V. Conclusions

Over the past few years, the use of SDR technology has provided a major leap forward in the development of mobile communication networks, attracting interest from manufacturers and customers of telecommunications systems and reducing the cost of modernizing communication facilities. At the same time, it contributed to the rapid development of high-speed DAC/ADC and wide-band (up to several gigahertz) transceivers with reprogrammable characteristics.

Today, SDR technology is used in such areas: Mesh, Smart-Grid, Smart Antenna, MIMO, RFID, WRAN, DVB, DRM, LTE.

Of the main radio platforms considered, LimeSDR is the most advantageous platform for solving educational problems.

Using a laboratory sample, software on Ubuntu Linux developed for LimeSDR operation. The working models of receivers and transmitters of the main standards of digital terrestrial television DVB-T2, satellite broadcasting DVB-S2 and base stations of GSM and LTE standards implemented.

The work of the developed models with LimeSDR tested in the educational process during a series of laboratory works on the study of new generation communication systems.

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Отримана в редакції 18.04.2023. Прийнята до друку 16.05.2023. Received 18 April 2023. Approved 16 May 2023. Available in Internet 19 June 2023.

УДК 004.852-029

CHARACTERISTICS OF THE TECHNICAL TASK FOR THE DEVELOPMENT OF A CHATBOT

Veronika Neliubii[1], Halyna Lukash[2]

[1,2]Vasyl` Stus Donetsk National University, Vinnitsa (Ukraine)
ORCID: [1] https://orcid.org/0009-0003-9447-7407 [2]https://orcid.org/0000-0002-9777-7718
E-mail: [1] neliubii.v@donnu.edu.ua [2]g.lukash@donnu.edu.ua

DOI: 10.15673/atbp.v15i2.2525

Abstract. *The article describes the general principles of the technical task for the development of chatbots of a modern educational institution. It is noted that chatbots are still a new tool that is constantly developing and improving. Almost any company can integrate a chatbot into its work, because today it has become a universal assistant for various tasks. Depending on the actual needs, it can be added to the site, application or messenger. The process of developing chatbots aimed at ensuring the effectiveness of documentation and communication activities of an educational institution has been studied. Technical tasks for chatbot development are described. The purpose of the study is to consider IT tools and chatbots to activate the process of increasing the efficiency of the documentation and communication activities of the*

educational institution. The following methods were used: analysis method, analysis of electronic resources, comparative method of review of free online services, synthesis method. The practical significance of the study is in the description of the technical task for the development of chatbots of a modern educational institution using the example of an interactive program created for the department of management information systems of the Donetsk National University, which can be used as a comprehensive platform for interaction with students, applicants and teachers with the possibility of automating a large volume of document flow between the chatbot and its users. Disadvantages of chatbots are shown - limited reactions and the need to develop complex conversation scenarios. Such programs look for answers to customers' questions in a database prepared in advance and do not know how to improvise.

Анотація. *У статті описано загальні принципи технічного завдання на розробку чатботів сучасного навчального закладу. Відзначено, що чатботи досі залишаються новим інструментом, який постійно розвивається та вдосконалюється. Інтегрувати у свою роботу чатбот може майже будь-яка компанія, адже сьогодні він став універсальним помічником для різних завдань. Залежно від актуальних потреб його можна додати на сайт, у додаток чи у месенджер. Вивчено процес розробки чатботів, спрямованих на забезпечення ефективності документаційно-комунікаційної діяльності закладу освіти. Описано технічні завдання для розробки чатбота. Мета дослідження – розгляд IT-інструментів та чатботів для активізації процесу підвищення ефективності документаційно-комунікаційної діяльності закладу освіти. Використано такі методи: метод аналізу, аналіз електронних ресурсів, порівняльний метод огляду безкоштовних онлайн-сервісів, метод синтезу. Практичне значення дослідження полягає в описі технічного завдання на розробку чатботів сучасного закладу освіти на прикладі створеної для кафедри інформаційних систем управління Донецького національного університету інтерактивної програми, яку можна використовувати як комплексну платформу для взаємодії зі студентами, абітурієнтами та викладачами з можливостями автоматизації великого обсягу документообігу між чатботом та його користувачами. Показано недоліки чатботів – обмеженість реакцій та потреб у розробці складних сценаріїв розмов. Такі програми шукають відповіді на питання клієнтів у завчасно підготовленій базі даних та не вміють імпровізувати.*

