mined. The maximum number of bitcoins is 21 million in existence. As time passes and miners continue mining, the process and reward of newly minted coins being gifted to miners will continue to decrease, due to the energy being needed to solve the complex algorithms increasing over time (Farell, 2015). From the previously stated studies, it can be understood that any analysis done on any cryptocurrency becomes outdated due to the size of the cryptocurrency market expanding until the limit is reached. The data is ever changing and requires new work to be done on it to allow for the consumers to receive accurate and current information.

## Popularity of Cryptocurrency

As discussed previously, the cryptocurrency industry is very large in both value and range across the world. Almost any individual with internet access and time can be a part of the cryptocurrency industry, along with large companies and organizations. According to CoinMarketCap, the current market capitalization of the cryptocurrency industry is $1.9 trillion with 17,957 coins in circulation. As discussed by Abraham et al. (2018), Bitcoin and Ethereum are the two leading coins accounting for 43.1% and 18.2% market cap respectively. Just under three years ago in May 2018, the market capitalization was just at $160.9 billion dollars (Abraham, 2018). This means that in the short amount of time described, the market capitalization has grown about 1080% to 1.9 trillion. For this reason, any current research regarding any studies relating to cryptocurrencies is pivotable for an accurate understanding of the very large industry.

## Overview of NFTs and the Industry

As discussed by Wang (2021), unlike other cryptocurrencies such as Bitcoin or Ethereum, NFTs are not all equivalent and they are all distinguishable. Each bitcoins feature is exactly the same in which each is a standard blockchain coin (Wang, 2021). NFTs differ in their features by being in different forms of art, music, trading cards and other digital assets. As mentioned previously, the basis of NFTs is both blockchain and cryptocurrency technology (Sarmah, 2018; Wang, 2021). Using platforms to perform NFT transactions, Ethereum is the basis of how to buy and sell most NFTs. The valuation of NFTs, like cryptocurrencies, is based on supply and demand. Due to the nature of how NFTs are all unique and in a form of art, a singular picture or GIF has sold for millions of dollars (hundreds to thousands of Ethereum). Ethereum was one of the beginning pioneers in NFTs, but now there are more blockchains creating their own NFTs. According to Wang et al. (2021), the average NFT market 24-hour trading volume is $4,592,146,914, and the average overall cryptocurrency market volume is $341,017,001,809. NFT average volume only accounting for about 1.3% of the overall crypto market seems very low, but it due to its relatively new introduction to the market, its average 24-hour trading volume is very high.

NFTs are continuing to become more popular and have more users creating projects daily (Wang, 2021). In fact, the industry is nowhere near its full potential. Many celebrities and companies are joining the NFT industry by using their large capital and follower outreach to promote their own NFTs. Companies and celebrities such as the NBA, Twitter CEO Jack Dorsey, and popular digital artist Beeple have all created their own NFTs which all have sold for millions of dollars, including Dorseys’ NFT which was an image of his first ever tweet he wrote (Kapoor et al., 2022; Ante, 2021). A tweet is simply a box of text with no intrinsic art value such as a picture/painting, collectible, or music piece. It can be concluded that the high value of the NFT created by Dorsey was valued based on the popularity that both him and his company has with consumers of the NFT market. This is an example of why understanding the thoughts of people in this market is so important. This research itself may give deeper insight into how the NFT market feels about Twitter and the impact it has on the NFT industry.

NFTs are sold in collections in which all the NFTs in the set share common characteristics. According to Nadini et al. (2021), most collections can be put into six different categories: Art, Collectible, Video Games, Metaverse, Other and Utility. Unsurprisingly, the most popular category is art, which can be seen in everyday life throughout social media being discussed and mentioned by celebrities (Nadini, 2021; Fowler, 2021; Regner, 2019). A recent study by Kapoor et al. (2022) discusses data surrounding NFT’s in the art, video, and GIF categories, which were gathered using an Application Programming Interface (API). This study used an API to extract data on the NFT marketplace, “OpenSeas.io”, and tweets referring to the trading marketplace (Kapoor et al., 2022). The study was therefore limited by the number of tweets using the singular marketplace. Future studies which can conduct analyses without specifying any singular marketplace can be impactful to gain a better understanding of the NFT industry in its entirety.

