Reengineering Support and Decision-Making System Based on Twitter Analysis

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Abstract

The aim of the article is to review the analytics and environment that Twitter algorithms create for the user with an aim to avoid spreading disinformation and predict possible reaction of other users at posts. Furthermore, it allows the development of a system which predicts the reaction to a user's tweet. There are two reasons for carrying out the research: 1. the lack of information on the operation of the algorithms presented by the platform; 2. the lack of reliable filtering methods for malicious accounts blocking creates the need for additional analysis, recommendations and the presentation of relevant and, most importantly, safe and reliable information for the consumer.

Keywords

Twitter, tweet, decision-making system, natural language processing, sentiments analysis, Twitter API, Dialogflow, agent.

1. Introduction

Social networks have a significant impact on people's lives today. In the past, they were considered to be a kind of entertainment, but now they influence all aspects of our lives.

The rapid growth of the amount of information that surrounds a person now, digitization and a huge flow of news became the key reasons for the tremendous growth of Twitter's popularity among foreign communities and led to the expansion of the Ukrainian segment of Twitter.

First of all, the popularity of the Twitter platform compared to other social networks was considered. For this, the statistics from the most reliable and open source Statista was used. Fig. 1 shows that Twitter was among the 5 most popular social networks in 2021 [1].

The Ukrainian Twitter community had 910,400 users at the beginning of 2022. A rapid increase of the Ukrainian users took place during April-May 2022, when Ukrainian Armed Forces started a successful counteroffensive to liberate territories occupied by russia. At that point of time, it became clear that events in Ukraine could be covered in Twitter social network.

The research object is the novelty of the social network, the lack of information on the operation of the algorithms presented by the platform, the lack of reliable filtering methods for malicious accounts blocking creates the need for additional analysis, recommendations, and the presentation of relevant and, most importantly, safe information to a consumer.

Scope of research is represented by improving existing methods of analyzing and supporting user decision-making when working with social networks to minimize the spread of disinformation.

The aim of the research is to create a system for the analysis of "hot" topics and profiles on the Twitter platform and further provide the user with support for decision-making based on their needs.

Nowadays, the impact of social networks on people's lives should not be underestimated. According to the website Datareportal and using their Kepios technology, it was determined that there are currently 4.74 billion users of various social networks in the world in October 2022. To make it clear, this is 59.3% of the entire population on the Earth. It is worth pointing out that these statistics do not represent each user as a separate individual, that is, one person mentioned in the statistics can occupy several

places, since it is currently not possible to check the uniqueness of accounts [2].

According to the same resource, 190 million new users have joined social networks in the last 12 months alone, that is, the total number of users increased by approximately 4.2%. The calculations state that every second a platform of this type receives 6 new users.

Fig. 2 shows that YouTube, Facebook, Twitter/LinkedIn social networks have the largest amount of unique users. WhatsApp has a high number too, but in this article we do not take it into account as it is a messenger. Facebook, Youtube, Instagram and Twitter have the largest number of shared users.
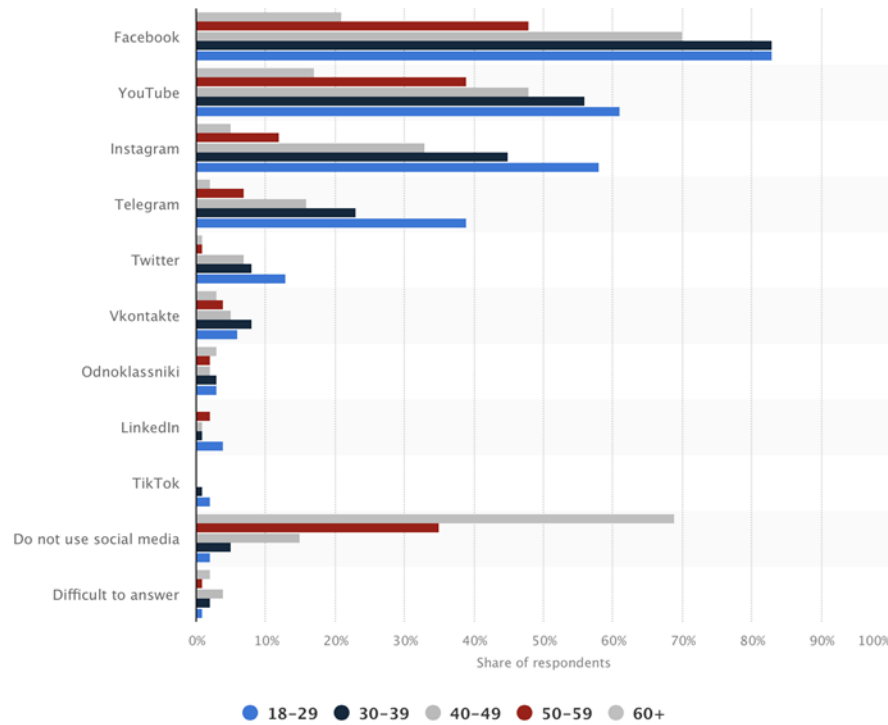

