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From Tweets to Token Sales: Assessing ICO Success through Social Media Sentiments

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Abstract. With the advent of social network technology, the influence of collective opinions has significantly impacted business, marketing, and fundraising. Particularly in the blockchain space, Initial Coin Offerings (ICOs) gain substantial exposure across various online platforms. Yet, the intricate relationships among these elements remain largely unexplored. This study aims to investigate the relationships between social media sentiment, engagement metrics, and ICO success. We hypothesize a positive correlation between favorable sentiment in ICO-related tweets and overall project success. Additionally, we recognize social media engagement indicators (mentions, retweets, likes, follower counts) as critical factors affecting ICO performance. Employing machine learning techniques, we conduct sentiment analysis on tweets, discerning emotional nuances and categorizing expressions as positive or negative. Employing established classification methods, we further analyze engagement data to reveal its impact on ICO interest and awareness. Our research findings offer insights into the predictive potential of social media strategies for ICO success and underscore the importance of investor sentiment and engagement in the volatile cryptocurrency landscape. These insights provide actionable guidance for aspiring crypto founders in formulating effective business development strategies.
The source codes and datasets of this paper are accessible at GitHub: https://github.com/inflaton/Success-Indicators-of-Initial-Coin-Offerings

Keywords: Cryptocurrency · Initial Coin Offerings(ICOs) · Sentiment analysis · Social media · Machine Learning

1 Introduction

The emergence of blockchain technology and cryptocurrencies has transformed fundraising through methods like Initial Coin Offerings (ICOs) and Initial Exchange Offerings (IEOs) [9]. ICOs, also known as token sales, provide cost-effective fundraising avenues by issuing new coins on blockchain-based platforms. Social media platforms, particularly Twitter, have significantly contributed to the promotion and dissemination of information about both ICOs and IEOs [22].

IEOs, facilitated by cryptocurrency exchanges, involve these platforms managing fundraising campaigns by issuing new tokens [10]. Acting as intermediaries between projects and investors, these exchanges offer comprehensive crowd sale services [23]. The ICO model witnessed substantial funding, with 3,782 ICOs launched in 2018 alone, collectively raising nearly $11.4 billion [6], [15]. Despite fluctuations, the prevalence of ICOs persisted in 2021, with 113 hosted on Coincodex [15], [12]. The foundation of an ICO rests on its whitepaper, outlining project details such as business strategy, token sale structure, fund allocation, team composition, and development roadmap [12]. Utilizing the broad reach of social media, ICOs frequently leverage platforms like Twitter to promote their offerings within the crypto community [13].

Businesses utilize Airdrop initiatives to increase awareness about emerging ICOs or IEOs, rewarding participants with digital tokens or cryptocurrency for engaging in marketing activities. This involves actions like joining Telegram groups, following on social media platforms, retweeting, and tagging friends, fostering community engagement and brand endorsement [16]. Social media, especially Twitter, plays a vital role in the success of ICOs and IEOs, offering swift, cost-effective means to raise capital, supported by blockchain's efficiency in creating digital tokens through smart contracts, ensuring security and reliability [21].

Existing studies on ICOs and IEOs often focus solely on direct social media mentions, neglecting the potential impact of indirect interactions. This study aims to bridge this gap by comprehensively analyzing both direct and indirect social media interactions related to crypto projects. It explores sentiment and engagement levels in direct tweets, replies mentioning token keywords, and project announcements on Twitter. By predicting ICOs success using social media sentiment and engagement, this study seeks to uncover their interrelation, offering insights into the factors influencing ICOs and IEOs success on social media.

The main contributions of this paper are summarized as follows:

1. We make use of well-documented machine learning classification methods to conduct empirical experiments, and confirm the intuition that sentiment and engagement are highly predictive of cryptocurrency project fundraising success, both individually and as a joint hypothesis.
2. We highlight the fundamental factors that have historically driven ICO success, from marketing to governance and venture funding. We also flag potential roadblocks in using social media for crypto project sentiment analysis, namely the introduction of bot tweets and paid advertising that may not reflect true sentiment.

2 Related Work & Motivations

ICOs have become a popular means for startups to raise funds. However, the success of ICOs is influenced by various factors that need to be considered for a comprehensive understanding of their fundraising outcomes. Several studies have investigated these factors and identified different predictors of success.