## Research Objectives

The review of the abundant pieces of literature above results in many questions which can potentially be answered through further research. This study aims to gain a deeper understanding of the non-fungible token community and industry through an in-depth analysis through social media discussion. The overarching research questions guiding this work is as follows:

*RQ1: What is the overall sentiment of tweets related to the users’ countries, age, and popularity of the accounts within the NFT community?*

Answering this question is very important in gaining insight on how the sentiment and price of the NFT’s can be compared through social media networks, such as Twitter. The technological side of cryptocurrency can be very difficult to understand, so an analysis of Twitter accounts feelings towards NFT’s and what those accounts are saying about NFT’s will allow for more people to be able to understand how the user’s sentiment can either change or reflect the price of the NFT.

Due to the nature of NFT’s and the industry, analyzing both the average Twitter user and the top Twitter users will have a tremendous impact on potential decision-making in the NFT market. The second research question can gain deeper insight on which Twitter users are highly credited as experts on NFT’s, resulting in their opinions being shown on actual NFT’s.

*RQ2: Who are the most influential Twitter users in the NFT market?*

There are many different types of NFT’s, and many unique projects created by various people within each of the different types of NFT’s. Understanding the most discussed NFT projects/collectibles through analyzing tweets will help gain an understanding of the trends of what NFT consumers are buying/selling/investing.

*RQ3: What are the popular topics being tweeted about, and are those topics popular NFT projects?*

# Methodology

To gain a deeper understanding of NFTs through social media discussions, the first step is to extract Tweets which pertain to NFTs and the NFT industry using python. The tweets selected for extraction to analyze will have specific words and mentions in them: “NFT”, “NFTs”, “Bored Ape Yacht Club”, “CryptoPunks”, “The Sandbox”, “Art Blocks”, “Doodles”, “Cool Cats”, “CyberKongz”, “Decentraland”, “FLUF World”, “DeadFellaz”, “NFT Project”, “NFT Collection”, “Azuki”. These specific mentions were selected due to the relevance of the words to the NFT industry, along with being top NFTs in the volume of transactions and popularity.

The tweets will be pulled into a comma separated values file (csv) to store the data. The Twitter listener will also be executing over a specific amount of time to ensure a proper number of samples of tweets represent an accurate depiction of the overall market. After the data is properly collected and stored into the csv file, it will then be ready to upload into programming applications such as MongoDB and DataBricks. After cleaning and exploring the data, the content analysis step of the study will be conducted regarding the research questions and overall goal of the study.

Content analysis will be a large part of getting a deeper understanding of the research topic. Analyzing trends in content such as who the big players in the market are, the trends of which NFTs are popular via number of mentions, and the overall trends of the industry will be performed with the data collected. Some specific queries that will be analyzed are: Which users tweeted the most about NFTs, Which tweets had the most retweets, How many users have over and under 1,000 followers, Which hashtags were most prevalent other than those listened for, Which locations did most tweets come from, What are the average and highest follower and friends counts, How many of the tweets were quoted tweets, and Which users were the most mentioned. Overall, all features of Twitter users and in-depth data analyses on these features will be conducted to discover trends and correlations between NFTs and Twitter users who tweet about the NFT industry.

Along with an analysis of the content, multiple other analyses will be conducted to gain a deeper understanding of the previously stated research questions and objective. Sentiment analysis will be conducted through the coding tool Python Jupyter Notebook. This sentiment analysis will be carefully executed to conclude how the Twitter users feel about the mentioned NFT’s.

# Data Analysis

First, we extracted 6,644,022 tweets from Twitter using a Twitter API from June 2022 to August 2022. As previously mentioned, these tweets were collected using specific keywords. The collection contained specific features about the tweets and their source, including but not limited to tweet date, entities of the tweets, likes, favorite count, location, bio, country, text, and followers. All the data collected allowed us to better understand the Twitter users interacting within the NFT community.

## Twitter Users by Joining Year, Verified Status and Country

The first analysis that we conducted on the data was an exploratory analysis to better understand the content containing to the overall dataset. One of the first things we looked at was the number of tweets by user, based on the year the user joined. The year the users joined Twitter can be effective in showing whether they joined before NFT’s became popular, ultimately adapting to the NFT community, or if they joined during the height of the NFT popularity to specifically discuss the technology. From Figure 1It can be seen that there was a 933% increase in users tweeting who joined Twitter from 2020 to 2022, (375,000 to 3.5 million users, respectively. Figure 1).