Figure 1: The most popular social networks in Ukraine as of February 2021

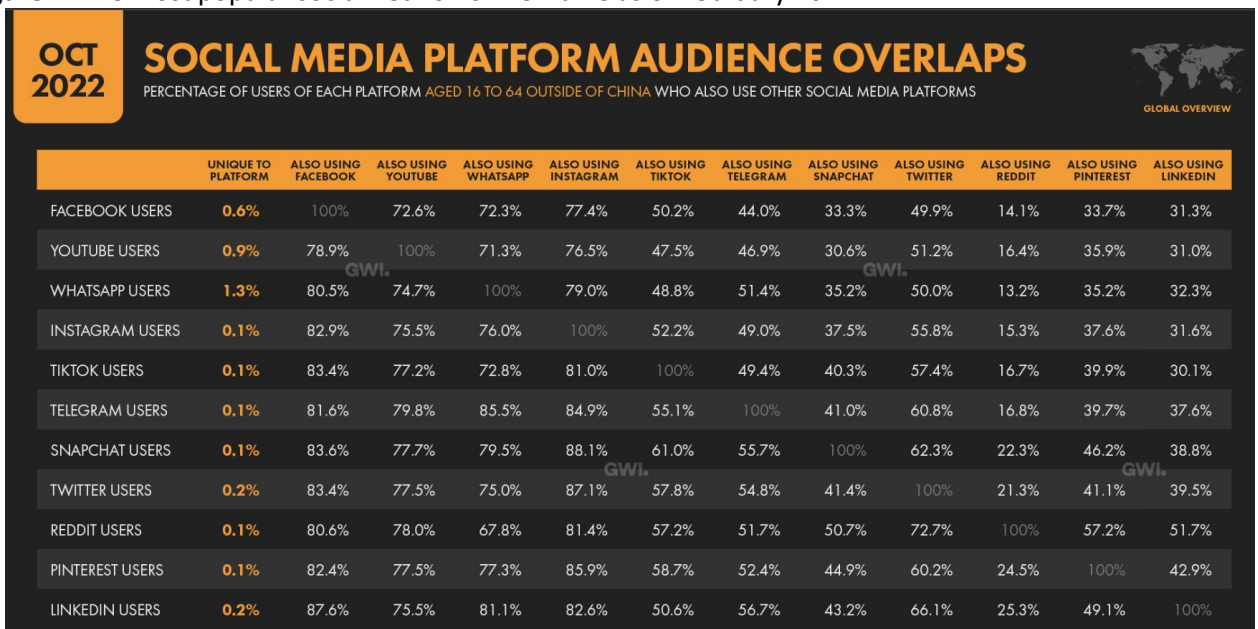|	UNIQUE TO PLATFORM	ALSO USING FACEBOOK	ALSO USING YOUTUBE	ALSO USING WHATSAPP	ALSO USING INSTAGRAM	ALSO USING TIKTOK	ALSO USING TELEGRAM	ALSO USING SNAPCHAT	ALSO USING TWITTER	ALSO USING REDDIT	ALSO USING PINTEREST	ALSO USING LINKEDIN
FACEBOOK USERS	0.6%	100%	72.6%	72.3%	77.4%	50.2%	44.0%	33.3%	49.9%	14.1%	33.7%	31.3%
YOUTUBE USERS	0.9%	78.9%	100%	71.3%	76.5%	47.5%	46.9%	30.6%	51.2%	16.4%	35.9%	31.0%
WHATSAPP USERS	1.3%	80.5%	74.7%	100%	79.0%	48.8%	51.4%	35.2%	50.0%	13.2%	35.2%	32.3%
INSTAGRAM USERS	0.1%	82.9%	75.5%	76.0%	100%	52.2%	49.0%	37.5%	55.8%	15.3%	37.6%	31.6%
TIKTOK USERS	0.1%	83.4%	77.2%	72.8%	81.0%	100%	49.4%	40.3%	57.4%	16.7%	39.9%	30.1%
TELEGRAM USERS	0.1%	81.6%	79.8%	85.5%	84.9%	55.1%	100%	41.0%	60.8%	16.8%	39.7%	37.6%
SNAPCHAT USERS	0.1%	83.6%	77.7%	79.5%	88.1%	61.0%	55.7%	100%	62.3%	22.3%	46.2%	38.8%
TWITTER USERS	0.2%	83.4%	77.5%	75.0%	87.1%	57.8%	54.8%	41.4%	100%	21.3%	41.1%	39.5%
REDDIT USERS	0.1%	80.6%	78.0%	67.8%	81.4%	57.2%	51.7%	50.7%	72.7%	100%	57.2%	51.7%
PINTEREST USERS	0.1%	82.4%	77.5%	77.3%	85.9%	58.7%	52.4%	44.9%	60.2%	24.5%	100%	42.9%
LINKEDIN USERS	0.2%	87.6%	75.5%	81.1%	82.6%	50.6%	56.7%	43.2%	66.1%	25.3%	49.1%	100%