Keywords: *chatbot, bot, educational institution, technical task, documentation and communication activity of an educational institution.*

Ключові слова: *чатбот, бот, навчальний заклад, технічне завдання, документація та комунікаційна діяльність навчального закладу.*

1. Introduction

A chatbots are computer program developed on the basis of neural networks and machine learning technologies, with the help of which it is possible to communicate in audio or text format. A chatbot is used to perform specific tasks (for example, obtaining reference information, performing calculations) or for entertainment. Chatbots are programs that perform the function of a virtual interlocutor. They allow you to automate communication with users using text or audio messages. The goal of implementing virtual assistants is to automate business processes and get away from routine, optimizing the working time of employees.

2. Analysis of literary data and problem statement

There are different types of chat bits in the educational process. Some of them are able to instantly answer numerous questions of applicants during admission to a higher education institution of education (questions about the admissions campaign, majors and their differences, dormitories, history of the faculty, etc.). Others aim to make it easier and faster for students of any course to find information during their studies (about the class schedule, educational and methodical materials, placement of classrooms, educational process etc.) and will help to quickly solve any organizational issues, because getting answers to questions quickly is one of the most desired features during the student's education. Studies show high student confidence to this technology and satisfaction with its use [7].

Thanks to machine learning, intelligent bots independently determine the appropriate communication model and establish communication with users. They are widespread in messengers and mobile applications and perform various functions (fig. 1):

-Notifications: the program can send messages to users about orders and events under specified conditions.

-Online registration: with the help of a bot, clients can receive advice and make an appointment.

-Newsletters: sometimes news, information about promotional offers, etc. are sent with the help of a bot.

-Support: the program can take orders and answer user questions directly on the site.

-Accepting payments: the chatbot allows you to quickly pay for goods and services, as well as transfer funds, track currency exchange rates, etc.

-Data Collection: One of the most important capabilities of a chatbot is the ability to collect information about your customers [3].

The program is used in many industries and areas of business, for example, for customer support or automation of internal company processes.

3. Purpose and objectives of the study

The purpose of the work is to study the process of developing chatbots aimed at ensuring the effectiveness of documentation and communication activities of an educational institution.

Research tasks: 1) study and describe the technical tasks for the development of a chatbot; 2) develop a chatbot to increase the efficiency of documentation and communication activities of an educational institution. Research object: a technical task for the development of a chatbot. The subject of the study: IT tools and chatbots to activate this process in the activities of educational institutions.

Practical significance: a chatbot has been developed for the Department of Management Information Systems of the Donetsk National University, which can be used as a comprehensive platform for interaction with students, applicants and teachers.

The scientific novelty of the obtained results lies in the description of the technical task for the development of chatbots for the optimization of the documentation and communication process of the organization of the work of a modern educational institution; data and information transfer, opportunities to automate a large volume of document flow between the chatbot and its users [1, p.62].

4. Methods and materials of research

Research methods: analysis method, analysis of electronic resources, comparative method for reviewing free online services, synthesis method.

5. Research results

Technical task for the development of a chatbot

The technical task for the development of a bot is an important document that contains not only a list of requirements for the future product, but also defines the ways, tools and means of project implementation.

The more clearly and in detail each point is written, the greater the chances that the specialist will understand the client correctly, and the client will receive exactly the product he needs [2, p.70].

Figure 1 – Functions of an intelligent chat bot

The technical task for the development of a bot include the following requirements:

-purpose and functionality;
-set of modules;
-requirements for subsystems;
-requirements for system operation modes;
-integration with services.

Conventionally, the creation of TK for an intelligent bot can be divided into several stages (fig. 2).