One study [8] identifies key predictors of ICO success, including third-party ratings, detailed whitepapers, and social media influence. However, our critique is aimed at the depth of analysis provided on the influence of social media; specifically, we believe the study does not adequately explore the evolving role and increasing significance of social media dynamics on ICO outcomes.

Another study emphasized detailed project information, idea uniqueness, and team competencies [3], yet overlooked the significance of social media's sway on investor behavior.

A different study identified conditions to bolster ICO credibility, including registration, GitHub code publication, and early funding [5]. However, it overlooks potential drawbacks like the effort in obtaining funding and risks in code transparency.

Study [18] identified ICO success factors including hardcap, whitepaper informativeness, pre-ICO social media activity, bonuses, and transparency. However, its limited time scope and absence of negative sentiment impact are noteworthy limitations.

Twitter sentiment analysis plays a pivotal role in evaluating ICO effectiveness [2]. The platform's global reach facilitates succinct communication, fostering high engagement rates [20]. Analyzing meticulously collected Twitter comments related to ICOs, sentiment analysis unveils behavioral and social sentiment patterns among investors. These insights serve as a foundation for devising effective marketing strategies [7].

Influencer-driven product tweets significantly influence brand trust and consumer decisions. Twitter discussions bolster brand recognition and attract new audiences, leading to increased sales [4]. Our study aims to comprehensively explore global social media strategies' impact on ICO success, contrasting with regional studies [11]. Understanding social media's influence aids startups in refining marketing strategies and engaging with investors. Analyzing social media metrics and sentiment guides effective investor targeting and platform selection for ICO promotion. A holistic social media study offers invaluable insights for ICO fundraising efforts.

3 Hypotheses

Hypothesis 1: Positive sentiment expressed in tweets mentioning an ICO is correlated with its success. Sentiment analysis of tweets can provide valuable insights into public perception of a cryptocurrency project. The NRC Word-Emotion Association Lexicon can be used to analyse the emotional content of tweets and identify positive and negative sentiments. A higher proportion of positive tweets is likely to indicate a successful ICO. Sentiment analysis can be performed by collecting and analyzing tweets mentioning the ICO and their respective replies. Table 1 illustrates some examples of original and reply tweet data that were used for the analysis.

Hypothesis 2: The level of engagement on social media, such as the number of mentions, retweets, likes, and followers, is positively associated with the success

Table 1. Example of data used for sentiment analysis.

	Tweet Content	**Sentiment**
Original Tweet	Just bought more $SOL, feeling great about this investment!!	Positive
Reply	I'm not convinced, I think $SOL is overvalued	Negative
Reply	Quite bullish on it too, the fundamentals are really strong	Positive
Reply	Waiting to see how the market develops, but currently looking for better options in the market	Negative

of an ICO. Engagement on social media can indicate the level of awareness and interest in a cryptocurrency project among potential investors. By collecting data on the number of mentions, retweets, likes, and followers of the project and the users mentioning it, we can measure the level of engagement and use it to predict the success of an ICO. Table 2 illustrates an example of the engagement metrics used, and the number of each metric collected for the $MATIC crypto token.

Table 2. Example of data used for engagement metrics.

Metric	**Data collected for $MATIC**
Number of mentions	799,849
Number of retweets	1,471,118
Number of likes	1,280,414
Number of project followers	34,755,686

4 Dataset

ICOs data was collected from iconbench[1] and cryptoran[2] using a combination of manual download and automatic scraping using Python beautiful soup package[3]. For each cryptocurrency project, we recorded ICO-related data as summarized in Table 3.

Data from Twitter was gathered using the Twitter API and Scrapy[4], an open-source Python framework. The collection encompassed two categories of tweets:

[1] www.icobench.com
[2] www.cryptorank.io
[3] https://beautiful-soup-4.readthedocs.io/
[4] https://scrapy.org/

Table 3. ICO data collected.

Data description	Data type	Hypothesis
Project name	String	1, 2
Project token	String	1, 2
Soft cap	Integer	1, 2
Total raised	Integer	1, 2
ICO Date	Date	1, 2

those that included a cryptocurrency project's keyword, marked by the prefix "$" followed by the token's name (e.g., "$SOL" or "$MATIC"), and tweets emanating from the project's official Twitter handle. For tweets featuring the token keyword, we compiled data on the number of retweets, likes, and the poster's follower count, in addition to the content of any responses. However, tweets originating from the project's own account were excluded from direct analysis as they primarily represent official communications from the cryptocurrency project's team, thus deemed not directly pertinent to the research hypotheses.