Figure 2: Cross-Platform User Matches

Social networks generate vast amounts of data on variety of topics every day and are therefore a key source of information for those searchers who explore 21st century society.

Twitter remains the most popular social network for academic research because it makes its data available through a number of APIs (application programming interfaces).

The situation with Cambridge analytic is the opposite. The consequences from this resource's data

leak has led to certain platforms restricting the data transmission through their APIs. However, although it is not possible to obtain data from all social networks, it is still possible to conduct qualitative and quantitative research such as interviews and surveys and involve members of online communities.

Research on platforms of this type can be carried out on a wide range of theories, constructs, and conceptual frameworks from various disciplines, which are described in the work "Social media research: Theories, constructs, and conceptual frameworks". This article vividly describes a number of approaches for working with social networks.

Sentiment analysis is one of the most important methods of social networks analysis. The use of this method specifically for the Twitter platform is described in the scientific article "Sentiment Analysis on Twitter Posts" by Ravikant Patil, Manish Kumar, Dr. Jyoti Dr. Jyoti Kharade, Rasika Pati [7].

The paper describes the methods of sentiment analysis of tweets using the Twitter API for live data streaming. The output of this work should be a report that will indicate whether the tweet has a positive, negative or neutral color.

It is indicated in the paper that algorithms for sentiment analysis are divided into rule-based, automated, and hybrid algorithms. Rule-based algorithms consist of lexicons and automated algorithms and are based on Machine Learning, where hybrid ones are algorithms that use both approaches. It is noted here that automated sentiment analysis algorithms use classification algorithms such as Naive Bayes classifier, linear regression, support vector method and deep learning [3].

Research in the field of sentiment analysis will remain relevant for a long time. This paper is very representative for understanding the possibilities of sentiment analysis and its use in various parts of nowadays life. The results show that the quality of the sentiment analysis highly depends on the subject of the text. Also, the results of this paper state that the combination of several classification algorithms has a positive impact on the level of outcoming data.

2. Methods and materials

When developing any system, the main thing is to define the problem that the current system should solve and indicate the goals of its creation. To achieve this, the method of system analysis, which is called the Goal Tree, is the most appropriate.

The general goal "Creating a reengineering support and decision-making system based on Twitter analysis" is located on the top of the tree.
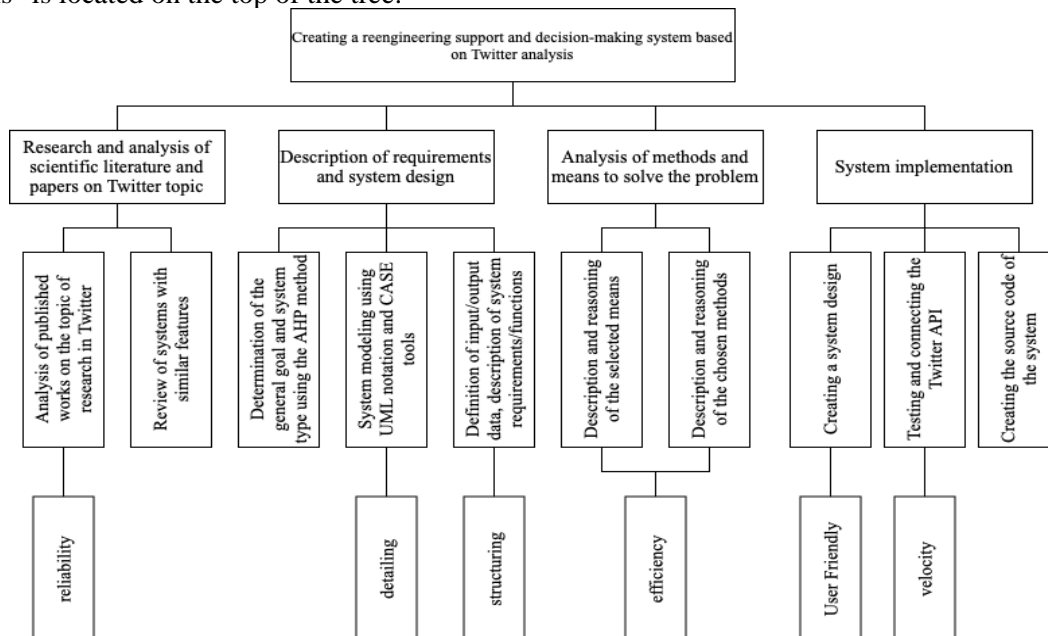

