Sentimental Analysis Of CBDC Tweets Using Machine Learning and Deep Learning Techniques

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Abstract— India is in digital spree, and it is forerunner in many streams. Central bank digital currency has been in many countries and it is under the process of testing in many nations. India had move one step ahead and have gone to pilot testing in recent time. Understanding public sentiments towards Central Bank Digital Currency by conducting sentiment analysis using tweets is the major objective of this research. The researchers have used the Twitter data to understand the public perception and sentiment towards digital currency using machine learning and deep learning techniques. The intention is to trace patterns and trends in the data to gain insights into the digital currency and to find the people reaction towards digital currency. The authors have utilized the natural language processing techniques and machine learning algorithms in Python to analyse the data and generate results.

Keywords: Sentiment analysis, tweets, Machine learning, CBDC, digital currency.

I. INTRODUCTION

Sentiment analysis, further identified as opinion mining, uses natural language processing, text analysis, and computational linguistics to trace and obtain subjective knowledge from source materials. In the context of CBDC, sentiment analysis can be used to gain insight on people's feelings about Digital currency. To conduct sentiment analysis on twitter data related to CBDC using Python, one can use a library such as NLTK or Text Blob. These libraries provide pre-built functions for common natural language processing tasks, such as tokenization, stemming, and part-of-speech tagging. To start, firstly, the twitter data related to CBDC is collected. This is done using the Twitter API, which allows developers to access tweets in real-time. The tweets are filtered by keywords or hashtags related to CBDC to ensure that the relevant data is taken for analysis. Next, the collected tweets are pre-processed to remove any irrelevant information, such as URLs or mentions of other twitter users. This is done using regular expressions or string manipulation in Python. After the data is pre-processed, it is passed through a sentiment analysis algorithm. There are different approaches to sentiment analysis, but one common method is to use a pre-trained model to classify tweets as positive, negative, or neutral. This can be done using a machine learning library such as scikit-learn. Finally, the results of the sentiment analysis are visualized using a library such as matplotlib or seaborn. This helps to identify patterns or trends in the data or which emotions are most associated with tweets about CBDC. Sentiment analysis of twitter data is a powerful tool that is used to gain insights on people's feelings about Central Bank Digital Currency.

II. OBJECTIVES OF THE STUDY

- To analyze tweets and extract public sentiments towards CBDC using Machine learning techniques.
- To identify and analyze the sentiments of top 5 nations' tweeting on CBDC and as well trace highly tweeting cities.
- To develop word cloud in order to determine the overall sentiment towards CBDC in Twitter

III. SYNTHESIS OF LITERATURE REVIEW ON SENTIMENT ANALYSIS TOWARDS CBDC

Significance of Sentiment Analysis in understanding the perception of public towards CBDC:

[8] the authors conducted a sentiment analysis of Twitter data related to CBDC from January 2020 to April 2021. The study used was machine learning techniques such as Naive Bayes, Random Forest, and Support Vector Machines to categorise tweets as positive, negative, or neutral. The study found that the overall sentiment towards CBDC was positive, with the highest sentiment expressed towards its potential benefits for financial inclusion, efficiency, and security.[9] conducted a sentiment analysis of Twitter data related to CBDC using natural language processing techniques. The study found that the sentiment towards CBDC was positive overall, with the majority of tweets expressing support for its adoption. [10] used machine learning algorithms to analyze Twitter data and investigate the factors that influence public sentiment towards CBDC. The study

found that factors such as news events, economic indicators, and social media influencers had a significant impact on sentiment.

Patterns and trends identified towards CBDC across nations:

Central Bank Digital Currency (CBDC) has been an interest area for many researchers and policymakers in recent years, with the aim of exploring its potential benefits and challenges. Sentiment analysis of social media data, particularly Twitter, has emerged as a popular method for understanding public opinion and attitudes towards CBDC.