1. Formation of the concept

To begin with, the goals of the bot are determined and theses are clearly formed, which should describe the purpose of the program. For example, a bot can be an information assistant for a client (support service), a marketing tool for a business (promotions, discounts, news), an organizer of instant communication with users, etc.

2. Description of technical data

At the next stage, technical solutions and tools that will be used in the program are selected:

-methods of chatbot interaction with the client;
-data sources;
-target audience;
-accumulation of results.

3. Determination of the monetization method

The development and implementation of a chatbot is directly related to attracting profit to the project. Not all intelligent bots are commercial, so sometimes the assessment of profitability is done indirectly, for example, the program can reduce the company's marketing costs.

There is no universal technical task for program development - each intelligent bot is unique. In order to avoid misunderstandings between the customer and the executor, a technical task (TT) is usually drawn up for each step, which describes the functionality of the bot in detail [9].

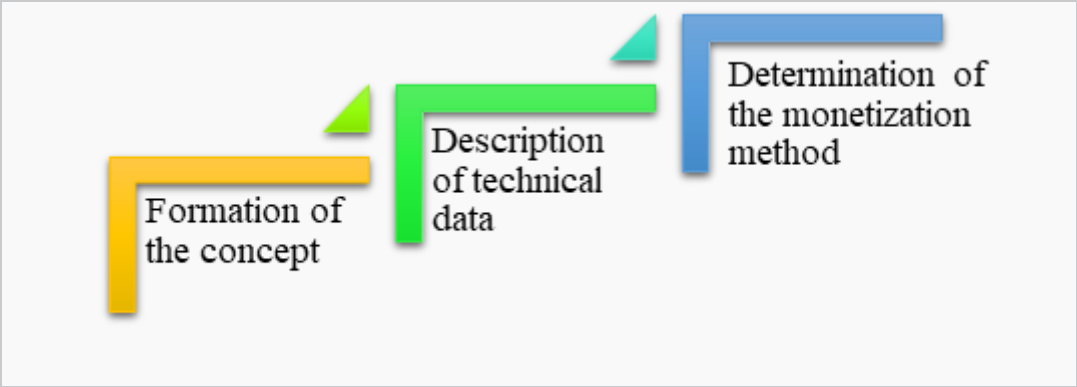

Figure 2 – Stages of TT development

Correct technical task for the development of a bot are a prerequisite for the success of the project. In order for the finished product to effectively solve the tasks set before it, the client and the executor must understand each other well.

The development of the technical task for the development of a chatbot takes place in several stages (fig. 3).

Stage 1: Prototyping

Developers create a prototype of the product, which includes the interface, design, algorithms of the systems, etc. Visualization simplifies understanding and helps to understand whether the layout meets expectations.

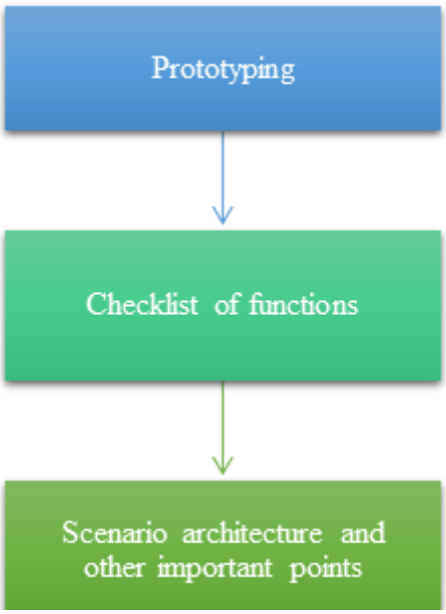

Figure 3 – Stages chatbot

At the same stage, it is possible to evaluate the convenience of the intelligent bot, check the functionality or make changes. This greatly simplifies the task of specialists and allows you to avoid problems associated with the further implementation of the project.

Stage 2: Checklist of functions

One of the most important tasks in the formation of technical specifications is the compilation of a complete checklist of product functions. For your convenience, a complete list of chatbot functionality is compiled to understand what can be added at this stage and what should be removed.