Figure 3: Goal Tree for Reengineering support and decision-making system based on Twitter analysis

To achieve the main goal, the following sub-goals were defined:
- to analyze published works on the topic of research in Twitter;
- to review systems with similar features;
- to determine the general goal and system type using the AHP method;

- to model system using UML notation and CASE tools;
- to define input/output data, description of system requirements/functions;
- to provide description and reasoning of the selected means;
- to give description and reasoning of the chosen methods;
- to create a system design;
- to test and connect the Twitter API;
- to create the source code of the system.

Unified Modeling Language (UML) is an internationally recognized standard for visualization, modeling, specification and documentation of system components or certain processes. The unified modeling language represents a wide set of diagrams that can be used at different stages of product development. A use case diagram is one of behavioral diagrams and defines system goals. It is very useful to start with this type of diagram as it will help to identify main users and different functions they perform in the system and the relationship between them.

Basic flow for Reengineering support and decision-making system based on Twitter analysis:
1. The user starts the system.
2. The user answers the questionnaire.
3. The system generates options to drive a successful Twitter page.
4. The user views the options for driving a successful Twitter page.
5. The user receives a list of the most popular accounts and methods of working with them.
6. The system generates the methods of working with the most popular accounts to satisfy the user's goal.
7. The user receives a list of the most popular hashtags and instructions for their use.
8. The system generates instructions on the most popular hashtags usage to satisfy the user's goal.
9. The user receives a list of the most popular news and possible options for their use.
10. The system generates options for the most popular news usage to satisfy the user's goal.
11. The system generates Twitter usage statistics for the past day.
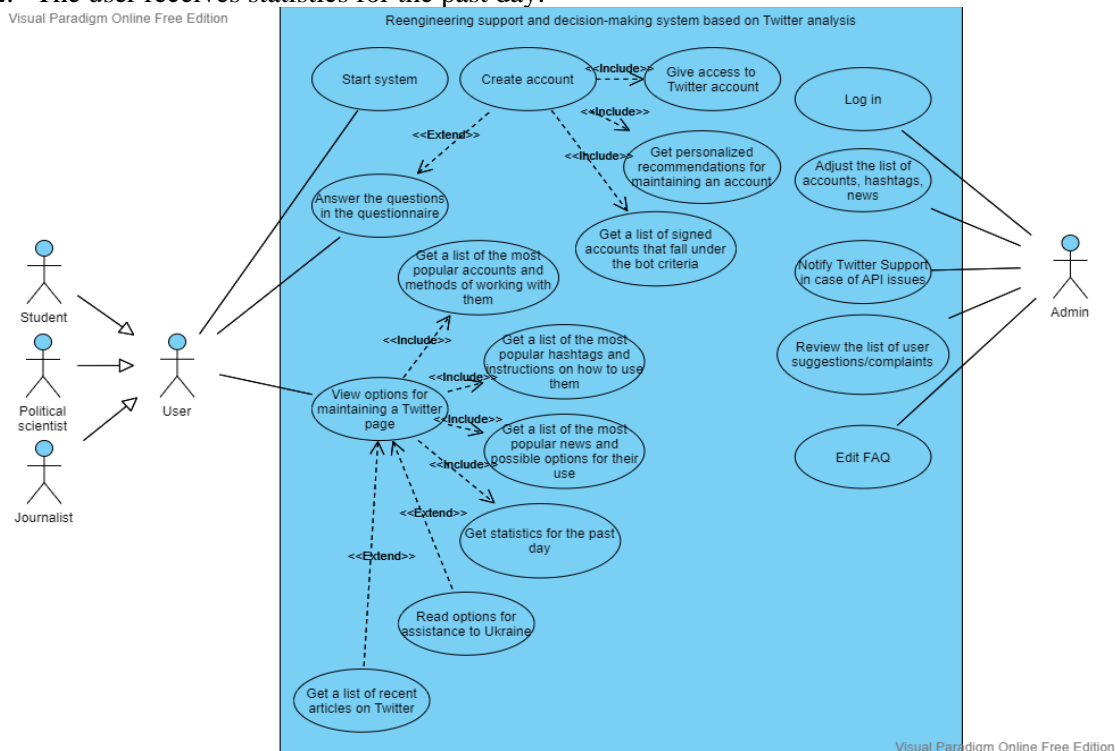12. The user receives statistics for the past day.