In a study by [11] analyzed Twitter data to examine the public sentiment towards the digital yuan, China's CBDC, found that overall sentiment towards the digital yuan was positive, with the majority of tweets expressing support for its adoption. [1] conducted a sentiment analysis of Twitter data related to CBDC in different countries. The study found that sentiment towards CBDC varied across countries, with countries such as China and Japan showing more positive sentiment than countries such as the US and UK. [2] used sentiment analysis to examine the public perception of CBDC in China using Twitter data. The study found that sentiment towards the digital yuan was generally positive, with the majority of tweets expressing support for its adoption and highlighting its potential benefits. Similarly, [3] a study by also conducted sentiment analysis of Twitter data related to CBDC. The study used a couples the rule-based and machine learning techniques to analyze over 600,000 tweets from January to October 2020. The study found that the sentiment towards CBDC was generally positive, with the most positive sentiment expressed towards its potential to reduce the use of cash and promote financial inclusion. [4] This article provides an in-depth review of the potential impact of CBDCs on financial stability, including how they may affect bank deposits, monetary policy, and cross-border payments. [5] in their paper explore the potential impact of CBDCs on monetary policy, discussing the benefits and drawbacks of using CBDCs for implementing monetary policy and their potential impact on interest rates, exchange rates, and inflation. [6] This article examines the potential impact of CBDCs on the monetary system, covering issues such as their impact on monetary policy, financial stability, and the banking system. [7] This article features a speech by Sir Jon Cunliffe, Deputy Governor for Financial Stability at the Bank of England, on the potential impact of digital currencies on central banking. It covers issues such as their potential impact on monetary policy, financial stability, and the banking system. [12] This article discusses the potential impact of CBDCs on financial inclusion, including their potential benefits for promoting financial inclusion and the challenges that may arise when implementing CBDCs in a way that promotes financial inclusion. [13] This article examines the trends in cash usage in Canada and Sweden and the potential for a cashless society, including the potential benefits and drawbacks of such a society and the role CBDCs that may play in facilitating the transition. [14] This article

discusses the potential impact of CBDCs on monetary sovereignty, including their potential benefits and drawbacks for monetary sovereignty and the challenges that may arise when implementing CBDCs in a way that preserves monetary sovereignty. [15] This article explores the legal aspects of CBDCs, including potential legal frameworks for CBDCs, their potential impact on financial regulation, and the potential legal challenges that may arise when implementing CBDCs.

Machine learning and deep learning techniques aids in analysing twitter data using Sentiment analysis

[16] in their paper discussed the text and opinion mining technique of Twitter sentiment analysis, which aims to train a machine learning model to make predictions about future sentiment and outlined data collection, text pre-processing, sentiment detection and classification, model training, and testing procedures. [17] in their paper introduced more sophisticated analytical techniques such as sentiment analysis and decision making in future studies. Few research outcomes could provide more accurate results for sentiment and behavior analysis by incorporating the location variable [18].

IV.   RESEARCH METHODOLOGY

The research design is supervised machine learning technique. The global tweet data on CBDC is taken from twitter. The population size of 14,974 tweets across globe is collected using VICINTAS application with twitter account. Advanced Excel was used to filter data and Python 3.9 Programming language is used for data cleaning and Visual basic analytics tool is used for visuals presentation (Tableau 2023.1). In the month of December 2022 to April 2023 data's are collected and using Google Collaboratory is the interface used here to run the python code to extract the data from the twitter. In this text blob sentiment an python library classify tweets according to polarity rate from -1,0,1 where negative, positive, neutral

HYPOTHESIS FRAMED

The following hypotheses are tested to test the polarity of the text in sentiment analysis,

H0- to find the perception of the people towards the CBDC is positive.
H1 - to find the perception of the people towards the CBDC is neutral.
H2- to find the perception of the people towards the CBDC is negative.