***Figure 1***

*Number of Tweets by User, based on Joined Year*

Graphical user interface, application

Description automatically generated

From here we wanted to analyze how many of these users were verified by Twitter, (“Previously, Twitter used a blue checkmark to indicate active, notable, and authentic accounts of public interest that Twitter had independently verified based on certain requirements”). Using a pie chart, we concluded that about .10% (6,624) of the tweets were by a verified user (Figure 2).

***Figure 2***

*Percent of Total Users Verified*

Graphical user interface, application

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Figure 2 effectively shows whether the users tweeting about NFT’s are very influential users, or simply everyday people. Lastly in the exploratory analysis, we analyzed what countries the users were from. As seen in Figure 3, the most tweeted from country was the United States, followed by Indonesia and Nigeria.

***Figure 3***

*Number of Countries by Twitter Users*

Graphical user interface, application

Description automatically generated

This analysis was conducted for the purpose of seeing which countries were dominating the NFT’s discussion, but due to the nature of this data being user-optional input, about 99.93% of this data was null.

## Sentiment Analysis

The next part of the analysis which we conducted was a sentiment analysis based on the text of the tweets that were collected. Sentiment analysis is a natural language processing (NLP) technique which labels data into three different labels: positive, neutral, and negative. To score the tweets accurately, we used a very popular NLP library, Hugging Face. Using Hugging Face, we used a very popular model called “RoBERTa-base Model for Sentiment Analysis”. This model created a pre-trained model based on 124 million tweets to be used to score sentiment. Each tweet was then assigned one of the three different labels.

Figure 4 shows the overall sentiment within the entire dataset. that the result shows that about 42.4% of the tweets were positive, while only 1.96% were negative, and the remaining 55.7% were neutral (Figure 4).

***Figure 4***

*Percentage of Overall Sentiment*

Graphical user interface, application, PowerPoint

Description automatically generated

That means that about 2.8 million tweets were positive, and that about only 130,000 tweets were negative. Next, we looked at the sentiment by the twitter users, based on the year they joined Twitter (Figure 5).

***Figure 5***

*Sentiment by Users, based on Joined Year*

A picture containing table

Description automatically generated

As we saw in Figure 1, the number of users started to exponentially increase in 2020, which resulted in a 933% increase by 2022. Looking at this new sentiment analysis, we were able to see that the positive and neutral tweets are almost exactly correlated with this increase in users with a 930% and 970% increase in amount, respectively. Negative tweets did not follow this trend though, with only a 577% increase from 2020 to 2022. Next, we analyzed the percent sentiment by twitter users, based on the countries they manually input. In Figure 6, we were able to see that most countries followed the same pattern as the overall dataset.

***Figure 6***

*Percent of Sentiment by Users, based on Countries*

A picture containing chart

Description automatically generated

The only stand-out information that this provides is that Indonesia is the only country with more than 8% of their tweets being negative (about 13.6%). Although they had a significant difference in percentages, the 13.6% only represents approximately 83 total tweets. The last part of our sentiment analysis was to see the percentage of sentiment by the twitter users, based on verification status. From here we can see that there is a relatively small difference of the sentiment labels between whether the user is verified (true), or not verified (false), (Figure 7). One thing to notice from this analysis is that although it is not a big difference, verified accounts tweeted a higher percentage of negative tweets.

***Figure 7***

*Percent Sentiment by Users, based on verified accounts*

Graphical user interface, application

Description automatically generated

## Topic Modelling

The final portion of our data analysis consisted of topic modelling. We conducted this analysis to try to determine common topics within the NFT Community. Topic modelling is a technique used in natural language processing and machine learning to identify topics or themes present in a collection of documents. LDA (Latent Dirichlet Allocation) is a machine learning algorithm used for topic modeling. The goal of LDA is to identify topics or themes present in a collection of documents. We started this analysis by creating a word cloud which consisted of the top hashtags mentioned throughout the collection of tweets (Figure 8).