Figure 4: Use case diagram for "Reengineering support and decision-making system based on Twitter analysis"

At the next stage, a sequence diagram was developed. It shows the sequence of steps that the user must go through in the system to achieve his/her goal. It is important to note that such diagrams are created for a specific scenario and not for the entire functionality of the system in general.

Fig. 5 shows the sequence diagram for the "Reengineering support and decision-making system

based on Twitter analysis". The following diagram is built for a basic flow described above.

There are 3 objects in the diagram: User, System, Twitter API and 12 messages that connect the objects.
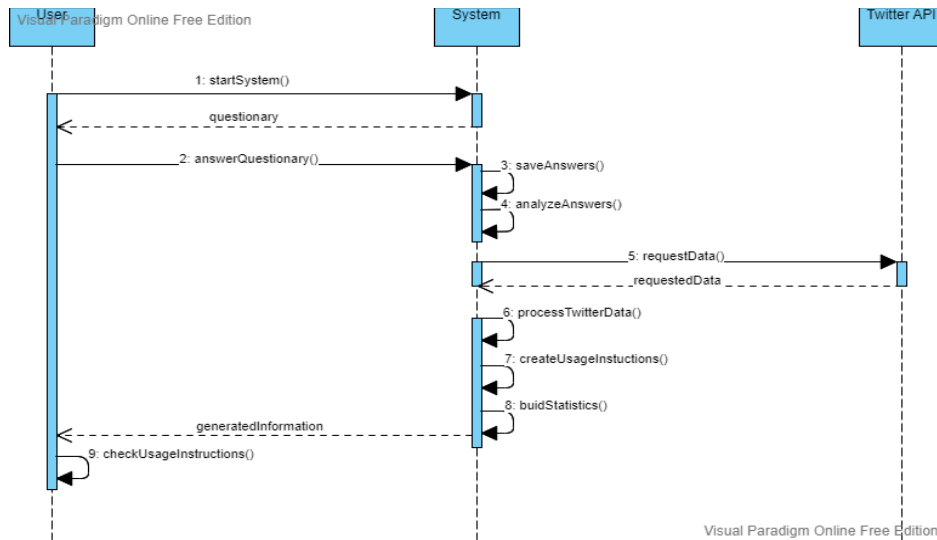

Figure 5: Sequence diagram for "Reengineering support and decision-making system based on Twitter analysis"

A state diagram is an abstract representation of a process. It is commonly used to model the development process, and can also help analysts map business processes. System elements are usually called objects and they can change state.

A state diagram can also be used to describe the various states of an object, the transition process between states, and the various events and conditions that cause state transitions.

States that are present in the diagram: system initialization, answering the questionnaire, generation of personalized recommendations for maintaining an account, presentation of options for maintaining a page in Twitter, obtaining access to the client's account, presenting a list of signed accounts that meet the bot's criteria.
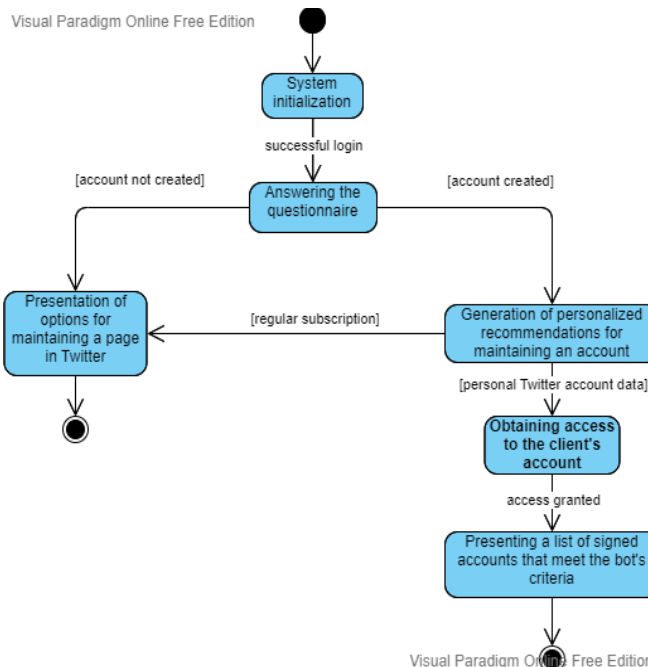

Figure 6: State diagram for "Reengineering support and decision-making system based on Twitter analysis"

In UML, deployment diagrams model the physical architecture of a system. Deployment diagrams show the relationships between software and hardware components in a system and the physical allocation of processing.

Fig. 7 presents a deployment diagram that contains 5 devices: application server, smartphone, DB

server, personal computer, Twitter server.