Tweets are categorized into direct mentions and indirect mentions. A direct mention occurs when a tweet explicitly contains the token keyword. An indirect mention refers to a tweet that either responds to another tweet featuring the token keyword or replies to a tweet from the project's official Twitter handle. It's important to highlight that to avoid look-ahead bias, only tweets published prior to the dates of a token's ICO are considered relevant for assessing the ICO's prospective success.

After collecting the above data, we processed and transformed it to obtain useful information. For each cryptocurrency project, we recorded the following twitter data as summarized in Table 4:

Table 4. Twitter data collected.

Data description	Data type	Hypothesis
Content of tweets - direct mentions	List of String	1
Content of tweets - indirect mentions	List of String	1
Total number of direct mentions	Integer	2
Total number of indirect mentions	Integer	2
Total number of likes	Integer	2
Total number of retweets	Integer	2
Number of official account followers	Integer	2
Total number of followers of users mentioning project	Integer	2

5 Experiment & Methodology

5.1 Data Processing

For the facilitation of machine learning algorithms in the examination of our hypotheses, data preprocessing was undertaken to convert the raw data into a format amenable to algorithmic training.

Sentiment analysis was a pivotal component of our study, aimed at capturing the emotional undercurrents embedded in both overt and covert mentions. This was achieved by leveraging the NRC Word-Emotion Association Lexicon[5], a compendium that assigns sentiments—either positive or negative—to various words. We utilized TextBlob[6], a Python library recognized for its simple API that enables execution of several natural language processing (NLP) tasks, including sentiment analysis. This was instrumental in quantifying the sentiment polarity of each tweet. Figure 1 provides a visual representation of the sentiment evaluation conducted on tweets pertaining to the DUO Network (DUO) ICO.

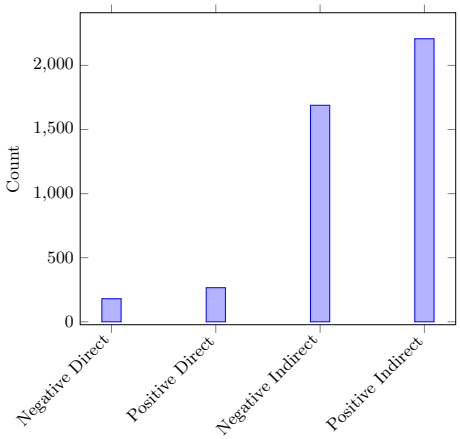

Fig. 1. Sentiment scores for DUO Network (DUO) tweets.

The success of an ICO was quantitatively determined by comparing the total capital raised against the soft cap defined by the project, with the latter serving as the minimum required funding level. In our corpus of 816 ICOs, 582 were classified as having achieved success by surpassing their respective soft caps, whereas 234 were deemed unsuccessful for not meeting these financial benchmarks. The dataset was structured into 12 columns, each representing a discrete attribute of an ICO from a specific cryptocurrency project. A condensed overview of these attributes is delineated in Table 8, which can be found in the Appendix.

[5] https://saifmohammad.com/WebPages/NRC-Emotion-Lexicon.htm
[6] https://textblob.readthedocs.io/

5.2 Machine Learning Methods

The objective of the current research was to forecast the potential success of Initial Coin Offerings (ICOs) by categorizing them as likely to succeed or not. This was based on an array of input variables, all represented by integer values, including attributes like 'soft_cap', 'total_positive_direct_mentions', among others. We segmented the data into two distinct groups: one for training, constituting 80% of the entire dataset, and the other for testing, making up the remaining 20%. Our methodological approach encompassed the deployment of six diverse algorithms, specifically Support Vector Machines (SVMs), Logistic Regression, Random Forest, Naïve Bayes, Categorical Boosting (CatBoost), and Neural Network. These methods were selected for their proven competency in executing classification tasks. The process of parameter optimization was conducted through grid search with the aim of maximizing accuracy.

6 Results & Discussion

6.1 Individual hypothesis testing

The classification methods were first applied to hypothesis 1 - "Positive sentiment expressed in tweets mentioning an ICO is correlated with its success" by using only the x variables directly linked to sentiments (variables 2, 3, 5, 6 in Table 8). Table 5 illustrates the performance outcomes of each predictive model.