V.   DATA COLLECTION

In this research, the data is collected by the method of web scraping from twitter using python. The "VICINTAS" web scrapping tool is used to scrape data from the twitter. This library helps in extraction

of the tweets in large amount by the basis of user id, hashtags, and even using keywords. Here the data is collected based on keywords related to various parameters of CBDC. Further, for each individual parameter, the data is collected by several keywords related to the corresponding parameters. The python program is run to collect the data from all over world, as the research is based on the world consumers. For this research, 14974 tweets were collected and processed using python language.

Source: Based on author calculation (Python 3.9)

NLTK, an open-source Python library that is commonly is used for processing human language data, such as text and speech. The library offers a range of tools and resources to support tasks such as tokenization, stemming, tagging, parsing, and semantic reasoning. NLTK's tokenization methods breaks text into words, sentences, or other meaningful units, which is a crucial aspect of natural language processing (NLP). The library's stemming algorithms allow words to be reduced to their root forms, which is helpful for tasks like search and retrieval, where variant word forms need to be treated as equal. Overall, NLTK is a flexible and powerful library for processing natural language data in Python that is widely used in industry and research and has a large community of developers and contributors which used by the researchers in this article as well.

VI.   TEXT PROCESSING:

The tweets collected on CBDC is processed by the following steps. Excel filters is used to remove links, and retweets and then the python libraries facilitate in cleaning. Next, identified the null values from the data which is a crucial step in text processing method. URLs were removed using the text processing method, if not done it will increase the processing time. Symbols like comma, full stop, exclamatory which does not add any meaning to the text are removed. As algorithm will analyse the same word separately if denoted in lower and uppercase, the final text is converted into lowercase, inorder to standardize the data. Later tweets which are in different tenses, are converted into base word or stem. After stemming, lemmatization is the other
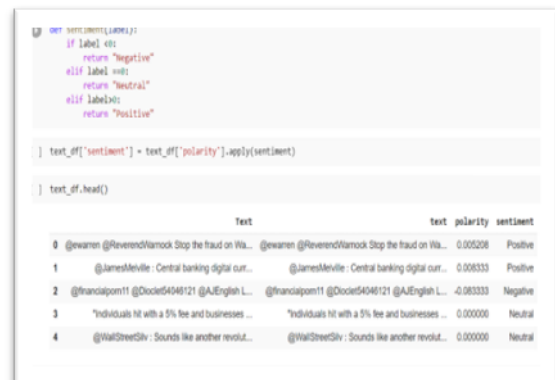
text processing step is exercised to convert the meaningless stem into meaningful contexts.

Seaborn is a Python data visualization library that is built on top of Matplotlib. It provides a higher-level interface for creating statistical graphics, such as heatmaps, violin plots, box plots, and more. Seaborn also has built-in support for visualizing data distributions and regression analysis, making it a popular choice for data exploration and analysis.

In summary, Matplotlib is a lower-level library that provides a wide range of customization options for creating 2D visualizations, while Seaborn is a higher-level library that focuses on statistical graphics and makes it easier to create complex visualizations quickly. In this research the classification for sentiments with related to polarity is plotted using these library

VII.   SENTIMENT ANALYSIS:

Sentiment analysis is performed on the pre-processed data with the help of NLTK library. This library include text blob which is a predefined sentiment analysis tool facilitates the rule to evaluate the sentiment of the text includes 8000 features like words, tenses, phrases, idioms, sentences with a score ranging from -1 to 1. From the calculated score, the sentiment label is assigned for each tweet which represents the overall sentiment of the text.

Source: Based on author calculation (Python 3.9)

VIII.   DATA VISUALIZATION:

After conducting sentiment analysis on the given data, the next step is to visualize the results in a more understandable and presentable format. One way to do this is by using a bar graph to represent the sentiment based on each topic in the data. This helps to identify the emotions of people towards CBDC, ie., higher positive sentiment or higher negative sentiment towards CBDC. This analysis helps the policy makers and central bank to gain valuable insights on people's preferences towards CBDC.