***Figure 8***

Text

Description automatically generated with low confidence*Word Cloud of Top Hashtags*

Figure 8 shows the most prominent words by basing the size of the hashtags on the overall count within the data, with the most mentioned hashtags being the largest. From here we could conclude that the top hashtags were #Giveaway, #nftcommunity, #crypto, #nftgiveaway, and #eth. The most popular hashtag, #giveaway, appeared 190,000 times which was 50,000 more than the 2nd most popular hashtag, #nftcommunity. After conducting the word cloud, we then began to create the LDA pipelines to sort all the tweets into 3 different topics as shown in Figure 9, 11 and 13.

***Figure 9***

*Topic One: Giveaways*

Chart

Description automatically generated

Figure 9 shows our first topic, “Giveaways”. It can be seen here that there are many words within this topic which relate to giveaways. The top-30 most relevant terms for the topic were about 38.6% of the total terms. Common words appear a lot such as, giveaways, tag, enter, prize and free. These words all relate to how a giveaway typically works. Figure 10 shows some of the tweets that were related to this first topic.

***Figure 10***

*Topic One Tweet examples*

Graphical user interface, application

Description automatically generated

The second topic, “Token Creation” (Figure 11), is about the process/actions being taken by people/artists to create/mint new or old NFTs and cryptocurrency projects.

***Figure 11***

*Topic Two: Token Creation*

Chart

Description automatically generated

As shown in Figure 11, there are many relevant terms within this topic such as mint, join, project, eth and new. All these terms are relevant within the process of creating NFT’s and cryptocurrencies. The top-30 most relevant terms for the topic were about 34.1% of the total terms. Figure 12 shows multiple examples of tweets within this topic.

***Figure 12***

Graphical user interface, application

Description automatically generated*Topic Two Tweet examples*

The last and third topic, “Community Interaction”, included many terms that related to different types of interaction between twitter users within the NFT community. Some of these terms include like, follow, tweet and quote (Figure 13).

***Figure 13***

*Topic Three: Community Interaction*

Chart

Description automatically generated

The top-30 most relevant terms for the topic were about 27.3% of the total terms. The 8th top term stood out as a very interesting term which stuck out more than any other term within all 3 topics. This term is “@projectxeno”, which after future research, turns out to be a strategic NFT video game based in Japan with multiple local celebrities supporting the game (Figure 14).

***Figure 14***

Graphical user interface

Description automatically generated*Topic Three outstanding term*

# Conclusion

From this sample of about 6.64 million tweets, it can be concluded that many users within the NFT community on Twitter have a positive sentiment towards the technology compared to a negative sentiment. One reason this might be is since the market took a downward trend prior to the collection of the tweets, we believed that the positive sentiment was an attempt to gain popularity in these tanked projects in efforts to regain their financial losses. In addition, there aren’t many influential users tweeting about NFT’s, but out of the small number there are still some very influential users. Overall, the influential users relatively add to more of the overall negative sentiment but are still overall heavily positive. Lastly and most importantly, after conducting this study, we believe that a lot of this community is flooded with bots, which is also a strategy for people to regain their financial wealth after the market fell. This conclusion was made from the fact that there are many key terms such as giveaways, free and prizes. Along with that, we noticed that these terms were in very common phrases which seemed to be automatically generated.

# Limitations and future research

Although this study contains great insight within the NFT community via Twitter, there are still certain limitations that could lead to further improvement within future research. Most importantly, the tweets collected in this study were only from the summer of 2022. Due to the technology being created in the mid 2010’s and are ever-changing, there are billions of new data points being added within twitter every day which could deeply impact the study. Along with that limitation, these tweets were only collected in real-time meaning we were not able to see how many likes, comments, quotes or retweets these tweets received. Analyzing these tweets in their current states after a long period of Twitter exposure could provide an even deeper understanding of the NFT community within Twitter. Lastly, another limitation is the number of tweets (6.64 million), which is somewhat minimal compared to the number of tweets which are tweeted daily. Along with multiple limitations, there are also multiple areas for future research. One possibility for future research includes model building, comparing the sentiment to the prices of different NFT projects and/or cryptocurrencies to analyze any potential correlations. This future research could provide a deeper understanding of the financial side to the NFT community within Twitter. Lastly, a deeper analysis of only verified accounts could have potential for much deeper insights on the NFT community. As mentioned before, only .10% of the tweets were verified, and looking at only verified accounts could be beneficial.

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