Table 5. Hypothesis 1 predictive results

Model	Accuracy	Precision	Recall	F1 Score
Naïve Bayes	65.9%	66.0%	98.1%	78.9%
SVM	65.2%	65.2%	**100.0%**	79.0%
Logistic Regression	66.5%	**81.7%**	62.6%	70.9%
Random Forest	73.8%	75.4%	88.8%	81.5%
CatBoost	73.8%	75.4%	88.8%	81.5%
Neural Network	**74.4%**	76.0%	88.8%	**81.9%**

Next, the same methods were applied to hypothesis 2 - "The level of engagement on social media, such as the number of mentions, retweets, likes, and followers, is positively associated with the success of an ICO" by using the remaining variables which are directly linked to level of engagement. Table 6 presents the performance outcomes for each predictive model.

The results shown in Table 5 suggest that the models trained to test Hypothesis 1 yielded moderate performance scores, with the highest accuracy achieved by the Neural Network model at 74.4%. The F1 Scores ranged from 70.9% to 81.9%, which is moderately high. These results indicate that Hypothesis 1 has

Table 6. Hypothesis 2 predictive results

Model	Accuracy	Precision	Recall	F1
Naïve Bayes	64.6%	65.4%	97.2%	78.2%
SVM	65.2%	65.2%	**100.0%**	79.0%
Logistic Regression	65.2%	**82.9%**	58.9%	68.9%
Random Forest	**76.8%**	78.0%	89.7%	**83.5%**
CatBoost	76.2%	76.6%	91.6%	83.4%
Neural Network	73.8%	76.2%	86.9%	81.2%

some merit and performs decently in predicting the success of ICOs based on positive sentiment expressed in tweets.

In contrast, the models trained to test Hypothesis 2 in Table 6 performed better overall, with the highest accuracy achieved by the Random Forest model at 76.8%. The Precision and Recall scores for all models were relatively high, ranging from 65.2% to 82.9% for Precision and 58.9% to 100.0% for Recall, respectively. The F1 Scores ranged from 68.9% to 83.5%, which is slightly higher than the accuracy/F1 scores achieved in the models trained to test Hypothesis 1. These results suggest that while sentiment expressed through tweets may be a moderately strong predictor of ICO success (hypothesis 1), the level of engagement a crypto project has on social media might act as a better predictor (hypothesis 2), supporting the plausibility of hypothesis 2 over hypothesis 1.

6.2 Combined hypotheses testing

A combination of the feature sets from both hypotheses was tested for predictive power. This appeared to improve the overall performance, particularly for the CatBoost model, as seen in Table 7.

Table 7. Combined predictive results

Model	Accuracy	Precision	Recall	F1
Naïve Bayes	64.0%	65.2%	96.3%	77.7%
SVM	65.2%	65.2%	**100.0%**	79.0%
Logistic Regression	64.6%	85.5%	55.1%	67.0%
Random Forest	**78.0%**	**79.3%**	89.7%	84.2%
CatBoost	**78.0%**	77.1%	94.4%	**84.9%**
Neural Network	67.1%	66.5%	**100%**	79.9%

The findings indicate that both Hypothesis 1 and Hypothesis 2 could be effective in forecasting ICO success, particularly when applied in conjunction. Among the tested models, CatBoost and Random Forest emerged as the top performers in accuracy.

6.3 Further Discussion

There are several potential reasons why the level of engagement on social media may be a more reliable predictor of the success of an ICO than positive sentiment expressed in tweets. One reason is that the level of engagement on social media is a more comprehensive measure of interest and support for a project, considering factors such as the number of mentions, retweets, likes, and followers [1]. Positive sentiment expressed in tweets, on the other hand, may not capture all forms of engagement and may be influenced by factors such as bots and fake accounts [19].

Furthermore, the sentiment expressed in tweets may not always reflect the true feelings and opinions of the wider community [17]. For example, some people may not reply to tweets or publicly express their support or interest in a project, but may still be engaged with the project on other levels, such as following its social media pages or participating in ICOs and purchasing the tokens without posting anything on Twitter. In contrast, the level of engagement on social media provides a more comprehensive and holistic view of the level of interest and engagement in a project.

Another potential reason why positive sentiment expressed in tweets may not be as strong an indicator of success as the level of engagement on social media is that sentiment can be influenced by a variety of factors, including competitors, influencers, and external events. For example, a project that is in direct competition with another project may receive a high volume of negative sentiment simply because of the rivalry, even if the project itself is strong and has potential for success. Therefore, sentiment expressed in tweets may not always accurately reflect the actual quality and potential of a project.