India
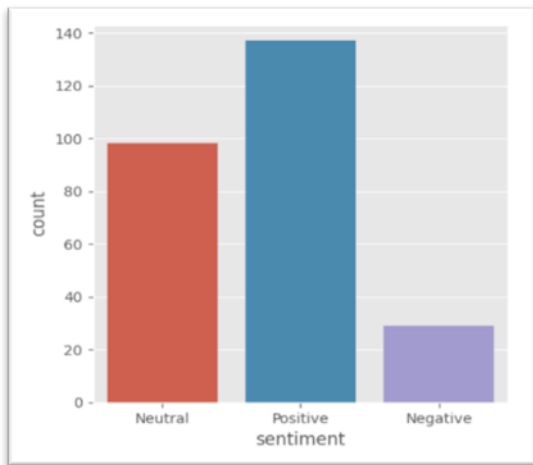
Source: Based on author calculation (Python 3.9)

The above bar chart indicates the public sentiment towards CBDC in India. It is understood that majority of the people in India reflect positive support in adoption of Central Bank Digital Currency (CBDC). This positive sentiment is attributed due to various factors covering convenience and security offered by a digital currency, potential for financial inclusion, and reduced transaction costs.

Implications:

It is important to acknowledge that sentiment analysis is just one factor in determining the success of CBDC implementation in India. Other factors such as regulatory challenges, infrastructure requirements, and public trust also play a critical role. Nonetheless, a positive sentiment towards CBDC in India could provide a competitive advantage in the global economy and position India as a leader in the digital currency space.

Figure 1 shows the city wise tweets in India
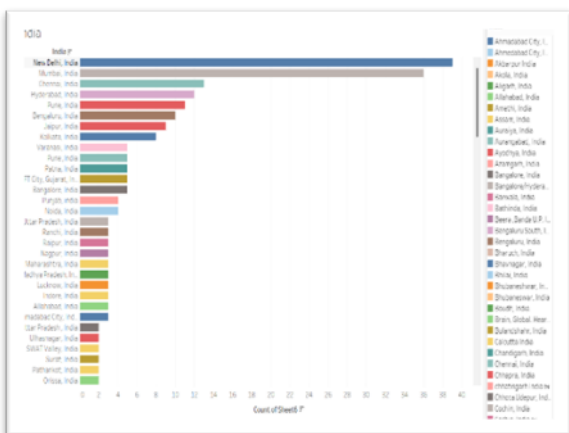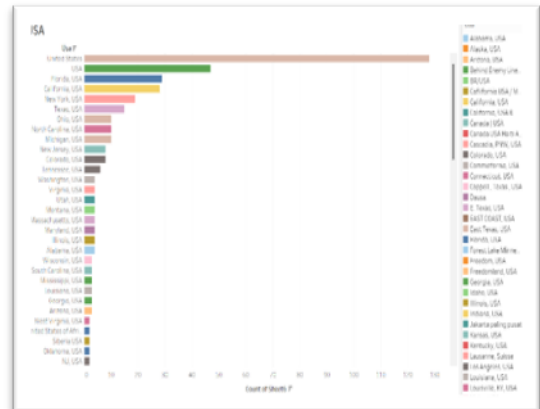

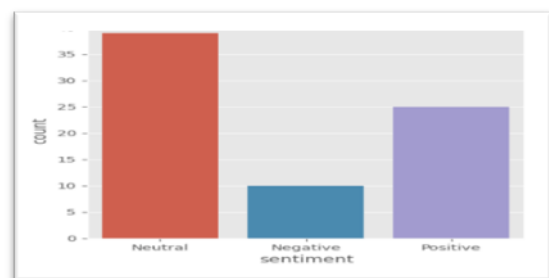Source: Based on author calculation (tableau 2023.1)