Also, two of the devices have execution environments. Browser is set as an execution environment for smartphone and personal computer.

There are also 5 artifacts present on the diagram. The execution environment "Browser" contains HTML 5 as an artifact. Web-site is set as an artifact for application server. DB server has MongoDB in a role of artifact. For Twitter server the artifact is Twitter API.
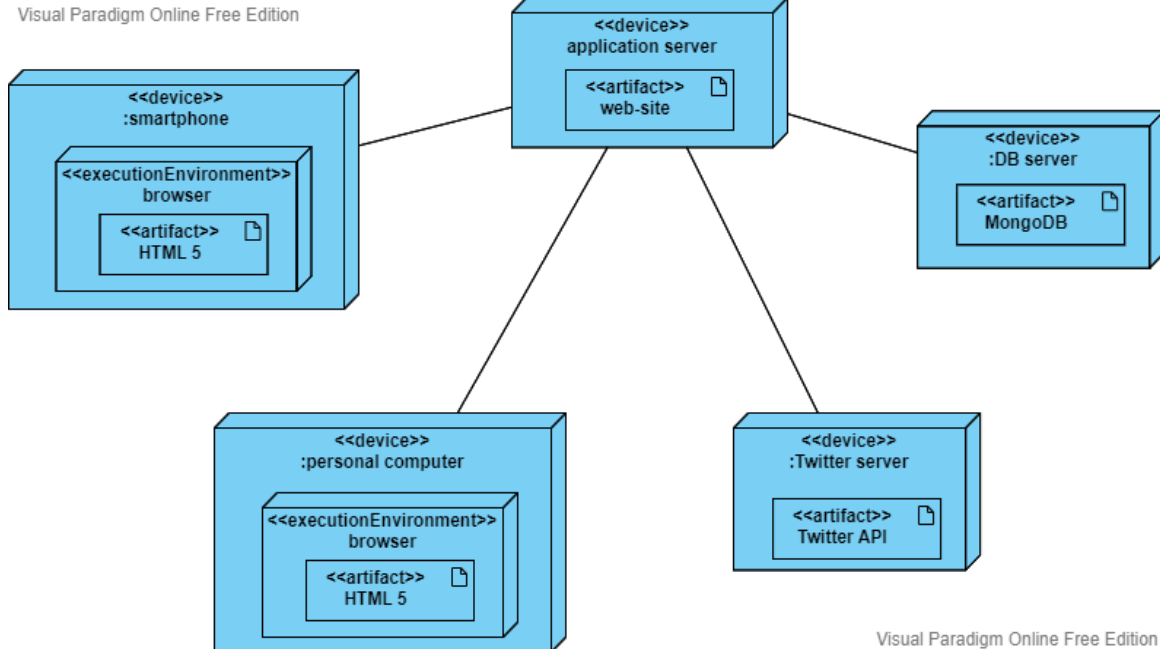

Figure 7: Deployment diagram for "Reengineering support and decision-making system based on Twitter analysis"

Reengineering support and decision-making system based on Twitter analysis contains the component of tweets analysis. To achieve this goal, the sentiment analysis of tweets using natural language processing methods will be of help.

Natural language processing (NLP) is a branch of computer science, namely Artificial Intelligence, which works on the idea of giving computers the ability to understand written and spoken human language and respond to it like a human.

NLP solves many different problems, especially those that require finding a meaning in text and voice data. Sarcasm, idioms, metaphors are just a few examples of the kinds of meanings that can be caught in human language. Usually, the other person understands them subconsciously, or by acquired experience of communication, or by facial expressions and expressions, but in the case of computer systems, programmers must teach themselves to recognize and correctly interpret such signs so that a system is useful.

In this research, NLP will solve the problem of sentiment analysis and recognizing correlations. Dialogflow ES is an NLP engine that will be implemented to solve this problem [4].

Dialogflow ES is an open platform for speech recognition from Google. This system requires prior training to understand the user's intent based on training sentences or lexicons. In addition to understanding user intent Dialog Flow if set up correctly will understand contexts and sentiments.

Reengineering support and decision-making system based on Twitter analysis will be developed as a web-site.

Many different applications are used to design the system interface. For this web-site Figma was chosen as a service for UX/UI design creation.

Figma is a vector-based interface design and prototyping tool with a web-based version and apps available for macOS and Windows. In recent years, Figma has become one of the most popular UX design tools due to its intuitive interface, full feature set, and extensive collaboration capabilities.

HTML markup language (HyperText Markup Language) is one of the most popular tools for creating websites. It defines the structure of the web page and what elements and data will be present on it. HTML code is interpreted by the browser and converted into what the end user sees on the screen. HTML uses tags and attributes to define the data that should be present on the web-page and to structure it.