Another point to consider is that negative sentiment expressed on social media can sometimes have unintended positive effects. In the age of information overload, negative tweets or comments may grab more attention than positive ones and can generate buzz and discussion around a project, leading to increased visibility and exposure [14]. It is also important to note that bad marketing is still marketing, and negative sentiment can still create awareness and interest in a project. Therefore, when evaluating the potential success of a project, it is essential to consider both positive and negative sentiment expressed on social media. While positive sentiment is a good indicator of potential success, it should not be the sole metric to evaluate a project, as it can be influenced by external factors such as competitors or influencers. Ultimately, a more comprehensive view of sentiment and engagement on social media is necessary to accurately evaluate the potential success of a project.

Overall, the level of engagement on social media appears to be a more reliable predictor of the success of an ICO than positive sentiment expressed in tweets. The comprehensive and holistic nature of engagement metrics such as mentions, retweets, likes, and followers, combined with their relative independence from external factors such as competition and sentiment, make them a more robust and reliable measure of interest and support for a project.

Our findings highlight the crucial role of social media engagement in predicting ICO success, suggesting a strategic focus on enhancing online interactions.

ICO projects should prioritize increasing social media activities like mentions, retweets, and followers to attract and sustain interest. A concise strategy would involve creating engaging content, managing active communities, and collaborating with influencers to amplify visibility. This approach underscores the importance of both engagement quantity and sentiment quality, guiding projects to optimize their social media presence for better funding outcomes.

7 Conclusion

This research explores how Twitter sentiment and engagement influence ICO fundraising outcomes. It was discovered that a positive sentiment on Twitter correlates with greater fundraising achievements. Twitter serves as a crucial channel for ICO promotion and a source for investors to obtain cryptocurrency-related information. The findings indicate that ICOs receiving more positive commentary and engagement on Twitter tend to secure higher funding amounts. Notably, a strong relationship was observed between the fundraising success of an ICO and both its Twitter sentiment and the volume of its direct and indirect followers. To assess predictive accuracy, six classifiers were employed: Support Vector Machines, Logistic Regression, Random Forest, Naïve Bayes, Categorical Boosting, and Neural Network. Among these, Random Forest and Categorical Boosting emerged as the most effective, leading in performance across two of the four evaluation metrics.

In addition to the current research, there are still many avenues to explore regarding the impact of social media on ICO success. One potential area of future work is to investigate "pump and dump" ICO projects, where the followers and their respective interactions are likely to be AI bots and paid Twitter accounts, specially paid to pump the projects. These types of projects have been known to manipulate social media sentiment and create an artificial hype around the project, leading to short-term gains but ultimately resulting in significant losses for unsuspecting investors. Understanding the impact of these tactics on ICO success could be valuable in detecting and avoiding such fraudulent projects.

Another area for future research is to explore how a few extremely influential figures can single-handedly affect the price of a crypto project. The impact of these influential figures on social media sentiment can be significant and may lead to short-term gains or losses for investors. Studying the impact of such influencers on ICO success could provide insights into the role of individual powerhouses in the cryptocurrency market and could lead to a better understanding of how to mitigate risks associated with their influence.

Additionally, further research is needed to explore the connection between social media marketing expenses and the financial performance of ICO projects. Investigating how an ICO's governance signals influence fundraising success can provide valuable insights into key success factors. Furthermore, understanding the broader impact of cryptocurrencies and blockchain technologies on businesses is crucial for predicting the future of ICOs.

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A Appendix

Table 8. Feature labels and description.

Index	Column	Data type	Description
1	total_direct_mentions	Integer	Total number of direct mentions
2	total_positive_direct_mentions	Integer	Total number of direct mentions with positive sentiment
3	total_negative_direct_mentions	Integer	Total number of direct mentions with negative sentiment
4	total_indirect_mentions	Integer	Total number of indirect mentions
5	total_positive_indirect_mentions	Integer	Total number of indirect mentions with positive sentiment
6	total_negative_indirect_mentions	Integer	Total number of indirect mentions with negative sentiment
7	total_retweets	Integer	Total retweets of tweets with token keyword and official account tweets
8	total_likes	Integer	Total likes of tweets with token keyword and official account tweets
9	total_project_followers	Integer	Total followers of official account
10	total_indirect_followers	Integer	Total followers of users mentioning the project
11	soft_cap	Integer	Project soft cap
12	ico_success	Integer	Boolean (0 or 1) to indicate success of ICO