USA
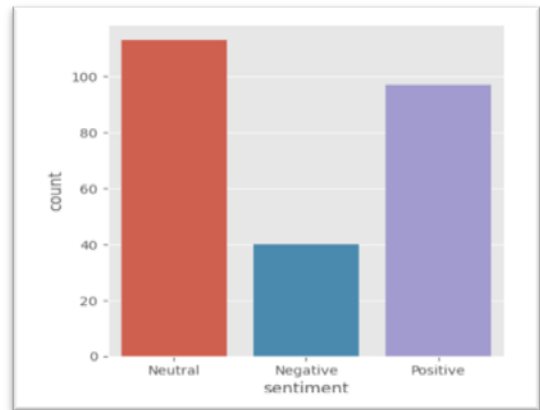
Source: Based on author calculation (Python 3.9)

Based on sentiment analysis, it appears that the general sentiment towards a Central Bank Digital Currency (CBDC) in the USA is positive. The positive sentiment could be attributed to various benefits, such as convenience, security, financial inclusion, and reduced transaction costs. The widespread adoption and usage of CBDC in the USA could lead to several advantages, including cost reduction for currency issuance and management by the Federal Reserve, increased financial inclusion, and potential growth in the fintech industry.

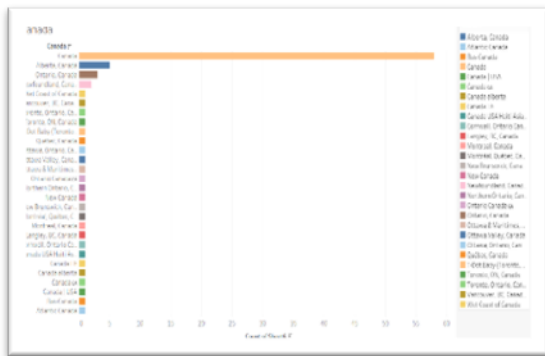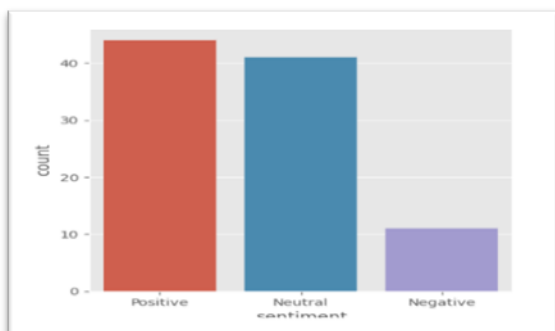Figure 2 shows the city wise tweets in USA

Canada

Source: Based on author calculation (Python 3.9)

According to sentiment analysis, Canada's attitude towards Central Bank Digital Currency (CBDC) is neutral, indicating that the country has not yet formed a clear positive or negative opinion on the matter. This could be due to several factors, including lack of awareness, uncertainty surrounding the potential advantages and disadvantages of CBDC, and the requirement for additional research and development.

Figure 3 shows the city wise tweets in Canada


UK:

Source: Based on author calculation (Python 3.9)

The sentiment analysis of the United Kingdom (UK) towards Central Bank Digital Currency (CBDC) is positive, indicating that the public is generally supportive of the idea of a digital currency issued by the Bank of England, and recognizes the potential benefits it could bring.
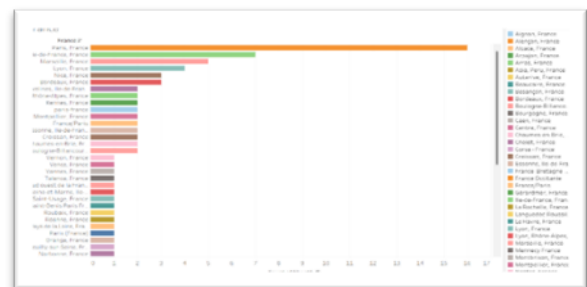
Figure 4 shows the city wise tweets in UK