Cascading Style Sheets (CSS) is an HTML feature that allows developers to make the appearance of the page more pleasant and control it. Using CSS, developers can create styles for individual elements of pre-written HTML. They can be added to any page to optimize it, or to improve or diversify its appearance. CSS is easy-to-use, requires only a few lines of code to create a beautiful interface and it is maintainable.

For the past eight years in a row, JavaScript has been the most popular programming language as voted by developers participating in Stack Overflow's annual survey. The popularity of the language is mostly explained by its wide range possibilities.

Although JavaScript was originally created for external development, a large list of related JavaScript libraries and frameworks have expanded its usefulness. Now developers can use it for almost anything, including server-side development, mobile development, and game development. Today, JS is used for front-end, back-end, game, mobile, virtual reality, and artificial intelligence development.

Taking into account that HTML, CSS and JS work very well together and were used to create almost every existing web-site, they will be utilized to develop the designed system.

One of the advantages of using HTML is that developers can write it even in a notebook. But now there are already better solutions that allow them to write code faster, find and fix errors, if there are any, and look more visually pleasing [13-15].

One such solution is Visual Studio Code. This is a free code editor from Microsoft. According to a survey on Stack Overflow in 2019, it was determined that it is used by more than 50% of surveyed developers. And it will also be utilized for Reengineering support and decision-making system based on Twitter analysis development.

MongoDB is a non-relational database. It is a NoSQL database management system. NoSQL databases are the alternatives to traditional relational databases using SQL (structured query language). Data is stored in tables, rows, and columns in a relational database with relationships between entities. In MongoDB, data is stored in documents using a JSON-like structure to represent and interact with the data. MongoDB will equip the designed system with such qualities as velocity, scalability and flexibility.

And last but not least is the Twitter API. Twitter provides access to various services through an application programming interface, better known as an API [16-19]. The social network provides access for integration to enterprises, or for scientific research. The Twitter API provides access to public data that has been published by Twitter users. Based on all the possibilities of Twitter API, it was decided to use it for the development purposes.

3. Discussions and results

This system contains a lot of unstructured data, the amount of which may be changed according to changes in the Twitter API or the data needed to create quality analytics. That is, the main requirements for a database are velocity and scalability, which are exactly what non-relational databases cover[20-22].

Therefore, it was determined that the database for the Reengineering support and decision-making system based on Twitter analysis should contain 2 documents to store the data.

The first document is "user". It stores all user data, such as:
- id - user ID in the database;
- schema - database schema versioning;
- username - username of the user in the designed system;
- usertype - user type to be selected during onboarding;
- preferences - data array of user preferences, which must be selected during onboarding;
- analyticsEnabled - a marker of whether the user has shared the data of his Twitter account for additional analytics;
- createdAt - date of account creation in the designed system.

It should be mentioned here that this document has 2 attachments. They are credentials - data structure for client authentication; tweetCheck - the data structure of tweet sentiment analysis and its content.

The next document is analytics. It offers data on detailed analytics of the user's account. The user has given access to his Twitter. This information was placed in a separate file, because not all users

operate this function, and such data are analyzed by a separate system component. This document contains information about the user's Twitter account, and it is not advisable to store such data in one table.

- id - identifier of the reporting record in the database;
- schema - database schema versioning;
- botList - a data array of found bots among the user's subscribers. Available fields: id - user ID in the Twitter system, username - the user's username in the Twitter system, name - the user's name in the Twitter system, url - a link to the user's account in the Twitter system, confidence - the percentage of confidence of the designed system that this boat;
- createdAt - date of creation of the record in the designed system.

Fig. 8 shows a diagram of a non-relational database for the Reengineering support and decision-making system based on Twitter analysis.
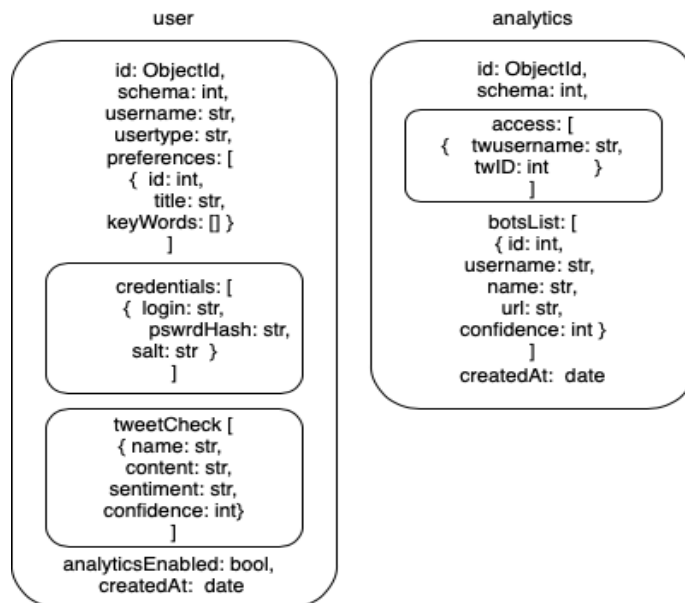

Figure 8: DB structure for the Reengineering support and decision-making system based on Twitter analysis

The Dialogflow platform is an NLP system that aims to provide sentiment analysis of text. It is integrated into the designed system [6].