Stage 3: Scenario architecture and other important points

Depending on what tasks the chatbot should solve, appropriate programs are created that work according to a given scenario or include a machine learning function. Based on these features, all details relating to the project are recorded in the TT [9].

Common mistakes when developing a chatbot

Using chatbots for sales, customer support, or marketing communications can have a ton of benefits. This can save time and allow you to focus on more complex tasks, improve customer satisfaction, reduce help desk calls, and more. However, many companies have rushed to introduce chatbots into their marketing strategy. They can be useful and effective, but only if they are used correctly and certain chatbot mistakes are avoided.

Below are six common chatbot mistakes that should be avoided during development (fig. 4):

1) Opacity

Often, companies simply forget to mention that they are communicating with a chatbot. Sometimes this is clear and obvious, but sometimes it can cause real resentment among customers who feel like they are talking to a human.

It's always a good idea to highlight the fact that the chatbot is communicating with you and explain in a sentence or two that it has limitations and how customers can contact a company representative if they encounter those limitations.

2) Over-use

There has been massive enthusiasm for artificial intelligence, machine learning and chatbots for years. This has led to many companies hastily implementing it into all of their marketing, sales and support mechanisms. Now you can see how chatbots answer complex, urgent and sensitive questions that often require the help of a real person [5, p.69].

Chatbots are great, but it's worth testing and evaluating if there are areas where errors occur. Perhaps bots are introduced at those stages when users expect communication with a human.

3) Under-use

The same problem discussed in the previous paragraph can have the opposite nature. Sometimes brands introduce chatbots as part of their marketing strategy, but underutilize them and pay too much for the technology and maintenance.

In this case, you need to develop a plan on how you can maximize the potential of using chatbots for marketing in your business. You can start exploring additional opportunities and platforms where a company can benefit from using chatbots.

4) Lack of testing

AI decisions are often rushed. Many business owners and managers see a chatbot as a set-it-and-forget-it thing. On the contrary, chatbots should undergo comprehensive and thorough testing before launch, but this is not enough. After launch, it is necessary to continue to observe and analyze how chatbots interact with users.

The more a bot is tested before launch, the more likely it is to perform well. However, there are things that can only be encountered and learned after talking to customers for a while, so you need to keep up with these learning moments.

5) User experience

When the user is given the opportunity to communicate with the company through chat, it simplifies the process without requiring him to work hard. There are many examples of chatbots exhibiting poor user experience:

-too much text;

-too many monologues on the part of the chatbot (does not require many answers from the user);

-too many steps to achieve the desired action;

-frequent situations when the chatbot does not understand the request or the answer.

These and many other errors are exactly what appear in the testing phase we talked about earlier. In this sense, user experience and testing are closely related. Make sure you always keep the user's perspective in mind when testing your new chatbot tool [4].

Figure 4 – Common mistakes when developing a chatbot

6) Dry and monotone texts.

Chatbots can and should bring pleasure from communication! If you spend a little time researching the market, you can see that many big brands are making the most of chatbots by offering a regular, cheerful robot to talk to. Not only are they fun and easy, but they're also healthy! Of course, these high-quality chatbots are a combination of a lot of time spent creating and configuring them, as well as very high budgets.

However, having a limited chatbot budget doesn't mean it's impossible to create entertaining chatbot scenarios that will keep your users happy and engaged. In fact, this is the best thing you can do to ensure a top-notch chatbot if you use a simple chatbot [6 Common].

Chatbot testing

The main purpose of a chatbot is to provide the best user experience and value through conversations. This does not mean that anyone can do chatbot testing. On the one hand, you don't need to have certain skills to assess whether a chatbot is showing clear answers and enough requests [5, p.69]. It is worth trying several scenarios and checking whether the received information corresponds to expectations. On the other hand, the communication flow is one of the many aspects that need to be checked. User interface, response speed, and error handling are some of the other things that need quality testing. And unlike a conversational stream, the average user won't be sharing information that would be valuable for quality improvement.