Source: Based on author calculation (tableau 2023.1)
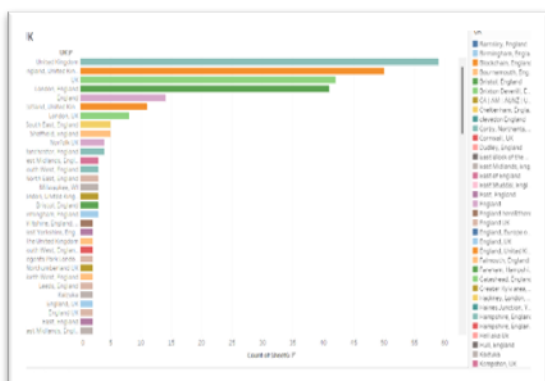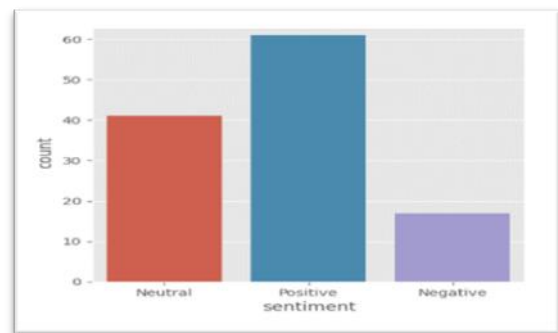
France:

Source: Based on author calculation (Python 3.9)

A favourable sentiment towards CBDC in France considers the likely advantages, such as increased usage and adoption, reduced currency issuance and management costs for the Banque de France, as well as better financial inclusion for unbanked and underbanked individuals. CBDC could also offer a more efficient and secure way of conducting transactions compared to traditional payment methods.
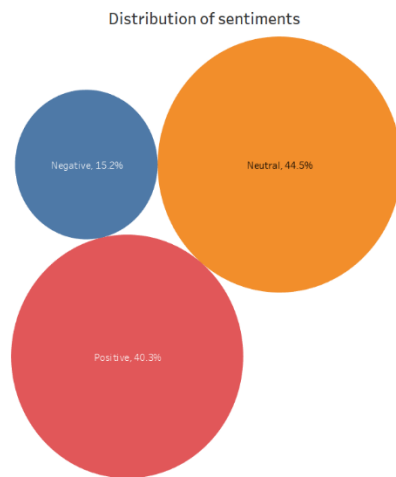
Figure 5 shows the city wise tweets in France

Source: Based on author calculation (tableau 2023.1)

Overall world:

Source: Based on author calculation (Python 3.9)

IX. OVERALL SENTIMENT ANALYSIS:

Source: Based on author calculation (Python 3.9)

The overall sentiment percentage for CBDC indicates that most people have a Neutral outlook towards CBDC, with 44.5% of tweets expressing Neutral sentiment. However, there is still a significant proportion of Positive sentiment (40.3%), which suggests that CBDC is more accepted by people where they are accepting new technology.

X. FINDINGS:

1. The global sentiment towards CBDC is a mixture of both neutral and positive attitudes.

2. A lack of clarity surrounding the potential benefits and risks of CBDC could be a contributing factor to the neutral sentiment.

3. Concerns about privacy and security issues related to CBDC may also contribute to a neutral stance.

4. The increasing interest and adoption of digital payments globally could be driving the positive sentiment towards CBDC.

XI. CONCLUSION:

According to sentiment analysis conducted using Twitter data, CBDC has received a mix of neutral and positive sentiment worldwide. While there are concerns around privacy and security, the potential benefits of CBDC, such as increased financial inclusion and reduced transaction costs, have generated positive sentiment. Central banks must prioritize providing clear information, addressing privacy and security concerns, and collaborating with stakeholders to ensure CBDC meets their needs. They should also conduct pilot programs, address competition-related issues, and establish legal and regulatory frameworks to support CBDC implementation. These insights into public perception and acceptance of CBDC can guide the development and implementation of CBDC by central banks worldwide.

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