To start working with Dialogflow, a developer needs to have an active Google account. Google account is used to log in to Dialog Flow. Then the console opens, and a developer needs to create an agent.

Next, the lexicons are filled with words that contain an emotional coloring and can indicate the intentions or mood of the user. Developers can fill the lexicons throughout the project and based on the statistics of phrases provided by DF in the History section. Reengineering support and decision-making system based on Twitter analysis lexicons with good and bad emotional coloring were created.

It is necessary to conduct a control test of the agent after setting it with lexicons and training phrases as well. A real user tweet is selected for testing. The content of the tweet is as follows: "Не дивлячись ні на що, ти добре тримаєшся. Все обов'язково буде добре, пам'ятай про це.", written by Nikita Rybakov. In English - "No matter what happens, you are holding up well. Everything will definitely be fine, remember that.". From a human's point of view and feelings, it is safe to say that this tweet is positive and even encouraging. Fig. 9 shows the result of the intent detection based on tweet sentiment analysis.

So, after testing the system on a real tweet, one can confidently state that system correctly recognized the user's intention, because it identified it as a positive tweet, which is true.

In addition, the confidence of Dialog Flow in intent detection is approximately equal to 0.71, which is a very good result, if you take into account the number of words in the tweet. In conclusion, the system works properly and in the future, it is necessary to fill it with a greater variety of phrases and words to cover many cases that can be encountered on the Internet.
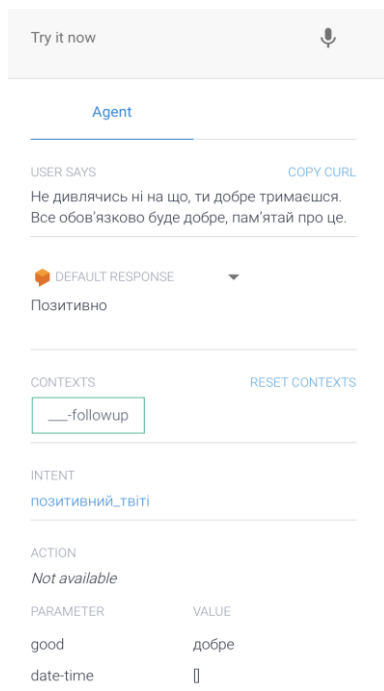
Figure 9: Result: a) Dialog Flow intent detection based on sentiment analysis, b) Dialog Flow confidence in the intent recognition.

4. Conclusions

As a result of the conducted research, a reengineering support and decision-making system based on Twitter analysis was developed.

The first module allowed the system to support the user's decision in forming its own "ecological environment" in the Twitter network, by creating a list of popular accounts, hashtags and topics that the user can follow and that are relevant.

This result was achieved using the Twitter API, which in turn provides access to trends and major events that are currently being discussed on Twitter.

Thus, Ukrainian officials who use this platform, volunteers, foundations and other influencers are recommended for user subscription to stimulate algorithms to propose relevant accounts which will form a reliable environment for the user in the social network.

The second module of the system allows users to check the tweets they are about to publish for audience reception. This functionality is especially useful for brands as it will help them predict their customers' reactions to future launches and products. In this way, they will be able to adjust the tweets before publication and make them more relevant for the perception of customers.

To achieve the goals of this component, the sentiment analysis of tweets using natural language processing methods is helpful. The NLP is a branch of computer science that works on giving computers the ability to understand human language in written and spoken versions, and the sentiment analysis is a task that is needed to separate subjective qualities from the text, for example, behavior, sarcasm, emotions, suspicion, bewilderment [4]. Dialogflow [5,6] from Google was chosen as the tool for such analysis.

Within the framework of the study, tweets of real users were analyzed. When comparing the results of Dialogflow and the real users reaction to the selected tweets, it was determined that the trained agent showed itself very good in determining the correct user reaction to the tweet.

This research provides a basis for further research in this area. For example, the use of mixed approaches (both lexicons and machine learning) to improve the sentiment of posts in social networks. Analysis of user profiles and posts to detect propaganda was implemented.

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