Let's consider typical chatbot failures. The author has analyzed some data on this issue to compile a list of common problems, and it consists of the following points:

-Cracked scripts that lead to malfunctions.

-Long pauses before answers, no instant answers.

-There is no connection with other business channels.

-Too many intents or business tasks for one bot.

-Lack of expression and/or precision.

-Without the right to make a mistake.

-Poor navigation.

-Bad conversation design [6].

If a chatbot is not useful, it simply frustrates customers, affecting the company's brand image and business performance. At the same time, software testing allows you to prevent all the errors listed above [Chatbot Testing].

The Telegram messenger was chosen to create the chatbot. The advantages of this application are ease of use and a fairly large user base in Ukraine. In addition, the first chatbots appeared in Telegram. Unlike other messengers, in Telegram it is immediately clear that the communication will be conducted by a bot. This is ensured by the platform's requirement for the bot name: it must always end with the word "bot". Telegram bots can: perform typical chatbot functions (translate, comment, teach, test, search for information, play and entertain, play video and audio, make bank payments, contain built-in games and much more); perform additional API functions available for Telegram bots (integrate into other services and platforms, interact with the user's devices and belongings connected to the Internet).

The capabilities of the bot in Telegram include a built-in "inline" mode. This mode allows users to access the bot from any other dialog. In any Telegram chat, you can enter a message with the name of the bot, and then the request itself. The bot is activated after mentioning his name and will respond to the request directly in the open chat. You can also add a "Switch to PM" button to the built-in bot. If you click on it, the bot will open in a new chat [4].

The purpose of a chatbot for an educational institution is to provide information for applicants, students of higher education and teachers of departments. The structure of the bot can be seen in figure 5.

The algorithm for creating a chatbot in Telegram is quite simple. For this, two auxiliary bots will be used: BotFather and Manybot.

In Manybot, click the "Add a new bot" option, after which the bot will provide the following instructions:

1. Go to BotFather.
2. Create a new bot in it. To do this, press the /newbot command inside the bot and follow the instructions.
3. Copy the Ari token that BotFather will give you.
4. Return to Manybot and send the copied Ari token in response to this message.

Next, we will be sent a link to the newly created bot, inside which we will configure its operation.

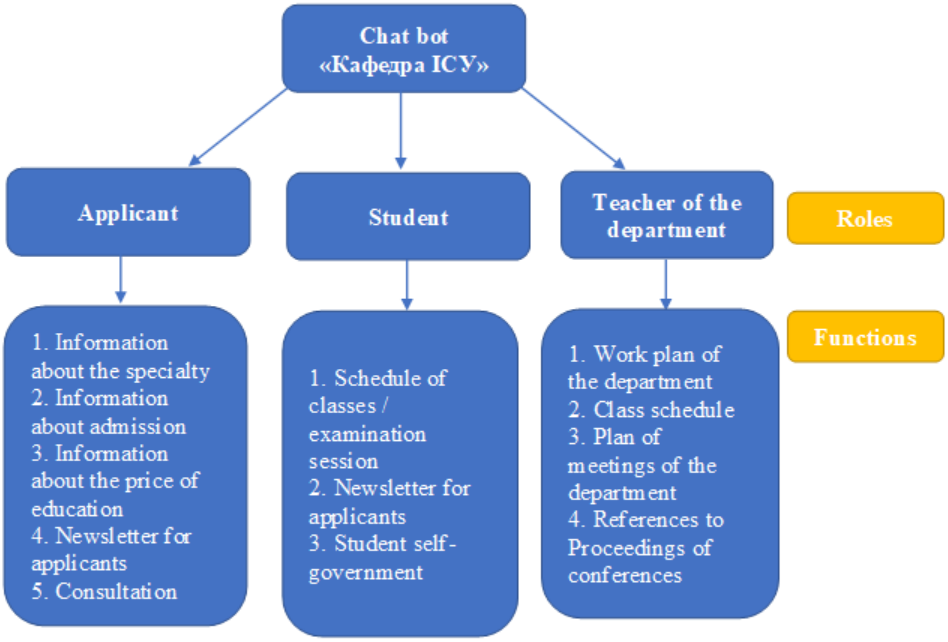

Figure 5 – Bot structure

The main tasks that the bot of the educational institution will perform are:

1. For the applicant (fig. 6):

1.1. Providing information about the specialty. When clicking on this option, the applicant will be sent a message with brief information about the educational institution;

1.2. Providing information about admission. With this option, the applicant will be able to find out the current information about the exams that must be taken for admission to the specialty, the date of admission, etc.;

1.3. Provision of information on payment of education.

1.4. Newsletter for applicants. The applicant will be able to find out about the university's activities related to admission. For example, holding an open day.

1.5. Consultation. With this option, the applicant will be able to find out how he will be able to contact the representative of the educational institution to provide more detailed information for admission.

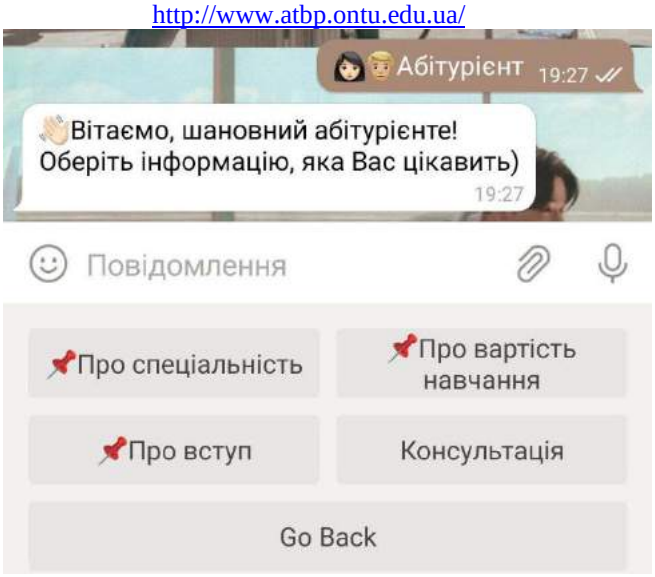

Figure 6 – Menu for the applicant

2. Graduate of higher education (Fig. 7).

2.1. Providing information about the schedule of classes/examination session. The applicant will be able to find out the schedule of classes or exams according to his course. He will be sent a message with the corresponding file or a link to it.

2.2. Newsletter for applicants. With the help of this option, you can find out about the events of the educational institution for applicants, which are arranged by the student council.

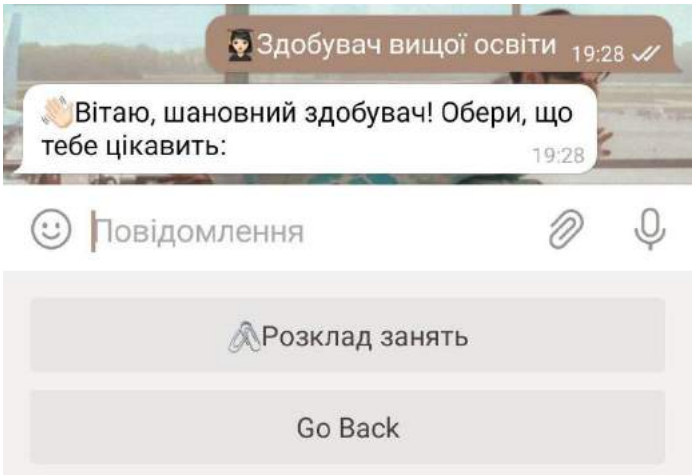

Figure 7 – Menu for a student of higher education

3. The teacher of the department (fig. 8).

3.1. Information about the work plan of the department.

3.2. Teachers' class schedule.

3.3. Plan of meetings of the department.

3.4. Links to conference proceedings.

When using a chatbot, a problem arises: how can each of the roles receive exactly the information that concerns them? The entrant should not have access to information for the student or teacher, the student – for the teacher, etc. The author proposed a partial solution to this problem. At this educational institution, students of higher education and teachers have their own corporate accounts with the university domain. So when asking for roles, after clicking on "Higher education applicant" or "Teacher", the bot would ask for login to the corporate mail. Thus, the information provided will be exclusively for the applicant or teacher.

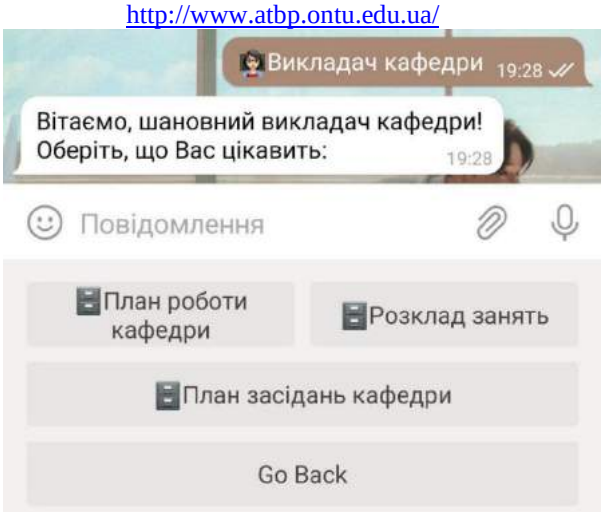

Figure 8 – Menu for the teacher

6. Conclusions

A chatbot is a great alternative to mobile apps that are oversaturated on the market. The results obtained as a result of the research show that various business entities are increasingly using chatbots for the process of exchanging informational messages in order to optimize their activities.

The introduction of chatbots has become extremely useful for an educational institution, in the work of which this technology can help in performing routine work. The practical result of the research was a chatbot for the Telegram messenger, the main purpose of which is easy and quick access to search information for applicants, students of higher education and teachers of the Department of Management Information Systems of the Vasyl Stus Donetsk National University.

The technical task for the development of a bot is an important document that contains not only a list of requirements for the future product, but also defines the ways, tools and means of project implementation.

The technical task for the development of a chatbot include the following requirements: purpose and functionality; set of modules; requirements for subsystems; requirements for system operation modes; integration with services.

The spheres and ways of using bots are very diverse and depend on the creativity of the developers. Chatbots are indispensable assistants in any field where there is a large volume of communication with customers.

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Отримана в редакції 20.04.2023. Прийнята до друку 22.05.2023. Received 20 April 2023. Approved 22 May 2023. Available in Internet 19 June 2023.

УДК 681-5; 004.4

РОЗРАХУНОК КОНІЧНОГО З'ЄДНАННЯ ЗА ДОПОМОГОЮ МОВИ ПРОГРАМУВАННЯ C#

Гулієва Н.М.[1], Батюк Д.Р.[2], Грибок Н.О.[3], Гулієва З.Н.[4]

[1,2,3] Луцький національний технічний університет, м. Луцьк, Україна
[4] Державний податковий університет, м. Ірпінь, Україна
ORCID: [1]https://orcid.org/0000-0001-9282-4880
E-mail: [1]n.huliieva@lntu.edu.ua, [2]demanbatuk@gmail.com, [3]nazarjj12345@gmail.com, [4]zemfira.hulieva.@gmail.com

DOI: 10.15673/atbp.v15i2.2526

Анотація. *На сьогоднішній день розробка програмного забезпечення є актуальним видом діяльності та застосовується практично у всіх сферах суспільного життя. Програмне забезпечення виконує роль пришвидшення і покращення технологічних процесів на підприємстві, що в свою чергу призводить до виготовлення більшої кількості продукції та підвищення її якості. Неякісне програмне забезпечення або його відсутність призводить до додаткових затрат. Це в свою чергу призводить до подорожчання кінцевого продукту, що негативно впиває на виробництво й, зокрема, на ВВП економіки країни.*

У науковій роботі розроблене програмне забезпечення в інтегрованому середовищі Microsoft Visual Studio 2022 для розрахунку конічного з'єднання на мові програмування C#. Оскільки конічне з'єднання має складну будову таких технічних параметрів як: герметичність, висока міцність, можливість легкого регулювання